Gabriola Streamkeepers—Water levels and quality

Observations at Coats Marsh, Gabriola Island

—with notes on Coats Marsh Creek, East Path Creek, and Stump Farm Streams.

References:

RDN Coats Marsh Regional Park, 2011–2021 Management Plan, Appendix A.
RDN Coats Marsh Weir Assessment, June 1, 2020, SRM Projects.
Gabriola Riparian Areas, February 24, 2012, Madrone.
RDN Berm Report, September 12, 2013.
RDN Water Level Management, September 14, 2021, Madrone.
RDN NHC/EDI Weir Replacement Study, April 12, 2023.
RDN/NTBC Coats Marsh Weir Management Proposal, May 2, 2023.
RDN NHC/EDI Decommissioning Plan, December 18, 2023.
RDN NHC Beaver Dam Risk Assessment, January 10, 2024.
RDN Coats Marsh Weir Pool Mitigation Plan October 2024.

For an up-to-date list see here and for pertinent Gabriola Streamkeepers notes see here.

Coats Marsh hydrogeology .

Water-levels' summary.

Coats Marsh RP and 707 CP Trail Maps: Maps Y and Z.

Gabriola Stream and Wetlands Atlas .

Coats Marsh Species Checklists .

Freshwater fish on Gabriola Island, BC

Coats Marsh – human disturbance of breeding and migratory ducks and geese.

Coats Marsh – beaver dam stability.

Coats Marsh Management - paper on, weir decommissioning

Coats Marsh brief history.

Long-term precipitation (1944-2024) – statistics. Updated every month and used as the "normal" meaning average precipitation at Coats Marsh.

Field observations—2025 (Jan.—Mar.)

THIS FILE (Field Observations 2025) IS A SUPPLEMENT TO:

"Observations at Coats Marsh, Gabriola Island" File: 673.

For an up-to-date list of supplements see here .

Gabriola Streamkeepers—Water levels and quality

Observations at Coats Marsh, Gabriola Island

—with notes on Coats Marsh Creek, East Path Creek, and Stump Farm Streams.

References:

RDN Coats Marsh Regional Park, 2011–2021 Management Plan, Appendix A.
RDN Coats Marsh Weir Assessment, June 1, 2020, SRM Projects.
Gabriola Riparian Areas, February 24, 2012, Madrone.
RDN Berm Report, September 12, 2013.
RDN Water Level Management, September 14, 2021, Madrone.
RDN NHC/EDI Weir Replacement Study, April 12, 2023.
RDN/NTBC Coats Marsh Weir Management Proposal, May 2, 2023.
RDN NHC/EDI Decommissioning Plan, December 18, 2023.
RDN NHC Beaver Dam Risk Assessment, January 10, 2024.
RDN Coats Marsh Weir Pool Mitigation Plan October 2024.

For an up-to-date list see here and for pertinent Gabriola Streamkeepers notes see here.

Coats Marsh hydrogeology .

Water-levels' summary.

Coats Marsh RP and 707 CP Trail Maps: Maps Y and Z.

Gabriola Stream and Wetlands Atlas .

Coats Marsh Species Checklists .

Freshwater fish on Gabriola Island, BC

Coats Marsh – human disturbance of breeding and migratory ducks and geese.

Coats Marsh – beaver dam stability.

Coats Marsh Management - paper on, weir decommissioning

Coats Marsh brief history.

Long-term precipitation (1944-2024) – statistics. Updated every month and used as the "normal" meaning average precipitation at Coats Marsh.

Field observations—2025 (Jan.—Mar.)

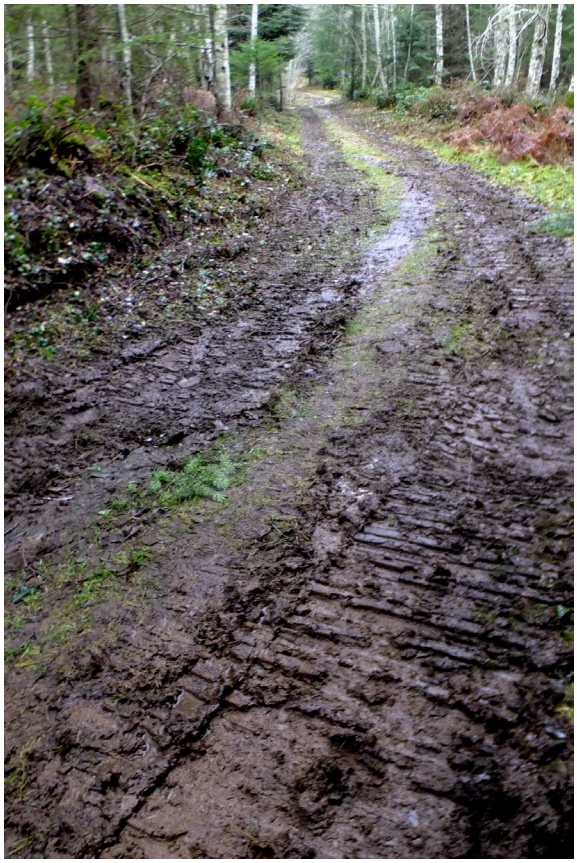
THIS FILE (Field Observations 2025) IS A SUPPLEMENT TO:

"Observations at Coats Marsh, Gabriola Island" File: 673.

For an up-to-date list of supplements see here .

Jan.02, 2025 (day 3456, 3288+168):ViGRG cum. 610.8 mm (norm. 560 mm).

The future of the park as a nature reserve is looking muddy this year, like East Path does now. Still relatively mild for time of year (8-10°C). Raining as usual.



On hiking passed the site where hair ice was seen last fall (Nov.28, 2024 File 673ze, p.ZE 643, Ridgeway west end) surprised to see that the fallen dead alder branch where the hair ice was photographed was sporting an unusual small fungus on the decorticated (de-barked) wood of the branch. A crust fungus with a white shelf-like cap with a slight blueish tint and a wrinkled maze-like underside -- no gills, pores, spines, or veins.

Plicatura nivea, which is a wood-decay fungus, fits as best as I can tell. Can't find any connection in Internet sources between this species and hair ice.[1]

I did promptly visit two other sites on the island where hair ice has been reported. One showed no sign of a polypore or crust fungus,

[1] The species mentioned in almost all articles on hair ice on the web is *Exidiopsis effusa* but the source of this identification is a paper published by German/Swiss scientists in 2015 (Biogeosciences, 12, 4261–4273, 2015) and this species is not found in BC. All three species in this genus that have been reported here (*Alloexidiopsis calcea*, *E. diversa*, *E. plumbescens*) are rare, or don't grow on alder (*Alnus rubra*), which is the common host on Gabriola. The fruiting body of *P. nivea* is quite unlike that of *E. effusa*.

the other showed what might be *Plicaturopsis crispa*, possibly a close relative of the *Plicatura nivea*. It was not on the dead branch where hair ice was seen, but on a standing tree several feet away,[2] which casts doubt on its significance (that's the top surface of the cap of suspected *P. nivea* shown on the *right*, Jan.2).

Jan.11, 2025 (day 3465, 3288+177):ViGRG cum. 643.3 mm (norm. 613 mm).

My interest in white rot,[3] or more precisely wood-decay fungi, peaked, triggered by the January 2nd hair-ice location observation.

Plicatura nivea NOTES

Attributes: white; rotting dead alder, normally on small branches or twigs lying on the ground; not on bark; no gills, visible pores, spines, or teeth; ridges on the fertile surface maze-like; sometimes exposed on broken pieces of sapwood as white rot. Seen on wood displaying hair ice. The picture *right* (Jan.5) shows fruiting bodies clustered on the broken end of the rotting deadfall that hosts the hair ice shown above.

Hair ice not seen on bark, an attribute seemingly of *P. nivea* also. The picture *right* (Jan.11) is of a specimen that at first seemed to be an exception, but on very very gently pulling the specimen away from the bark it could be seen that it had a "stem" which allowed it to poke its head through a small 2-mm diameter hole in the bark from the wood inside. Such holes and those rather smaller are common on red alder bark. The holes can't be implicated in hair-ice growth as their density is too low [4] and their diameters are probably more than one order of magnitude too large.

[2] The far more common "little white mushroom" on wood around here is *Marasmiellus candidus*, it being too common to make it likely to be associated with hair ice. It's also a cap-and-stem mushroom, not an expected crust.

[3] White rot: cell walls (cellulose and lignin) are degraded: brown rot: cellulose only is degraded: soft rot: cellulose and lignin are degraded but the preference is cellulose especially in hardwoods.

[4] Not the work of sapsuckers. Not unknown but almost never seen in the forest, preferring gardens.

P. nivea (surmised)appearing (Jan.5) to be using the alder bark of a snag as a holdfast (*right*), but is actually held by a "stem" growing through the bark as shown on the previous page. Not the only crust fungus to do this.

END of NOTES

Plicaturopsis crispa NOTES

Attributes: white when young but with amber spreading over the cap, becoming zoned; on decaying wood, more often on snags than *P. nivea*; on alder; no gills, visible pores, spines, or teeth; fertile surface flat, maze-like indentations if present less frequent and more obscure than on *P. nivea*; often larger than *P. nivea*. No known association with hair ice.

Following is based on assumption ID is correct, which is uncertain. Zones may look like (false)turkey-tails.

END of NOTES

Hair ice slow to melt even at +4°C. Pixie cup lichens (*Cladonia* sp.) on the partially-shed bark. East Path.

Wood-decay oddities NOTES

Little piles of stuff the colour of charcoal on the peeling bark of decaying alder wood. Not squirrel poop nor a fungus.

I suspect it's dead material from the cambial zone, the thin boundary layer between the inner-bark and the outer-sapwood, a layer that in alder is green when the tree is alive. This dead, now black, layer is habitat for fungi and is often being turned into frass by arthropods and their larvae and by annelids (worms).

Possibly soaked in rainwater and then extruded through small holes in the bark by frost.

Hairy cap; blueberry-juice blood-stains (good give-away), *Stereum* sp. but not *S. ostrea* (false turkey-tail). Alder snag.

Assuming a fungal pathogen on this Oregon-grape leaf, the decay sequence is green-red-black, not dissimilar to changes in the colour of the cambium of trees, except that the cambium of young alder trees on Gabriola tends to skip the red, as do their leaves that go from green to dark brown, greenish-black, or to black-spotted green in late-fall.

A potentially interesting one (*right*) as the fruiting body is emerging from beneath the peeling bark of this alder snag.

Peeling away the bark reveals (*lower right*) its cotton-woolly mycelia on the cambial zone. So not a whole-hearted white-rot fungus. Certainly a killer, but not one to dispose of the sap- and heart-wood. Uncommon to rare.

It's possible to observe the dietary preference of fungi on chain-saw cuts. Ones that show special interest in the cambrial zone produce fairy rings of a different sort from usual. The few I've seen are usually polypores like turkey tails (*Trametes versicolor*).

Chain-saw cut, probably Douglas-fir. The rot fungi are polypores, turkey tails or something similar. Disinterested in the heart wood.

Polypores. Turkey-tails or similar on bigleaf maple.

Another chain-saw cut. A bracket-fungus, like other polypores only interested in the inner-bark/outer sapwood zone.

Another chain-saw cut, probably bigleaf maple. The rot fungi here though are crust-fungi, no visible pores, beautifully zoned.

More crust-fungi, no sign of pores. Underside *Plicatura-nivea*-like but that's not an alder. Might be a bigleaf maple.

Plicaturopsis crispa or more likely false turkey tails (*Stereum hirsutum)*, inset *right on the same log*. Quite willing to venture through the sapwood.

My take-away based on this scant evidence is that polypores tend not to be dead wood decay-fungi and mycelia immediately under the bark are distractions when looking for a fungus responsible for forming hair ice. Some polyporaceae species however can cause white rot, while others cause only brown rot. Turkey tails specifically cause white rot.

Although trees are the focus on looking at wood rot and hair ice, some broadleaf shrubs can be quite woody and one of them, oceanspray (*Holodiscus discolor*), is abundant in the brush left by the flail mower where hair ice was frequently seen on small fragments of wood.

While these twigs were often from alder branches, the fragments also included fragments of oceanspray (reddish-brown peeling bark, longitudinal ridges), some of which were thin (2 mm diameter). While I can't say I saw hair ice on these shrub fragments, I also can't say there weren't any; I wasn't looking for that association and was just assuming that they were all alder when alder trees were about. The

inner-bark-cambium layer of oceanspray doesn't readily shed to reveal the sapwood in the manner of alder wood.

Cut ends of dead oceanspray wood that has been afflicted with wood-decay fungus is very commonly hollow, with the heart wood missing.

Occasionally you see some examples where there are cotton-woolly hyphae filling where the heart wood or core once was. The only fungus fruiting body in these cases I've observed is false turkey tail.

Here's another interesting find, a piece of thoroughly decayed wood, fragile and weighing almost nothing. East Path Creek riparian area where there are alders and coniferous trees. A white with yellowish patches crust with an underlayer of shallow pores (poroid) and a forest of spines.

It might be *Schizopora paradoxa*, which is familiar because this cosmopolitan species occurs in the list of fungi associated with hair ice in the paper by Hofmann et al. 2015, along with everybody's (foreign)favourite *Exidiopsis effusa*.

If *Schizopora paradoxa* is here, it's not abundant and only occasionally seen flourishing the way it is here. Other samples observed were on the bark of recently felled branches, film-like attachment with "underside" facing out.

Jan.19, 2025 (day 3473, 3288+185):ViGRG cum. 644.2 mm (norm. 658 mm).

Cyclonic weather given way to blue-sky anticyclonic weather for the last few days. Creeks dry, except Little Creek. Lots of ducks on the lake (>50), mainly ring-neckeds, but a few mallards, buffleheads, and wood ducks. Water level (thankfully) looking normal (natural).

Light frost overnight, morning temperature around —0.3°C, but noon air temperature around +4°C. Sunny. No wind. Hair ice frequently seen.

The hair ice is seemingly resistant to melting. Some short fragments of wood lying in the duff left by the recent flail-mowing of brush along the sides of trails were carrying hair ice despite the above-freezing air temperature and despite the fact that all of the surrounding detritus on the ground, including that from the same

branch, was wet and showed no hint of frost.

The short answer as to whether there exists a chemical that dissolved in water and then frozen would raise the temperature needed to melt that ice above 0°C is, there isn't one. Solutes always lower the melting point.

Researching the long answer leads to a warren of rabbit holes (gels, supercooling, differences between mixtures and solutions).

It is not rare to see hair ice growing beneath the shedding bark of the decaying wood when there is sufficient room. It looks like it's pushing the bark away from the sapwood, but it's not.

Isolated hair ice. Seen often enough and undamaged to make it not possible that it's due to human intervention. Air temperature a few degrees above freezing.

My theory is that the hair ice once formed is slower to melt than frost on the dark surroundings (its albedo is higher), and if the melting is incomplete at nightfall, water vapour from the now melted surroundings encourages the growth of hoar frost on the hair ice. Latent heat of fusion also slows down the melting when the temperature hovers around zero. After a few days the hair ice becomes hard to distinguish from regular hoar frost.. It's a delicate balance depending on local humidity, local temperature, and local exposure to the sun.

The word "hoar" is derived from older words with the connotation of grey-haired, old, like the related German word for Mr., *Herr*.

Jan.26, 2025 (day 3480, 3288+192):ViGRG cum. 644.3 mm (norm. 697 mm).

The extraordinary commonality of hair ice the past few days has narrowed down the list of possible hosts.

On the island as a whole, not just the CM-RP area, the trees and tall-shrubs that are NOT less common than the hair ice are:
alder (*Alnus rubra*);
bigleaf maple (*Acer macrophyllum*);
Douglas fir (*Pseudotsugo menziesii*);
grand fir (*Abies grandis*);
cedar (*Thuja pliata*);
arbutus (*Arbutus menziesii*); and
oceanspray (*Holodiscus discolor*).

Coral-like fungus not minding the frost. Very white and fresh. Young, so branching may not be complete. On mossy litter. Jan.11

Others are here (meaning the whole island) but too isolated, scattered, or local to be primary candidates.[5] Of these, the Hofmann et al. 2015 paper lists only (of the same genera) *Acer* and *Alnus*.

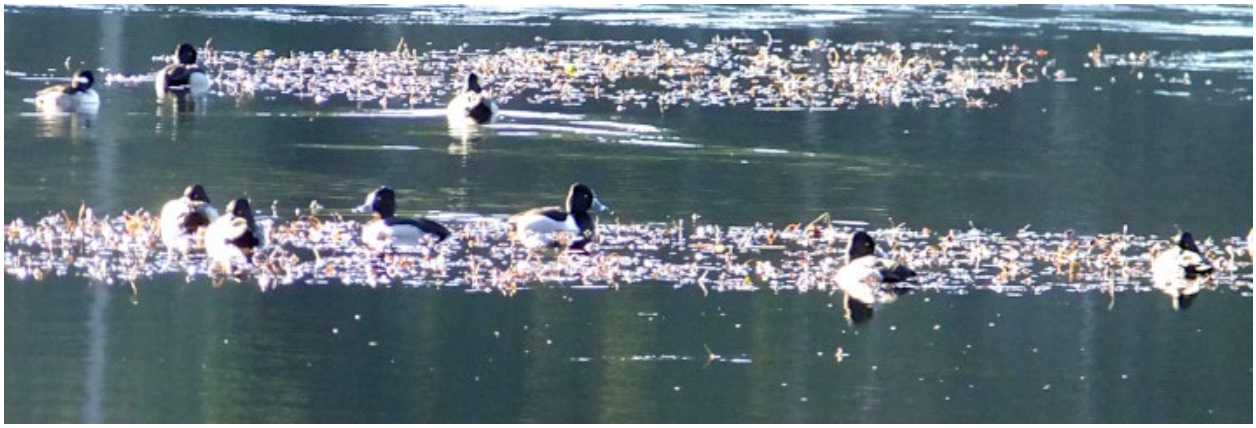
The fungi genera listed in the same paper are:
Dacrymyces (witch's butter, on conifers, not abundant, brown rot);
Diatrype (black or colourful jellies, not recorded here);
Exidiopsis (crust fungi, white rot, may be species here, all rare or difficult to identify, no record of *E. effusa*);
Fomes (brackets, here but too big to go unnoticed, white or brown rot);
Hypoxylon (forms cankers, not widespread in BC, soft rot);
Schizopora (named S. *paradoxa* probably here, crust fungus, not rare but also not very common if it is, white rot);
Pycnoporus (colourful brackets, oak and cherry, if here, unusual, not common, white rot);
Tremella (hardwood witch's butter, here, but not abundant, parasitic).

Identifying species of interest is fraught. The vast majority of crusts are impossible to identify without a microscope and white rot fungi can be present in hardwood trees for many years before fruiting bodies are produced. There's also no reason I'm aware of that several species may be capable of being a progenitor of hair ice.

The Field Guide to Forest Damage in BC, Joint Production Canada and BC, March 2001 does not list any non-rare white-rot species for red alder beyond *Armillaria nabsnona* (honey mushroom, gilled, fleshy and conspicuous, here but not abundant).

My favourites for further scrutiny are definitely *Stereum hirsutum* and *Plicatura nivea*; both cause white rot; but also not ruled out is a so-far unrecognized crust fungus with only microscopic sporocarps.

[5] In general, conifers seem to be afflicted by fewer saprotrophic species than hardwoods. Arbutus wood seldom looks like it's being attacked by fungi beyond thin whitish patches, but its leaves very often do.



Jan.31, 2025 (day 3485, 3288+197):ViGRG cum. 655.6 mm (norm. 723 mm). Cistern -320 mm SCB. [cal. datum: cistern +0.047 m].

Precipitation this month 72% below long-term average. Hasn't been so low since 2009. There was another low in 1985.

RDN yo-yoing the lake level again despite the lack of rain this month. Resident ducks fewer in number than before and very skittish.

Another form of ice, pipkrakes (needle ice) East Path Jan.25,2025. Formed when the soil temperature is >0°C and the air's <0°C.

Feb.09, 2025 (day 3494, 3288+197):ViGRG cum. 684.0 mm (norm. 767 mm).

Snow covering much of the ground. Most trails have been broken and the going on the self-packed-down icy snow (firn)[6] is easy.

Freezing at night and melting during the day. No trace of hair ice.

Lake surface frozen but with small refuges of open water along the fringes. Not a good time to be visiting the cistern or weirpool area where the ducks are sheltering.

Feb.15, 2025 (day 3500, 3288+212):ViGRG cum. 698.5 mm (norm. 794 mm).

Heavy snowfall Feb. 03 started at last to thaw. Light rain.

Some January hair-ice weather observations at Coats Marsh and the adjoining 707CP that is part of the Coats Marsh Creek catchment area.

Interested in temperature, relative humidity, absolute humidity, and wind. The humidity interest because on days when hair ice was exceptionally common, it appeared to be somewhat more common in areas of the woods near to what in non—freezing temperatures would be open water. These of course are areas where alder is more common which is the most likely explanation for the effect if it exists, but humidity might play a minor role in the formation of hair ice.

For temperature I first went to Environment Canada (EC) Entrance Island, but the minimum daily temperature never fell below zero for the whole month of January.

EC Nanaimo City Yard had no temperature data for January 2025.

EC Nanaimo A (YCD) did have data which do not look too different from my at-home casual observations (not recorded).

For precipitation I used my daily records designed to reproduce rain gauge readings at Coats Marsh. There was no snow in January and it was a very dry month with rain only for a few days at the very beginning and at the very end of the month.

For relative humidity all I could find were the EC Entrance Island hourly figures. I simply took the mid-night (00:00 hrs) and noon (12:00 hrs) figures and averaged them. Rough, but it’s a start.

For absolute humidity I took the average value of the value calculated daily using the EC Nanaimo A mean of the max. and min. temperature, and the EC Entrance Island average daily mid-night and noon relative humidity data. Not very rigorous, but this is not a PhD thesis.

There was little wind all month. At the airport (EC Nanaimo A), half the month at noon there was a light or gentle breeze (6-16 km/h) and in the other half it was calm or with only a light air (0-5 km/h). The wind in Gabriola’s forests would have been even calmer.

A summary of the results is in the tables below.

[6] Snow covering well-trodden water-eroded trails is lower than that of the adjacent vegetation-covered surfaces making it look like somebody has dragged along a heavy flat board the width of the trail to neatly compress the snow. However, there are no footprints, seams, or signs of runners. The hard-packed bare soil surface possibly offers a geothermally warmed micro-climate that encourages melting at the soil/snow interface creating ice.

Period	Hair ice	% Days w.precip.	% Days w. frost at night	Average daily max.temp.	Average daily min.temp.	Average RH %	Average abs.H g/m^3
A	no	35	35	7.2	0.9	87	5.6
B	yes	0	100	6.8	-3.5	77	4.2
C	no	40	80	6.6	-3.0	89	4.9

Column 1: Period
A: Jan.1—17; 17 days
B: Jan.18—26; 9 days The early date may be a day or two too late.
C: Jan.27—31; 5 days The late date is arbitrary.

Column 2: Hair ice
no: no sign of hair ice anywhere
yes: hair ice common, partially melted towards the late date.

Column 3: % Days with precipitation
all rain: mostly early in the month in Period A and at the end of the month in Period C when it was not responsible for the disappearance of the hair ice.

No entry: % Days with frost during the day
none. There was melting every day. EC Nanaimo A (YCD).

Column 4: % Days with frost during the night
EC Nanaimo A (YCD).

Column 5: Average daily maximum temperature
EC Nanaimo A (YCD) °C. Mostly sunny weather.
The equivalent figure for EC Entrance Island were:
Period A 8.1°C; Period B 7.2°C; Period C 6.8°C, less than a degree or so higher. The sun supplying the warmth.

Column 6: Average daily minimum temperature
EC Nanaimo A (YCD) °C. Clear skies common.
The equivalent figure for EC Entrance Island were: Period A 4.8°C; Period B 3.1°C; Period C 2.8°C, higher by 4 to7 degrees. The sea supplying the warmth.

Column 7: Average relative humidity percentage
For relative humidity all I could find were the EC Entrance Island hourly figures. These are average of the mid-night (00:00 hrs) and noon (12:00 hrs) daily figures for each period. Rough, I know. Local relative humidity could have been different.

Column 8: Average absolute humidity g/m^3
Average of the calculated values using the daily average EC Nanaimo A (YCD) maximum and minimum temperature and the daily average relative humidity calculated as for Column 7. The values for data from Entrance Island alone were: Period A 6.4°C; Period B 5.3°C; Period C 6.0. About 1 g/m^3 more.

Period	Hair ice	Rain mm.	Calm days per period %	Light air days per period %.	Light breeze days per period %	Gentle breeze days per period %
A	no	37	6	23	59	12
B	yes	0	11	56	11	22
C	no	11	60	20	0	20

Column 8: Period
Column 1 above

Column 9: Hair ice
Column 2 above

Column 10: Rain
Total per period.

Column 11: Calm days per period %
Calm = <1 km/h.

Column 12: Light air days per period %
Light air = 1-5 km/h.

Column 13: Light breeze days per period %
Light breeze = 6-11 km/h.

Column 14: Gentle breeze days per period %
Gentle breeze = 12-16 km/h. The breeze in Period C accompanied the rain at the end of the month.

NOTES

1. The failure of hair ice to re-form after several days of above zero temperatures during the day and frost at night is likely due to dehydration of the pores of the rotting wood. More than once I've gone out to observe reported hair ice a day or two after it was first observed and found no trace of it. There was a complete absence of hair ice in Period C despite the fact that the weather was similar to what it had been in Period B and the locations of the hair ice were well-known.
2. I did unsuccessfully try in Period C to grow hair ice on a twig of oceanspray which had *Stereum hirsutum* (false turkey tail) growing on it and white rot internally. I soaked it in rain water before putting it outside in the cold, but nothing grew. What was interesting though was that while soaking it I observed a small patch (abt. 1 cm diameter) that exhibited numerous sources of streams of very tiny bubbles of air being forced out of the wood by the water, the bubbles being much less than 1 mm in diameter and rising quickly to the surface. I could not see the open pores in the wood where this occurred; they were too small.

Feb.23, 2025 (day 3508, 3288+220):ViGRG cum. 776.5 mm (norm. 829 mm). Cistern 113 mm SCB. [cal. datum: cistern +0.480 m]. Weir 533 mm WPB scale. [cal.datum: weir -0.114 m]. Beaver dam head 0.6 m.

Snow gone. Lake clear of ice. Meltwater busy refilling the lake after the (unnecessary) RDN draw down. East Path Creek flowing at almost the full capacity of the culvert and the NE Arm spillway flowing strongly (illustrated) as it becomes NE Arm Creek.[7]

The concrete weir showing no sign of wanting to go anywhere.

Ducks out in the sunshine. Mainly ring-neckeds. They prefer freshwater while others like buffleheads and mallards always have the option of going down to the sea when the lake freezes over. Widgeons too who occasionally used to visit the lake are common in False Narrows this time of year.

Handsome male hooded merganser; they used to breed here but not recently.

[7] There's also flow through the rocky subgrade. There's no culvert here; most locals are well aware they need to be wearing rubber boots after days of rain. Not a problem.

Feb.28, 2025 (day 3513, 3288+225):ViGRG cum. 796.5 mm (norm. 849 mm). Weir 576 mm SCB. [cal. datum: weir -0.071 m].

Precipitation this month 18% above long-term average. Annual rainfall this year so far 33% below long-term average.

Winter precipitation (Dec.Jan.Feb.) was 20% below long-term average.

Lake level looking its winter normal (not measured).

All creeks running.[8] Just a few ducks seen (ring-neckeds, buffleheads, and a wood duck) but they are accustomed to sheltering in the reeds if they have been disturbed.

Beaver dam at the weir. Neither of the two beaver dams are perfect “dams” in that they allow some flow-through, especially when water levels are high. Some would-be flood water flows over spillways in the dams, and some flows around the ends of the dams. At all times there are also leaks through the dams.† At the moment, inflow from creeks is fairly strong, as is outflow into Coats Marsh Creek over the weir’s sill and through the pond leveller. Matching inflow and outflow stabilises water levels.

† For completeness I should add “and some moves through the fractured bedrock beneath the dams though this route is atypically not significant at Coats Marsh. See also next page.

[8] East Path Creek, NE Arm Creek, Stump Farm Number 1 and Number 2 Streams, and Coats Marsh Creek.

On the topic of leakage through “dams” (previous page), not even the concrete weir at Coats Marsh is free of all leakage, with implications as to its stability even though such leakage itself is trivial.†

From left to right: the wooden baffle; the concrete weir; the blasted-out rock wall of Coats Marsh Creek; with a stagnant pool of water at the bottom.

The orange slime (iron-ochre) indicates seepage through what might be a cold joint in the concrete. It also shows seepage through a mudrock interbed in the sandstone bedrock. The concrete was poured ca.1968 and doesn’t appear to have moved since. The photograph was taken on July 17, 2016.

† Ref: A professional analysis is in SRM Projects June 2020, https://nickdoe.ca/pdfs/Webp699.pdf

March 10, 2025 (day 3523, 3288+235): ViGRG cum. 839.7 mm (norm. 885 mm).

Wonder what these are. Look like uncooked hen’s eggs without shells. They haven’t moved since first spotted at the end of January, almost 40 days ago now, which doesn’t suggest slime mold. I know there are egg-yolk jellyfish, but they don’t often appear here!

Meanwhile, the RDN plan to remove and not repair the weir continues, something I regard as tantamount to bureaucratic vandalism.

March 19, 2025 (day 3532, 3288+244):ViGRG cum. 872.7 mm (norm. 914 mm). Weir 288 mm SCB. [cal. datum: weir -0.359 m]. The weirpool as it is today. Off and on a pool has probably existed here since it was formed from meltwater at the end of the last ice age, more than ten thousand years ago. But it has apparently become too inconvenient for humans and has to go.

Gloomy weather. Fitful gusts driving ice-cold raindrops, roaring through the canopy and unheeded through the leafless alder groves, the temperature hovering uncomfortably only a few degrees above zero, or too-many degrees below ten. Bird songs as rare as sunlight. Depressions depressing.

THIS SECTION SHOULD NOT BE CITED AS AN AUTHORATIVE SOURCE. I am not a qualified geologist and I don't have a portable X-ray diffractometer; these are just the result of ponderings while wandering the trails.

The recent finding that the mineral *ferrihydrite* in the dust on Mars (*top left*) is why the planet appears red has interesting links with the mineralogy of the soils, regoliths, and rocks of Gabriola. The finding of this hydrated mineral ($Fe_5O_7OH.nH_2O$) shows that at some time in the ancient past, the Martian climate was both cold and wet. And that's exactly how it feels here on Gabriola today.

Seepage in the rock walls of the Coats Marsh Creek channel immediately below the weir (photo *lower left*) in places reveals, by its reddish-orange colour, concentrations of an iron mineral, almost certainly at least in part an oxyhydroxide of iron like that found recently on Mars.

This leads to the following **rabbit hole** that I'm now going to go down.

The usual weathering pattern of Gabriola's bedrock is for iron-bearing silicates (*biotite* and *hornblende*) to eventually weather to *goethite* (α-FeO.OH), which can be yellowish-brown or black.[9] *Goethite* is thermodynamically the most stable of all Fe-oxides and oxyhydroxides.

However, in dry and warm conditions the bright-red mineral *hematite* (α-Fe_2O_3) can create a pause in the weathering process that may last indefinitely if conditions remain perfectly dry and warm.[10] The absence of water on the surface of Mars used to be the reason for suspecting that the planet's redness was generated by *hematite* in the surface dust, it being conjectured that the dust had been dehydrated long-ago.

The paths, there are several, from iron-bearing silicate minerals to "rust" in wet environments can involve several hydrated oxides and oxyhydroxides of iron that are thermodynamically less stable than *goethite*. "Rust", the common name for loosely defined mixtures of such compounds, is known to geologists as *limonite*.

Oxides and oxyhydroxides of iron are mostly created chemically during weathering but they can also be created by iron bacteria that thrive by oxidizing ferrous ions (Fe^{2+}) in aqueous environments to iron III (Fe^{3+}) in mainly solid ferric compounds.

The most common among the several oxides and oxyhydroxides that may constitute rust are *lepidocrocite* (γ-FeO.OH), which is bright orange when not masked by other pigments, and *ferrihydrite*, which is on the border of being a mixture and a mineral in its own right as its expanded chemical formula suggests ($2Fe_2O_3.FeO.OH.nH_2O$). *Ferrihydrite* is commonly reddish brown.

---

9 *Goethite* crystals are tiny and usually observed only in aggregates, the organizations of which are varied and account for the mineral exhibiting different colors. I always assume that the yellowish-brown version is what you often see in the fine sediment that settles last in undisturbed puddles on the trails, and the black version is what makes lichen-free patches and coatings of well-weathered sandstone bedrock exposed to the elements look black..

10 *Hematite* can also be black but I've never knowingly seen any this colour. I believe *hematite* is quite rare on Gabriola. In our climate it would weather to black or dark-brown *goethite*. It may be present in some of the reddish rinds of weathered sandstone that has been exposed to the sun or fire but not rain, and it probably accounts for the redness of bricks made from Gabriola's mudrock. The weathering reaction is $Fe_2O_3 + H_2O = 2FeO.OH$.

Lepidocrocite forms in wet conditions, often underwater, when oxidation is slow. It will continue to weather to *goethite* when exposed to the atmosphere. You can find what may be *lepidocrocite* in the interior of fossilized late-Cretaceous brachiopods that occur in Gabriola's mudrock.[11] It may also be what is providing the orange colour of some glaciofluvial sands.[12] There is another polymorph of *goethite* called *feroxyhyte*, but it is unstable.

Ferrihydrite forms when oxidizing is rapid and it is stabilized by the presence of silicates, which are ubiquitous in all of Gabriola's geological formations. Its continuing on to weather to *hematite* requires more warmth than we commonly provide; however, we do have sufficient warmth to provide wetness that continues to slowly weather *ferrihydrite* to *goethite*.[13] In earlier articles, I wrongly tended to ignore *ferrihydrite* because at the time it was regarded simply as hydrated *hematite*.

So, the light at the **end of the rabbit hole** is that the reddish-orange films you sometimes see in seepages in mudrock (shale) outcrops look much like Martian regolith, because they too probably contain some *ferrihydrite*.

March 22, 2025 (day 3535, 3288+247):ViGRG cum. 889.0 mm (norm. 923 mm).

Buffleheads, ring-neckeds, wood ducks, and in the weirpool,
cavorting couples of mallards
and hooded mergansers.

[11] https://nickdoe.ca/pdfs/Webp517.pdf *SILT* 21, p.29. Gabriola Island's late-Cretaceous fossils, August 2017. These fossils contain high levels of phosphorus which is conducive to the formation of *lepidocrocite*.

[12] https://nickdoe.ca/pdfs/Webp533.pdf *SILT* 8-13, pp.7-9. Ice-age fossil sites on Gabriola, 2014.

[13] $Fe_5O_7.OH.nH_2O = 5\ FeO.OH + (n-2)H_2O$. n=4 has been proposed [$5Fe_2O_3.9H_2O$] but not generally accepted.

I don't know when the concrete culvert for Coats Marsh Creek under the Marsh Trail was built but it looks like it could be in the same era as the weir. If so, it looks in very good shape for its age having withstood several large flood events including draining the whole wetland.

March 30, 2025 (day 3543, 3288+255):ViGRG cum. 889.0 mm (norm. 944 mm).

Many buffleheads still and mallards, but the ring-neckeds are not to be seen. A pair of Canada geese.

Among the snags in the weirpool, a small group of hooded mergansers maybe in the six to ten range, both males and females.

Precipitation this month 36% above long-term average.

Annual rainfall this year so far now down to 15% below long-term average.

This winter's precipitation (Oct./24 to Mar./25) has been 3% below long-term average.

Photographing the several hooded-merganser couples in the weirpool without them noticing you is a challenge. Here, the female is partially hidden behind the tree on the right. The fir is a downed tree felled by the RDN in preparation for draining the weirpool.

◊ *previous file*

next file