

# Comox Valley Naturalists Society

August 2016 Newsletter  
(Special Edition)



## Chris Pielou (1923–2016)

*By Loys Maingon*

Last month, the scientific world in Canada, the Comox Valley as a whole, and Comox Valley Nature, in particular, lost a 5 foot 2 inch giant. Nobody is ever likely to replace Dr. Chris Pielou. I knew her long before I came to the Comox Valley, and I joined largely because she was a member – what self-respecting scientist wouldn't have – but I was shocked and amazed that she was given so little recognition locally. If I had to rate Canadian biologists or Canadian environmental scientists, I would have to say that she was perhaps Canada's greatest contribution to our global understanding of the environment.

I knew Chris Pielou intimately (I choose that word carefully, and she laughed when I slyly told her that), because I, as many postgraduate biology students, had learnt multi-variate statistics from her classic book *The Interpretation of Ecological Data* which is a key work for any mathematical ecologist. In this she towers above a David Suzuki, whom I also respect, but while he gives mere information, Chris Pielou gave us the tools to get the information, destroy corporate lies, and tell the truth, which we are always obligated to communicate.

Every serious biologist in Canada is a student of Dr. Pielou, and she deserved every bit of respect she received. Regrettably, few people in the Comox Valley understood how important, how brilliant she was, and how much she deserved to be heard. And man, thank god she could roar!!!

She was an extremely important member of CVN, who worked tirelessly at the head of the Conversation Committee, which for decades was CVN's advocacy voice, taking on both local and provincial issues. In addition to being provincially well-known as the Chair of the Scientific Panel on Clayoquot Sound in 1993–1994 which led to Clayoquot Sound being designated as

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Chris Pielou

*Photo by Loys Maingon*

### About This Issue

In this special edition of the CVNS newsletter, we honour the life of Dr. Evelyn Chrystalla Pielou, known to her friends at CVNS and elsewhere as Chris Pielou. An eminent ecologist and long-time member of CVNS, Chris died on July 16, 2016 at the age of 92.

We start with a remembrance of Chris by CVNS Past President Loys Maingon, followed by a selection of articles by Chris herself, reprinted from past issues of this newsletter, to which she was a regular contributor.

This issue also includes some general content that's available in advance of the next regular issue in November.

a United Nations Biosphere Reserve, she had been an avid outspoken and forceful environmental protester.

Her drive led to the creation of the Comox Lake Ecological Reserve, for which she was appointed the first voluntary warden.

Chris Pielou had a delightful lack of patience for fools and people she disdainfully referred to as "twits." She hated presentations of "pretty pictures" - she demanded substance in everything, had and always met the highest environmental standards. And she had cause to demand high standards – because she always met them herself.

She was known world-wide as a pre-eminent biostatistician. As a brilliant ecological mathematician she pioneered multivariate statistics in ecological studies, which is now the universal standard for ecological research. After obtaining a PhD in mathematics, she went on to do a second PhD in mathematical ecology at The University of London, and then to teach at Yale, Dalhousie, and ultimately at Lethbridge University on a Canada Research Chair – which gave her a free hand to do the research she wanted to do. And that led to her work on arctic ecology.

She published widely, both academically and as a consultant. Late in life she wrote a series of popular books for naturalists which endeavoured to make the wonder of science accessible to everybody – books on flora and fauna, and on popularized physics, such as *The Energy of Nature* (highly recommended if one wants to understand what a biologist looks at beyond the individual organisms and their populations after being a naturalist – it's like understanding the orchestra and everything that brought it about after you have identified the individual oboe).

She combined an understanding of mathematical modelling with a practical insight into the structure of the natural world. She was herself a product of a very English view of Darwin's theory of evolution. In 1979 she used this background in an early work written for her graduate course at Dalhousie on evolutionary biology to write a book on biogeography – the geographical distribution and evolution of species – summarily entitled with her typical terseness *Biogeography*. No unnecessary flourishes or subtitles. If one expected the usual descriptiveness, Chapter 6 hit the reader and student with what she rightly felt was the ineluctable mathematical basis of Island Biogeography! In 1992, as all useful books should be, it was reprinted, and remains unique in its treatment of the subject.

This diminutive lady was not only a giant in the recognition of women's equality in science, she was

widely recognized internationally for her endeavours and merit. UBC granted her yet another honorary PhD in 2001. Part of her 2001 address to UBC's graduating class is worth quoting, if only because it encapsulates the quintessential Chris, and it is a belief I share:

This may explain why so many people say, complacently, "Of course, I'm lousy at math but ... " and then go on to imply that their mental powers are perfect apart from this trivial defect. Well, it isn't trivial – a person who blocks out math is a mental couch potato.

Diminutive she was – trivial she was not. There was seriousness even in her wit. Sharp as ever at 90, she once pointed out to me that most anti-environmentalists were dunces at math. In particular, one who caused me grief at UBC, and her grief on the Scientific Panel, was a forester who was, in her words, "a mathematical dullard and fraud," and she could prove it – he had failed her statistics class at Yale!

Today the world is poorer, and nature is diminished, CVN has lost a very great friend, leader and mentor, and the naturalists' and environmentalists' community is greatly diminished internationally. She burnt with a bright green fire only committed environmentalists know, and she was proud of her environmental advocacy. We owe it to Chris to perpetuate her environmental commitment. As she once said to me: "Fight every day, and have the math to prove it!" ..... And so we will, death be damned... I am sure she would appreciate that.

## Articles by Chris Pielou

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### Three Billion Years of Plant Life at Seal Bay Park

By Chris Pielou

If you want to see plants that have probably descended almost unchanged from the time plant life first appeared on earth 3.6 billion years ago, you need only go about 100 metres along the main trail in Seal Bay Park, and you'll encounter a big Douglas-fir with the bottom of its trunk coated with a pale greenish-grey layer of "dust". The dust grains are, in fact, fragments of lichen

containing blue-green bacteria, the most ancient plants on earth. A “plant” is any organism that creates its own food by photosynthesis (the chemical combination of carbon dioxide and water, powered by sunlight and catalysed by chlorophyll). The blue-green colour of the bacteria comes from a bluish pigment present too.

Chlorophyll has three forms, named chlorophyll *a*, chlorophyll *b*, and chlorophyll *c* (by a biochemist having a bad day?). Blue-green bacteria have only chlorophyll *a*. More modern, truly green plants, with both *a* and *b*, date from one billion years ago. The oldest of these are single-celled and appear as no more than a leaf-green stain on occasional bare rocks.

To see their many-celled descendants, go to the beach. If the tide is lowish, it doesn't take long to find the bright green seaweed *Enteromorpha intestinalis* (in English, Gut-shaped Intestines, but the books call it Green String Lettuce). It's abundant and unmistakable. The same plant also appears as exceedingly thin sheets, sensibly called Sea Lettuce; nowadays these two seaweeds (or algae) are treated as one species. They are the oldest “large” (big enough to pick up) ancestors of garden lettuces and weeds, and date back about 660 My (million years). Among their more advanced algal descendants are Stoneworts (*Chara*), upright little plants resembling miniature horsetails, that grow submerged in shallow water. Stoneworts and their kin are probably the ancestors of all green land plants. Locally, the only place I've seen them is in a pond in Paradise Meadows.

Back to Seal Bay and the land plants in the forest. The most ancient of them are mosses and fernlike plants, hereafter just “ferns” (ferns, club mosses, horsetails, spike mosses and quillworts) which are about 500 million years old. Both mosses and ferns reproduce sexually but they produce spores, unlike the more advanced seed-bearing plants. However, the sexual arrangements differ markedly in the two groups. Seed plants (modern trees and all flowering plants) are believed to have descended from ferns, but the descendants of the primitive mosses are just more mosses.

Continuing with the fern lineage, next come coniferous trees about 250 My ago and finally flowering plants (including all hardwood trees) about 140 My ago. To compare plants with dinosaurs which, unaccountably, have a much better press, note that dinosaurs first appeared about 230 My ago, and died out 65 My ago. So the early dinosaurs roamed in forests consisting of conifers plus many spore-bearing trees that are now extinct. The later dinosaurs were able to smell the flowers.

All plant groups (that is, blue-green bacteria, algae including seaweeds, mosses, fernlike plants, conifers, and flowering plants) are evolving still. Among flowering plants, for instance, grasses first appeared a mere 50 My ago. All these dates are based on fossils, and represent the oldest known date for the organism concerned. In fact, they could have evolved earlier.

To return to a topic left dangling above, what about plants with other chlorophyll combinations. First, consider plants that, like blue-green bacteria, have only chlorophyll *a*. These are the “red” (really more like purple) seaweeds, among them the well-known Turkish Towel (*Chondracanthus*), whose appearance is exactly described by its name, and Purple Laver (*Porphyra*), used for wrapping sushi; in shape and texture it resembles sea lettuce, but with the green chlorophyll overwhelmed by a purple pigment. Though closely resembling blue-green bacteria in their chemistry, the red algae have cells with nuclei, as have all other plants except blue-green bacteria. In a bacterial cell, the DNA is awash in undifferentiated cell contents instead of being tidily packaged in a nucleus.

Lastly, where's the chlorophyll *c*? It's the chlorophyll which, together with *a*, catalyzes photosynthesis in the brown seaweeds. Familiar examples are rockweed (*Fucus*) and the various kelps. Fossils have been discovered resembling rockweed and kelp except that they have many characteristics of terrestrial plants. It's possible some brown seaweeds may have become land plants about 370 My ago and have since gone extinct. No later fossils have been found. The thought of land vegetation made of a mixture of what we have now plus a multitude of treelike brown seaweeds is a bizarre notion to conclude with.



Chris Pielou in Manning Park.

Photo: Sharon Nisack

## Ferns and Their "Allies"?

By Chris Pielou

Anybody who hasn't brushed up on their botany since the year 2000 is in for a big surprise. The news dates from the 1990s. Most plant books written before then (and some more recently) are united in the way they divide up the plants. After pages and pages of seed-bearing plants (conifers, hardwood trees, all the shrubs and flowers, plus grasses, sedges and rushes), they have a short section called "Ferns and Their Allies". The so-called allies are put into two groups ranking equally with each other and with the Ferns: one of these groups is the Horsetails and the other the Lycophytes (clubmosses, spikemosses and quillworts). This is the classification that has now been shot down and replaced by another. Keep in mind that a proper classification should show how plants have separated and diversified over time since the first primitive land plants appeared nearly half a billion years ago; in a word, how they have evolved. A classification is not just a convenient way for list maniacs to divide things up tidily.

What follows applies to all the land plants (that includes the freshwater aquatics) but NOT the mosses. They are another story.

The division into seed-bearing plants on the one hand, and all the spore-bearing ferns-plus-allies on the other, seemed to make good sense because their contrasting modes of reproduction, seeds versus spores, are so radically different. Things were straightforward in pre-DNA times!

The ferns-plus-allies are now split differently. On the basis of their leaf sizes they are divided into small-leaved plants and broad-leaved ones. The small leaves and broad leaves themselves are called, respectively, microphylls and macrophylls, and they differ in anatomy as well as in size.

Microphyll-plants comprise clubmosses, spikemosses and quillworts. They are unobtrusive plants, fairly uncommon in the Comox Valley, and collectively they're called Lycophytes. Some clubmosses (*Lycopodium* species) grow scattered in dry woodlands. A single spikemoss species (*Selaginella wallacei*) is fairly abundant on dry rocks in Comox Bluffs Ecological Reserve. And the two quillwort species we have, namely, *Isoetes nuttalli* and *Isoetes echinospora*, are both rare. The first, Nuttall's Quillwort, grows in wet ditches and I've seen it at only one site, on Denman Island, and the second, Bristle-like Quillwort, only in one pool near Paradise meadows. The microphylls on dryland plants (club- and spike-mosses) are small, dry

and stiff, those on quillworts longer and soft: the quillworts are aquatic in form even though Nuttall's can survive in wet ditches. Notice that horsetails are NOT members of the Lycophyte group; I'll return to horsetails later.

As the name implies, microphylls are small leaves. They never have leaf-stalks. They are never compound (with several leaflets to a leaf) and always have smooth borders without teeth or lobes. And each has only a single, unbranched vein. Macrophylls, in contrast, always have several veins, sometimes parallel with one another (as in grasses and sedges), and sometimes intricately branched (as in ferns, coltsfoot and false bugbane, for example). Often they are compound (e.g., yarrow, vetches, elderberries and columbine) or deeply lobed (e.g., the majority of ferns, buttercups, oaks) or toothed (blackberry, alder); and more often than not they have leaf-stalks.

Now for some ancient history: the earliest land plants, which appeared about 410 million years ago, were small and exceedingly simple. They had no leaves: their green stems did the photosynthesis. And they reproduced by spores. They soon evolved, however, developing little one-veined leaves which we now call microphylls.

Then, sometime in the Devonian (410-360 million years ago), their descendants took two evolutionary "leaps". In some of the primitive plants, the microphylls evolved into macrophylls; and in some, the seed-bearing mode of reproduction evolved. For a period in the Devonian the amount of carbon dioxide in the atmosphere dropped to a mere 10% of what it's been before and since. As a result, macrophyll-plants, because they could carry out photosynthesis more efficiently than microphyll-plants, soon became far more numerous and quickly dominated the vegetation. The evidence from fossils, and more recently from DNA studies on living plants, shows that this was the first evolutionary leap.

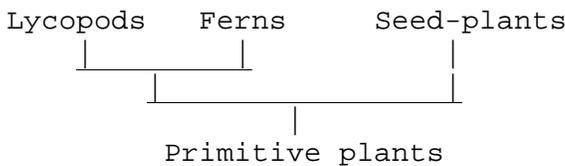
The second happened soon after, and affected only the macrophyll-plants. Some of them became seed-bearing; this proved a more efficient mode of reproduction than spore-bearing, and soon seed plants greatly outnumbered spore plants among the macrophyll-plants. The microphyll-plants, i.e., the Lycophytes (clubmosses, spikemosses and quillworts) with inefficient leaves and inefficient reproduction have been doubly outclassed: today they are both primitive and comparatively scarce.

Now for horsetails. They don't look "big-leaved" but the DNA evidence makes it quite clear that in fact they are really ferns, not just allied to them but strictly belonging to them. They are as closely related to the "ordinary"

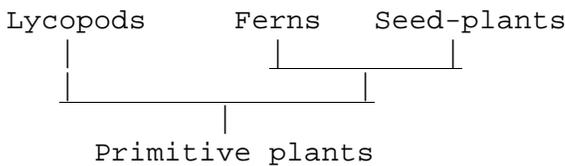
ferns as are grape ferns and hairy water-clover (*Marsilea*), another way-out fern. A plant doesn't have to look like a fern to be a fern genetically, just trust the DNA. (Note to birders: until now, to call a horsetail a fern would have been as outrageous to botanists as it would be for you to call a goose an eagle, for instance.)

The conclusion: The family tree (oldest at the bottom) of all the land-plants-except-mosses has been modernized as shown below.

#### Old:



#### New:



Reference: *A Natural History of Ferns* by Robbin C. Moran (Cambridge, Timber Press, 2004).

## The Magic of Pollen

By Chris Pielou

If it weren't for pollen, the world would be wholly devoid of flowers and trees. This is because all living beings big enough to be seen without a microscope reproduce sexually. To achieve this, a sperm has to reach a waiting egg, and to get there it must swim, or float, through water or some other liquid. All organisms can manage this except for the seed-plants, i.e., except for coniferous trees and all the flowering plants including hardwood trees. The seed-plants have had to evolve a means of bringing their germ cells together in spite of the parents being separated by seemingly impassable dry air.

This is where pollen comes in. A pollen grain is NOT equivalent to a sperm: it is much more complicated. Inside it is a microscopic 3-celled organism separate from the parent plant on which it was formed. Each grain is carried, usually by wind or insects (especially bees), to another flower, where it sticks to the stigma, the sticky part of the carpel or female part of the flower. Inside the carpel are eggs waiting to be fertilised. The pollen grain starts growing: one of its cells lengthens into a long pollen tube that penetrates the tissues of the carpel and finally reaches an egg. The second of the three cells is

the actual sperm cell; it travels down the pollen tube and fertilizes the egg. The third cell has important tasks to perform too, but they're not relevant here.

A high-powered microscope is needed to see pollen tubes, but a good way of visualizing what's happening is to look at a corn plant when the uppermost flowers (the "tassels") are shedding pollen. Some of the pollen will land on the silk just beginning to emerge from developing cobs on a nearby plant (corn won't self-fertilize). Then each pollen grain will grow a tube the full length of the silk to which it has stuck; the tip of the tube finally penetrates the corn kernel to which the silk is attached, getting there in less than a day, usually. As the tube grows, the sperm cell travels from the pollen grain down the tube, fertilizes the egg inside the kernel, and the job is done. Corn silks are unusually long, narrow styles (the botanical name for them), and the pollen tubes of corn grow unusually fast.

When it comes to pollen production, flowers are of two kinds: pretty ones, which attract bees to pollinate them and people to delight in them; and inconspicuous ones, like grasses, sedges, and alders, which rely on wind to carry their pollen. The latter have to produce vastly more pollen than the pretty flowers do, to ensure that at least some reach their targets, the carpels of flowers on other plants. This is true of the flowerless coniferous trees, too.

The outer coat of a pollen grain is hard, waterproof, and very resistant to decay. Countless millions of surplus grains from the lavish producers settle out of the air onto the ground and onto the surfaces of lakes and ponds every spring. The latter sink through the water after floating for a while, and come to rest on the mud at the bottom, where they are soon buried among the sand and clay particles that collect at the bottom of any calm water body. This happens year after year, leaving a continually updated record of many successive years of "pollen rain". Fortunately, pollen grains are recognizable (under a high-powered microscope), and pollen analysts can identify the plants from which they came. So a core of mud collected from a lake bottom serves as a history book of the surrounding vegetation back to the time, maybe tens of thousands of years ago, when the lake came into existence.

For example, Richard Hebda of UVic and a colleague found that 30,000 years ago (during a warm interval in the most recent ice age), the east coast of Vancouver Island was covered with herbs and grasses typical of treeless tundra. The land was arctic "barrenlands" for a while until the final advance of the ice covered it again. Once the last ice melted, our familiar conifer forests

became established, about 10,000 years ago. Garry oaks, however, arrived later, less than 8,000 years ago: should we regard them as invasives?

To return to fresh pollen. It is indispensable to bees as food and they carry pollen from flower to flower coincidentally. Bees need sugary nectar for energy and pollen for its protein. Honey bees bearing pollen are a familiar sight; they carry it in pollen baskets of coarse hairs on the outsides of their hind legs. Mason bees carry it in a pollen brush, on the lower side of the abdomen. In both cases, the pollen is prevented from dribbling away by being stuck together with nectar. Bumblebees mix pollen with wax in constructing cells for their eggs; it strengthens the cell walls.

Pollen is useful for people-food, too. On the Web, you'll find a tempting pancake recipe using cattail pollen.

## There Are No Saprophytes

By *Chris Pielou*

Until recently, non-green plants, which cannot feed themselves by photosynthesis, were classified as either parasites or saprophytes. A parasite gets its food (sugar solutions) from a green plant (its "host") by growing narrow root-like haustoria that penetrate the host's root and suck up dissolved sugar.

Local examples of parasites are Ground Cone which parasitizes salal, and both species of Broomrape which usually parasitize sageworts; they are said to attack other hosts, too. The haustoria connecting parasites and hosts can be seen if the linked plants are carefully dug up and rinsed.

Other non-green plants appeared not to be parasites because haustoria linking them to possible hosts had never been found. Examples in the Comox Valley are Indian-pipe, Pinesap, Pinedrops, Candystick, Gnome-plant (all "monotropes" in the family *Monotropaceae*) and the two Coralroots (*Orchidaceae*). They were thought to be "saprophytes", and are listed as such in Pojar and Mackinnon's *Plants of Coastal BC*. A "saprophyte" is defined as a plant that feeds on the decayed remains of dead plants or other organic remains. But since the book was written, biochemists have proved there can be no such thing. Plants cannot chemically convert the complicated molecules in dead and decaying matter into the comparatively simple sugar molecules that are all they can assimilate. So what's going on?

It turns out that the so-called "saprophytes" are getting their sugar from trees, at second hand. Nearly all trees are connected to fungi: a tree root and a fungus grow together to form a "fungus-root" (a mycorrhiza) which

allows the fungus to take nourishment from the tree. It also allows the tree to absorb far more soil water plus nutrients, than it otherwise could, because a fungus's absorbing filaments spread through a much greater volume of soil than do the tree's own roots. In short, tree and fungus parasitize each other and both benefit. Most (maybe all) the common fungi growing on or in the ground form fungus-roots: that is, all the mushrooms, chantarelles, boletes, etc. as well as various subterranean fungi.

What were once known as "saprophytes" are now recognized as epiparasites, the name for organisms that parasitize a parasite. The non-green plant (pinesap, candystick, or one of the others) is a member of a single three-member system. The tree and the fungus benefit each other, and the non-green plant is a hanger-on, helping itself but giving nothing in return to the tree or the fungus. This doesn't matter as its demands are small – compare the size of a white pine and one or two small gnome plants, for example. The epiparasites are not numerous enough to damage trees.

The knowledge that trees and herbs were linked dates back to 1960, when a Swedish botanist, Erik Björkman, injected a radioactive tracer into spruce trees and found that nearby pinesap plants became radioactive a few days later. After that, an electron microscope was needed to reveal the individual fungus filaments that connect monotropes to mycorrhizal fungi. Case solved.

The monotropes "epiparasitize" coniferous trees. You'll always find them growing close to conifers, often in heavily shaded sites. They don't need light.

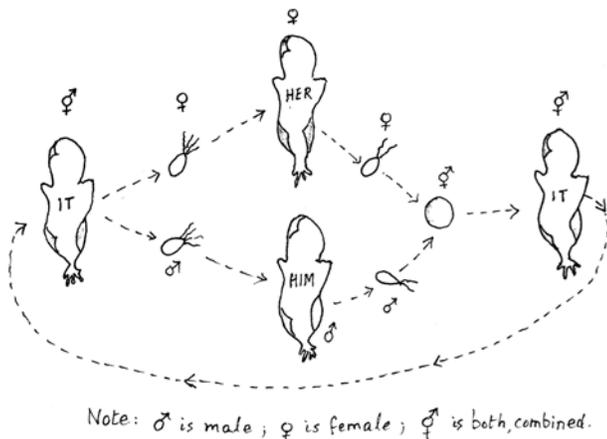
## Sex and the Lonely Sea Lettuce

By *Chris Pielou*

Sea lettuce is probably our commonest seaweed. You'll find it on almost any beach, in greatest profusion on stretches where fresh water flows onto the beach from higher ground, sometimes from leaky septic fields. It's bright green, usually thin and limp, and found as limp "rags" of weed. It doesn't attract much interest, let alone admiration, but it should. It is a direct descendant of 2-billion-year-old ancestors, themselves the ancestors of all the vegetation on earth. They were the organisms in which sexual reproduction originated, which ensures that different combinations of chromosomes, creating genetically "new" offspring, can appear often without waiting for occasional gene mutations, which is all the "newness" you'd find in a clone.

There are THREE indistinguishable forms a sea lettuce can take: HIM, HER and IT. See the diagram. Every cell

in an IT contains pairs of identical chromosomes and reproduces by spores, each with 4 flagellae (little “whips” that power their swimming). Each spore receives only one representative of every chromosome pair, and even though the spores look all alike, in fact, they are males and females. They grow to become HIM and HER lettuces which reproduce sexually. Each produces gametes (the collective word for eggs and sperms) each with two flagellae. Though each gamete is either male or female, they all look exactly alike. In spite of this, they manage to unite pairwise appropriately. The new cell formed by a union is the first cell of an IT, which grows to look like any other sea lettuce. The cycle repeats endlessly, but you’d never know it – to repeat, ALL sea lettuces look alike. See the diagram.



Sea lettuce reproductive cycle

They’re not green, however, when they’re “dead”. All of them, IT, HER, and HIM, use up all the material in their cells to make spores or gametes as the case may be, and when every cell in a particular lettuce is empty, the whole lettuce is colourless or white. But it’s no more dead than an empty egg shell, or an empty chrysalis is dead. Its contents have simply moved on to the next stage of living.

For even more simplicity, note that the closely associated (both genetically and on the beach) Green String Lettuce behaves in the same way. The ordinary sea lettuce is in the genus *Ulva*, and the string lettuce used to be in the genus *Enteromorpha*. The title of a 2003 research paper in the *European Journal of Phycology* is “Linnaeus was right all along: *Ulva* and *Enteromorpha* are not distinct genera”. Hooray, one fewer name to remember.

## Why Is Comox Bluffs Home to Botanical Rarities?

By Chris Pielou

“Our” ecological reserve – the Comox Bluffs ER – is home to a number of interesting plants. That is why the Reserve was created. Four of our botanical treasures are comparatively rare, blue-listed species, defined by the BC Conservation Data Centre (the CDC) as species of “special concern”, though not “endangered or threatened” as red-listed species are (we have none of those, that we know of). Our blue-listed species are Least moonwort, *Botrychium simplex*, one of the grape ferns; Macoun’s groundsel, *Senecio macouni*; Dune bentgrass, *Agrostis pallens*; and Western St. John’s-wort, *Hypericum scouleri*. I’ve not yet seen any of them there myself. They were observed several years ago, by Adolf and Oluna Ceska, Hans Roemer, and Betty Brooks; we must hope they’re still there.

Besides these true rarities, we have eight yellow-listed species, but yellow-listing is nothing to boast about. The CDC defines such species as “apparently secure and not at risk of extinction”. It’s unclear why they are listed at all, but perhaps they rate as “slightly rare.”

A third category of plants worth noting consists of 5 species whose geographic ranges are surprising:

- American wild carrot, *Daucus pusillus*, a miniature version of Queen Anne’s Lace to which it is closely related. Besides its small size, it differs from Queen Anne’s Lace in being an indigenous species and in being an annual. In BC it grows only near the east coast of southern Vancouver Island, plus the Gulf Islands and adjacent mainland.
- Hairy manzanita, *Arctostaphylos columbiana*, a big spreading shrub with grey-green leaves and urn-shaped pink flowers. It hybridizes with its close relative kinnickinnick where the two grow close together, producing hybrids known as *Arctostaphylos X media* which are obviously intermediate between their parents. They grow over much the same range as American wild carrot and in western Vancouver Island.
- Rocky Mountain juniper, *Juniperus scopulorum*, a small tree juniper which is very common in the Interior and the Rockies, and also along the east coast of VI and the Gulf Islands. It grows in Helliwell Park on Hornby Island, as well as on Comox Bluffs.
- Narrow sword fern, *Polystichum munitum*. It’s smaller than ordinary sword fern and the two halves of each of its fronds spread like a partly open book instead of lying flat. The pinnules (“leaflets”) don’t

lie flat either; they are twisted to form a miniature step ladder. In BC this fern grows only in southern VI and in the southern part of the Fraser Canyon.

Locally, it's to be found on Nanoose Hill as well as Comox Bluffs.

What these species have in common is their habitat. They all grow on dry, grassy, rock outcrops in dry, hot, lowland areas. Comox Bluffs provide suitable habitat because of their geological origin.

Consider the scene when you walk from east to west through the ER, starting at the bay in Comox Lake with Comox Dam at the head of it. The first part of the walk is through shady Douglas fir forest, beside a wide sandy beach. Not until you're half way through the reserve does the scenery suddenly change. Down at lake level, the beach is abruptly replaced by a rock precipice descending steeply into the water. Back from the water's edge, the gently undulating, low-lying forest gives way to the bluffs proper, which are steep and rocky. From cool shady forest you emerge onto hot sunlit slopes (weather permitting). The bluffs face south and because of their steepness, the sun's rays at midday in summer strike them almost at right angles. No wonder they are hot and dry.

Now for the geological difference that accounts for the striking visible contrast between forest and bluffs. The bluffs consist of ancient volcanic lava (now basalt) of the Karmutsen formation. The lava was extruded from long cracks in the sea floor about 250 million years ago (in the Triassic period), when VI was at the bottom of the ocean far out in the Pacific and south of the equator, long before the shifting tectonic plate on which it lies had moved up to, and latched on to, the North American continent. The forest immediately east of the bluffs grows on much younger, sedimentary rocks, namely sandstone laid down under the ocean about 80 million years ago (in the Cretaceous period).

The sandstone is much softer and more easily eroded than the basalt. That is why the land surface is low and undulating and the lake beach wide and sandy. The basalt, though much older, has resisted erosion. Weathering has produced only a little dust and grit, the first-formed ingredients of soil, and much of what was produced was easily washed away over the steep, smooth rock. Hence the thin soil.

This explains the botanical contrast between the forest and the bluffs. It is all a matter of habitat. The bluffs are as hot and arid as the southern Gulf Islands, the southern Fraser Canyon and much of the southern Interior, and

that is why these areas have some plant species in common.

It would be interesting to know how the Comox Bluffs acquired the five "rocky bluff" species described above. Either their seeds (or spores) chanced to blow in on the wind from their distant mainland territories, which seems unlikely. Or they migrated, northward with all other plants as the ice-sheets of the last ice age melted back twelve or thirteen thousand years ago, leaving bare ground waiting to be occupied. These five particular species could only migrate through, and settle in, hospitable habitats – places where the summers are hot and dry. The steep south-facing slopes of Comox Bluffs are baked by the sun all through hot summer days, and rain, when it falls, drains away quickly over the smooth, steep rock, and that is why we have these plants in our Ecological Reserve.

## Secrets of Flight

By Chris Pielou

Probably everybody envies birds' ability to fly, and that of insects too if they think of it. Consider an airplane: it uses wings for lift, and propellers or jets for forward drive or thrust. Birds and insects manage these two essential forces, *lift* and *thrust* with only one tool, a pair of wings. It's a remarkable feat.

*Lift* is the force one usually thinks of first, because birds have it and people haven't. Obviously the wings' downstrokes provide lift. How then does each following upstroke not force a bird downward and promptly cancel the lift? A bird manages this by raising its wings' leading edges on the upstroke so as to tilt them, by partly folding the wings so as to reduce their area, and by twisting the primary feathers to make slots between them which allow air to pass through. Insects can manage only the first of these actions, so their flying is even more of a feat than that of birds.

Now for *thrust*. It results from the fact that the wings aren't horizontal on the up and down strokes. Instead, they tilt forward (with the leading edge slightly lower than the trailing edge) on the downstroke and tilted more steeply backward on the upstroke. These manoeuvres mean that a downstroke is simultaneously a forward stroke as with a paddle, and an upstroke simultaneously another forward stroke as with an oar. The upstroke is the more effective of the two.

Lift and thrust are the two forces a flier must exert: lift to counteract *gravity*, the force pulling it down; and thrust to counteract *drag*, the forces (note the plural) holding it back. With apologies to Einstein, drag is the more

interesting. Except for space travellers, gravity is the same always and everywhere. But drag constantly varies: with the speed and direction of the wind; and also, especially for a bird, with the tilt of its wings, the spread of its wings and tail, and the fluffing or smoothing of its plumage. Insects have less scope for adjustments, which makes their flying all the more praiseworthy.

Drag is really two forces: there's *skin-friction*, which depends on the surface area of the beast and the smoothness of that surface, just as you'd expect. And there's *pressure-resistance*, the resistance the flier has to overcome to force aside the air in its path: it has to displace air if it's to move anywhere. Up to a point, reducing one form of drag increases the other: a streamlined shape, slicing through the air, meets less pressure-resistance than a bluff body of the same size but, because it has a bigger surface, it suffers more skin-friction. It's a trade-off.

The weird thing about pressure drag is that, in some circumstances, it aids forward motion. This happens when a bird with a bluff rear end (think of a grouse) is flying fast: the air in its immediate wake becomes turbulent instead of flowing smoothly as it would if the bird flew more slowly, and in turbulent air the currents flow in little spiral eddies. About half of these little eddies always chance to spin so as to "kick the bird in the butt", giving the flier a welcome push from behind. This is why large, gregarious birds, like geese and sandhill cranes fly in Vs. Except for the leading bird, who's doing most of the work, each profits from the turbulence in the wake of the bird next ahead. They needn't be "in-flap".

The efficiency of flight, in either a bird or an insect, can be measured. Using high-grade math, you can divide *thrust* by *skin-friction* and come up with the so-called "Reynold's number" (symbol "Re") which is the single best measure of the flight efficiency. The numbers range from high (300,000) for a duck going at 70 kilometres per hour, to medium (40,000) for a pigeon flying slowly, to somewhat lower (20,000) for a dragonfly at 25 kph, to very low (30) for the smallest flying insect doing its best. For the energetic duck Re is 10,000 times as great as for a tiny midge and the contrast is due both to the much greater thrust of the duck and the much greater skin-friction of the midge. But both beasts are equally good at what they do.

Only a light-weight flier can hover in one place. Surprisingly, hovering takes far more energy than forward flight. Plenty of insects can do it, most conspicuously the hoverfly. The only bird light enough

to hover for any length of time in still air is a hummingbird. A kingfisher only hovers for short stretches, facing into the wind to obtain some lift.

There's no doubt that flying of any kind (except, perhaps, soaring which, strictly speaking isn't flying) is extremely hard work. It is at its hardest when a bird has to take off again and again at short intervals, because of repeated disturbance. This is what exhausts herons and migrating brant when dogs chase them on the beach.

A final note: most naturalists wonder how high a bird can fly and what sets the limit. It's a hard question to answer: knowledge depends on what plane pilots happen to observe and record. Usually the species of an observed bird can't be stated, either because it was too far off to see or because the pilot is unfamiliar with birds. A duck is reported to have struck an airliner at a height of 6.4 km, and a bird has been reported over the Himalayas at 8.8 km. If the wind is in the right direction, the higher a bird can go the faster it will travel. The height limit is probably set by the availability of oxygen. Could a bird wearing an oxygen mask do better?

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Reference: *Life in Moving Fluids* by Steven Vogel (Princeton University Press, 1989).

## Rain

By Chris Pielou

Here's a short read for a rainy day. Rain as a natural phenomenon certainly ought to attract the interest of Wet Coast naturalists.

The first surprise (to many people) is that raindrops do NOT have the familiar tear drop shape always given them in cartoons. The smallest raindrops are almost perfectly spherical and big ones are flattened horizontally by pressure against the air they're falling through. The larger the drop the greater the flattening – the largest drops approach the shape of a hamburger bun.

The sizes of raindrops range from less than a millimetre in diameter for the smallest to about 5 mm for the largest. This means that the heaviest possible drop is more than 600 times as heavy as the lightest possible, a big contrast. But why should there be limits to a raindrop's size? A raindrop can't be smaller than the lower limit because if it were it wouldn't be heavy enough to fall and would no longer be a raindrop: the air's continual turbulence would keep it aloft indefinitely as a fog droplet. And a raindrop can't be larger than the upper limit because any larger drop would inevitably break apart: A water drop is held together by surface tension, the same force that creates a "skin" on a calm pond strong enough to support a whirligig beetle or a

water strider. In the same way that a heavier animal would break through the surface skin, a heavy water drop automatically breaks up because of its own weight.

Next, how far and how fast do raindrops fall? They fall from almost any height in the troposphere, and in our latitudes most of them start out as snow and melt on the way down. This explains why, even in summer, big raindrops are unpleasantly chilly. It's not just that they seem cold, they really are cold, especially big drops which fall faster than small ones and so have less time to warm up on the way down. (Air temperature decreases as you go upward – think of the bone-chilling outside temperature of –60 degrees C that the pilot announces when you're flying at 10,000 metres). As for their speed when they hit the ground, the largest, and therefore coldest, strike at over 30 km per hour in still air. The still air proviso is important. Rain is affected by updrafts and downdrafts. Indeed, heavy rain creates its own downdraft by dragging air with it.

The downdrafts are seldom noticed, it's unpleasant enough to be heavily and coldly rained on. But updrafts can be surprising. On a sunny summer day, you will occasionally be rained on from a clear blue sky, with the nearest rain cloud kilometres away. What is happening is this: rain fell from the distant cloud while it was above the point where you are now, and then drifted away. But the rain from it was held aloft floating high in the air by an updraft from the warm ground, until you happened along. Rain showers from a blue sky would be more frequent but for the fact that floating raindrops evaporate in mid-air if the updrafts supporting them persist for too long.

Now imagine that a rain shower has passed and the sun has come out. With luck you'll see a rainbow, created by sunlight from behind you being reflected back to you by the raindrops in front of you after being broken into rainbow colours within the drops. If the shower was small and not too heavy, you'll probably see the distant scenery beyond it through the falling rain. This must be because light rays coming from the distant scenery can pass clear through the shower, which proves that light from behind you, including sunlight, must also be able to shine through the shower. It follows that the rainbow's light is coming to you from drops throughout the whole depth of the shower, from those on the farther side as well as from the ones nearest you. In other words, the rainbow isn't flat (as it appears in some textbook illustrations!) but has depth. Starting from the rain nearest to you, it stretches directly away from you for tens or hundreds of metres. This isn't something you can inspect. Nobody ever gets an oblique view of the

rainbow because every rainbow is personal to the viewer: it is formed by light shining directly back from the sun into her or his eyes alone. To my mind, the knowledge that a rainbow is a three-dimensional object gives it added, unobservable beauty in addition to that you actually see.

## General News

### Counting and Celebrating Swans

A Volunteer Opportunity  
*By Krista Kaptein*

Trumpeter Swan season in the Comox Valley is starting soon! The swans will start to arrive in the valley around the end of October, and several swan-related activities are happening at that time.

The Comox Valley Naturalists Society has been counting swans every fall and winter since 1991, gathering important information for the Trumpeter Swan Management Project. Swan counters go out in teams every Tuesday at 10 a.m. from the last week of October to the last week of March, to their assigned fields, and then meet up for coffee at a local restaurant to share findings. Counting swans is a great way to get started with bird counts, since swans are large, white, and easy to see even without binoculars! For more experienced birders, an additional incentive is the chance of seeing unusual birds in fields that are restricted to the public – birds such as Northern Shrike, Western Meadowlark, and Mountain Bluebird have all been seen during the swan counts. New participants in the fun weekly counts are welcome – please contact Ernie Stefanik at [ernie.stefanik@gmail.com](mailto:ernie.stefanik@gmail.com) who will assign you to a suitable area team.

Another annual swan-related event on the Island is the **WildWings Nature & Arts Festival** in Duncan, which celebrates the return of the Trumpeter Swans and other migratory waterfowl to their overwintering habitat in the Duncan/Cowichan area. This year, from October 6 to November 19, events will include raptor photography and bird call workshops, as well as a presentation on November 9 focusing on the Somenos Marsh Important Bird & Biodiversity Area (IBA), designated for its importance to Trumpeter Swans. More information about the Festival is on their website at [www.wildwingsfestival.com](http://www.wildwingsfestival.com).

This year, an additional special event that will conclude the WildWings Festival is the **Biennial Conference of the North American Trumpeter Swan Society** (TTSS). The 24th Conference of TTSS in Duncan, from November 16–18, will include swan experts from all over North America presenting to the public. More information and registration for the conference is on the TTSS website <http://www.trumpeterswansociety.org/2016-registration.html>. The Conference will close with a gala fundraiser featuring keynote speaker Robert Bateman, at the Quw'utsun' Conference Centre, a fitting finale to the weeks of celebrating birds and biodiversity.

## Short Notes

### Conservation: Little River

By Frank Hovenden

One of my first outings with CVN was to rescue and move White Rein-orchids (*Platanthera dilatata*) from the proposed road into a new development in the Little River area. We moved them out of the roadway, and into the protected riparian area. This must have been back in about 2007.

On a recent walk through the area, I was pleased to see Rein-orchids but not nearly as many as I had hoped. I also saw several Clustered Broomrape (*Orobanche fasciculata*) – one of which was outside the fence, so I hope that one survives.

There are a few small broom plants in the area, which we will be removing later, with as little disruption to the soil as possible.



At Little River: Clustered Broomrape (left), White Rein-orchid (right)

Photos: Murray Little

### Some IBAs Still Need Caretakers

The BC Important Bird Area (IBA) program is coordinated by BC Nature with support from national partners Nature Canada and Bird Studies Canada. BC's 82 designated sites form a significant portion of the network of ~600 IBAs across Canada, which is not surprising considering 76% of Canada's bird species are found in BC.

Volunteer Caretakers are the eyes, ears, and hands on the ground at IBAs. They monitor birds, assess habitats, and conduct outreach and conservation activities within IBAs. To view a list of areas that still need Caretakers in BC, please visit <http://www.bcnature.ca/projects/iba/ibas-needng-caretakers-in-bc/>.

### Meditation on a Natural Lawn

By Charles Brandt



Charles's natural lawn.

Photo: Charles Brandt

This is my lawn: uncut, unwatered, unfertilized, just the variety of natural grasses spotted with Shasta Daisies, Yarrow, Hairy Cat's Ear, Sword and Bracken Ferns, Snowberry, Salmonberry, Thimble Berry, Dandelion, surrounded by Hemlock and Bigleaf Maples. This is the natural world, the other-than-human world that we must learn to love, because it is a sacred world. We only love something (someone) because it is sacred. Only the sense of the sacred will save us.

## Upcoming CVNS Activities

Volunteers to lead walks are heartily welcome. Please volunteer to be a guide.

### General Instructions for Field Trip Participants:

- All walks are club events and reserved for members only, unless otherwise stated. Typically, one walk each month is opened to the public.
- Car-pool at the Old Church Theatre, 755 Harmston Avenue in Courtenay, or meet guides at trail heads, unless otherwise announced (check the President's weekly e-mail announcements). Arrive at the meeting area 10 minutes prior to the appointed time.
- Wear clothing and footwear suitable for the conditions.
- Bring water and a snack.
- No dogs please.
- Share travelling expenses when car-pooling.

### Schedule

This schedule lists only the walks confirmed to date, and some details are not yet available. Please check the website and watch for e-mails.

**Sunday, September 4:** (Public Walk) Pub-to-pub walk at Oyster River/Salmon Point. Meet at 10:00AM at the Courtenay Country Market on the Old Highway (19A), across from the Golf Course just north of Courtenay or at 10:30AM at Oyster River Regional Park. Sunday brunch/lunch at Salmon Point Restaurant.

**Saturday, September 17:** Bear Creek. Salmon may be spawning. Leaders: Mandy and Charley.

**Saturday, September 24:** Garry oaks at Lazo. Leader: Judy Morrison.

**Saturday, October 1:** Kin Beach to Little River shoreline walk. Meet at Kin Beach main entrance. Wear sturdy footwear as this beach is a combination of cobblestone and sandy areas. Leaders: Helen and Robbie.

**Sunday, October 9:** Puntledge Park. Meet at 1<sup>st</sup> Ave. entrance of park at 9:00 a.m. Leaders: Karen Franzen, Alison Maingon.

**Saturday, October 15:** Ralph River walk. Focus on mushrooms. Leaders: Alison and Loys Maingon.

**Saturday, October 22:** Estuary birding walk. Leaders: Dan and Bill.

**Sunday, October 30:** (Public Walk, limit of 40) Nymph Falls Regional Park. Focus on mushrooms. Meet at park entrance. Leaders: Alison and Loys Maingon.

**Saturday, November 12:** Headquarters Park: history and nature. Meet at Farnham Road. Leaders: Loys and Alison Maingon.

**Saturday, November 19:** (Public Walk) Maple Lake. Meet at Harmston or trail head. Leaders: Loys and Alison Maingon.

**Sunday, November 27:** Goose Spit. Meet at DND entrance. Leader: Loys Maingon.

**Sunday, December 4:** Kye Bay. Meet at Kye Bay parking lot. Leader: Loys and Alison Maingon.

### Reminder for Field Trip Leaders

All field trip participants who are non-members must sign the waiver recognizing that there are risks inherent in all outdoor activities.

## About the Society

### Website

[comoxvalleynaturalists.bc.ca](http://comoxvalleynaturalists.bc.ca)

### General E-mail Address

[coordinator@comoxvalleynaturalists.bc.ca](mailto:coordinator@comoxvalleynaturalists.bc.ca)

### Mailing Address

Comox Valley Naturalists Society  
Box 3222  
Courtenay BC  
V9N 5N4

### Board of Directors

President: Jim Boulter  
([coordinator@comoxvalleynaturalists.bc.ca](mailto:coordinator@comoxvalleynaturalists.bc.ca))

Past President: Loys Maingon

Vice-President: Jarrett Krentzel

Secretary: Gabriel Baubaiges

Treasurer: Isabella Erni ([TreasurerCVNS@gmail.com](mailto:TreasurerCVNS@gmail.com))

FBCN Director: Sharon Niscak

### Group Leaders and Other Volunteers

Membership Secretary: Maris Ratel

Birding: Dave Robinson

Botany: Karin Franzen, Alison Maingon, Joel Kositsky

Families Group: Jocie Brooks, Rene Jorgensen

Photography: Terry Thormin

Conservation: Norma Morton

Wetland Restoration: Murray Little

Garry Oak Restoration: Loys Maingon

Swan Count: Ernie Stefanik, Krista Kaptein

Comox Valley Conservation Strategy liaison: Murray Little

Trip Planning: Joyce Bainbridge

Bursary: J. Harrison, M. Stewart, K. Wilkinson

Website: Jim Boulter, Isabella Erni, Krista Kaptein

Facebook: Jillian Jones

Newsletter Advertising: Kathie Woodley

Newsletter Editors: Sharon Niscak, David Orford

## Constitution

Available in PDF form on this web page:  
<http://comoxvalleynaturalists.bc.ca/about-us/>

## Membership

One adult: \$30; Family: \$40;

Junior (12-17): \$10; Student (18-22): \$15

Pay on website using PayPal, or mail cheque (payable to Comox Valley Nature) to:

CVNS Membership Secretary  
 314 Aitken Street  
 Comox BC  
 V9M 1N4

Receipts are provided at meetings, or include a self-addressed stamped envelope.

Membership fee is due January 1. If not paid by March 30, names are removed from the CVNS and BC Nature lists. New memberships started after September include the following full calendar year.

Change of address, phone number or e-mail: Please advise the Membership Secretary.

## Meetings

**Monthly general meetings** are held on the 3rd Sunday of the month at 7:00 p.m. in the Florence Filberg Centre, 411 Anderton Avenue, Courtenay.

**June meeting:** Potluck at a member's house.

## No general meeting in July, August, or December.

**Bird meetings:** First Thursday of the month, 7:00 p.m. at the Filberg Soroptimist Lounge, Courtenay. For information, contact Dave Robinson.

**Botany meetings:** Second Monday of the month at a member's home, 12:00 p.m. An e-mail is sent prior to the meeting to confirm location and topic.

Botany walks (weather permitting) follow the meeting and are also scheduled at other times. To be included on the botany list, contact Karin Franzen or Alison Maingon.

## Newsletter

The newsletter is published 3 times per year (March, June, and November). It is e-mailed to members, and is also available at the monthly meetings. If you wish to receive printed copies by Canada Post, the fee is \$5.00 per year.

The newsletter depends on your contributions. Please consider contributing an article or note on any topic of general interest to other members—for example: natural history, conservation activities, trips, or unusual sightings. You can send your contribution by e-mail to [newsletter@comoxvalleynaturalists.bc.ca](mailto:newsletter@comoxvalleynaturalists.bc.ca).

We would appreciate receiving articles by the first day of the publication month.

All articles are subject to editing for grammar, spelling, length, and readability.

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