

Wonalancet Out Door Club Newsletter

JUNE



2021

Caring for the Sandwich Range since 1892 - *or so*

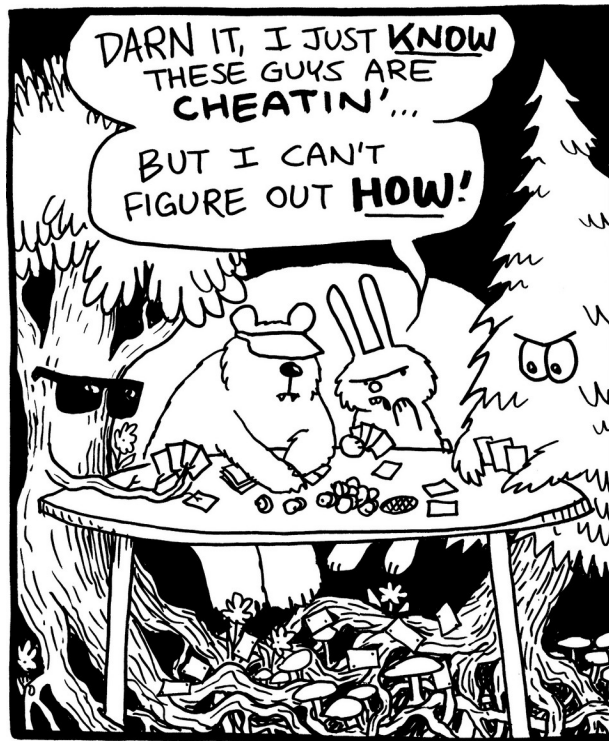
TREE TALK

It's almost 40 years since botanists first realized that trees were sending each other airmail. The messages were pretty straightforward: "Someone's chewing on me; beef up your defenses".

Of course, it might be more accurate to say that a very small number of botanists realized this. One of them was David Rhoades at the U. of Washington, (Maybe it's meaningful that Rhoades was actually a zoologist interested in the insects that do the chewing.) But another report — this one by botanists — coming out in the same year from Dartmouth, showed that tree seedlings grown in the lab next to seedlings with damaged leaves started to produce chemicals in their leaves that would repel herbivores.

As it happened, about the time this work was published, I was working with a forester who told me about it. Since I was also a zoologist who knew no botany, and therefore had no preconceptions, it seemed perfectly reasonable to me that chewed upon leaves might emit volatile chemicals that signaled their neighbors. Unfortunately, the botanical establishment, which had plenty of preconceptions, did not share my opinion.

They condemned the idea, the research leading to it, and the researcher who'd done it. (Rhoades actually lost his funding, left science and ran a B & B instead.) But times have changed. A recent article in *Wired* summed up 40 years of research as, "The evidence for communication is only a few decades old, but in that short time it has leaptfrogged from electrifying discovery to decisive debunking to resurrection."



Marek Bennett ★ comics WORKSHOP ★ © www.MarekBennett.com

Rhoades' original work was done on alders and willow; the Dartmouth work was done on poplars and sugar maples. Since then, much of the research on this topic has been carried out on shrubs and crop plants. The signals appear to cross all sorts of boundaries; damaged sagebrush tells tomato plants to gear up for attack and so on. And this despite the fact that the mix of volatiles emitted is (somewhat) species specific; the receptors seem to cross genus as well as species lines.

Why should this phenomenon occur? Plants — or at least most of them — live surrounded by enemies who'd like to eat them. Why don't they all produce protective chemicals all the time? Well, that production is expensive. The metabolic cost of manufacturing protection is high. Just look at the US budget and how we put so much of what could be spent on social welfare

into defense. What are we defending against? This is precisely the issue for plants. Most of the time those herbivorous enemies are either absent (like 17 year cicadas for 16 of those years) or present, but in low numbers. Plants being smarter than humans, they don't ramp up defense until it's needed. (And someday we might take up in these pages the question of who's actually making those defensive chemicals: is it the plant itself or its endophytes; the tiny fungi that live inside every leaf, every petiole, every needle of every plant, forming the plants' microbiome.)

Actually, no one who's inhaled the pleasant (to us humans) odor of cut grass can deny that injured plants emit volatiles. The question has always been whether those volatiles are speaking to neighboring plants and if so, who's getting the message, and what precisely *is* that message anyway. Although some botanists are grumbling that more research, more controls, better experimental design are needed to really prove that plants speak (and listen) to each other, the idea is no longer regarded as the lunatic fringe of botany. Were Rhoades still doing research, he'd be funded.

(Parenthetically, one of the reasons that this research was dropped and mocked earlier, was because it was taken up by what was if not the lunatic fringe, at least the fringe of the lunatic fringe; the folks who insisted that their houseplants responded to speech and music, and so forth and so on. And who am I to say that they're wrong? But when non-scientists jump in on revolutionary concepts, it's the concepts and the scientists working on them that take the heat. Just think about Timothy Leary and his followers on LSD and magic mushrooms. It took 50 years for research on these amazing chemicals to be decriminalized and restarted.)¹

Meanwhile, an even more revolutionary plant communication network has come to light. Well, not exactly to light since it functions in the dark. For a

¹“The Secret Language of Plants” by Kat Farmer, Quanta Magazine, 2013, available online at: <https://www.quantamagazine.org/the-secret-language-of-plants-20131216/>

decade or so now, a different group of researchers; mycologists rather than botanists, have been working on an parallel story that takes place underground, where the fungal network that connects the forest seems to serve the same function of carrying the news of attack to other members of the community. This is welcome news since it solves some of the biggest problems facing tree talk via airmail; the fact that transport of volatiles is iffy in a forest with other trees blocking pathways, the short distances most volatiles travel before dispersion, and the variability of wind and weather.

When Suzanne Simard first started talking and writing about her research on that underground fungal network (an unknown *Nature* editor was the one who headlined her first paper in 1997 as “The Wood Wide Web”, and that's been its name ever since), focusing on what she now calls “Tree Talk” (and yes, I stole that title), the response was not exactly enthusiastic. She was young, she was a woman and her idea was clearly nuts. Furthermore, she put forward the socialist idea of what can be best described as child care in the forest, with the larger trees up in the canopy sharing sugars with the smaller trees down in the dark understory. Maybe it was the socialism of it all that made US (male) scientists the last to accept her work. (Suzanne is Canadian and is now a faculty member at the U. of British Columbia in Vancouver.)

For a long time, the forest was viewed as being a capitalist ecosystem, with sunlight as capital and all trees vying for a place up in the canopy where they could grab as big a share of that capital as possible. When Suzanne showed undeniably, using radioactive tagging, that the forest was underpinned by a complex fungal network that connected large numbers of trees and was transferring capital (carbohydrates) between them, some deniers were placated by the idea that after all, for a tall tree to transfer nutrients to its children, who were down in the dark nursery of the understory, was understandable — if not quite believable — in the light of evolutionary fitness and genetic survival. However, Suzanne and her students and colleagues then went on to show, via DNA analysis, that the recipients of the tall trees largesse were not necessarily their seedlings, although it turns out that the seedlings do get a somewhat larger

portion. And this was only the beginning. More recent work has shown that trees share their excess photosynthates with trees (and even shrubs!) of different species, so that — for example — a group of scientists applying labeled carbon to the canopy of tall spruces, found sugars being traded over to neighboring beech, larch and pine via the underground fungal web. These resource shares were not trivial; they were calculated to be about 280 pounds/acre/year of carbohydrates being transferred around the forest, out of view.

As scientists started examining more forests and more species, they discovered a more surprising transfer of nutrients, where partnerships seemed to support each other in turn, remembering what was owed and paying it back in different seasons. For example, maple trees often coexist with trout lilies, a native flowering bulb. In the spring, the lilies flower under the bare branches of the maple, dying back as the maple leafs out. When researchers looked underground, they found



Trout Lillies rising through maple leaf litter

that in spring, the dying back lilies donated sugars to the maple to help fuel its leafing out; in fall, when the maple sucked nutrients out of its leaves prior to dropping them, some of those nutrients were given to the lilies which were building up their bulbs.

Then things started to become even more complicated. For example, in the Scottish Highlands, where Scottish pine lives in the impoverished soils of heathland, along with an understory of Cowberry, it was discovered that the pine, photosynthesizing up in

the canopy, was sharing sugars with the Cowberry. The Cowberry, which has a different type of fungal net, specialized for survival in heaths and bogs, was repaying the pine with some of the nitrogen it was able to extract from the soil. In different ecosystems, nitrogen-fixing or fertilized plants have been shown to share some of their nitrogen with plants that were nitrogen deprived.

All of this has profound effects for forests. “In the interior Douglas-fir forests of western North America, the transfer of carbon, nitrogen and water from older trees to regenerating seedlings through fungal networks has been associated with rapid increases in net photosynthetic rates, shoot water relations and shoot and root growth of the young seedlings. These responses were linked to improved seedling survival and productivity, and hence regenerative capacity of the forest”

Once scientists realized that wood wide webs were transferring a variety of nutrients, they started to look for other other types of chemicals that might be moving along these underground highways from tree to tree and shrub to shrub. And — of course — they found them. To quote from an article by Simard and colleagues, “interplant resource and signal fluxes through mycorrhizal (fungal) networks have the potential to alter plant behavior. These fluxes have been shown to include carbon, water, nitrogen, phosphorus, micronutrients, stress chemicals and allelochemicals, and can occur between plants of the same or different species.” (Allelochemicals are stress or attack agents; life in the forest isn’t all childcare and gifts of food.)

So how about those warning signals sent out by damaged leaves? Are comparable signals also transmitted underground? Of course. The same article states, “Using experimental designs that prevent the aboveground transfer of volatile organic compounds, stress signals have been shown to transfer from injured to healthy plants through fungal networks even more rapidly than carbon, nutrients or water. Herbivore- and pathogen-induced stress responses were up-regulated in undamaged neighbors in as little as 6 h following insect or fungal infestation

of donor plants linked by fungal networks...For instance, broad beans (*Vicia faba*) responded to aphid attack by swiftly transferring defence signals to neighboring bean plants, which responded in turn by producing aphid-repellent chemicals and aphid-predator attractants. In a different study, defoliation of Douglas-fir resulted in simultaneous transfer of defence signals and carbon to neighboring healthy ponderosa pine through fungal networks, resulting in increased defence enzyme production by ponderosa pine, possibly orchestrated by the networking fungus as a strategy to protect itself against the loss of healthy hosts“

And this last sentence brings us to the heart of the matter. Does Tree Talk really tell us about the generosity, cruelty, family feelings and negotiating strategies of plants, or are the plants just the sources and sinks of materials manipulated by the fungal networks that connect them? Because fungi, like animals, depend on plant partners for their survival, it's clearly advantageous to the fungi to maintain a healthy ecosystem and to ensure that if one partner or one species of plant dies out, that others survive.

Sorry, folks. We can't answer this question yet. And the answer may not be a simple one. But to end with yet another quote from Simard's group, "The hierarchical integration of this phenomenon (the fungal network) with other biological networks at broader scales in forest ecosystems, and the consequences we have observed when it is interrupted, indicate that underground 'tree talk' is a foundational process in the complex adaptive nature of forest ecosystems.”

For those who'd like to learn more, much of the material in this article is available on the web. The work on airborne volatiles is accessible at: <https://www.quantamagazine.org/the-secret-language-of-plants-20131216/>

The work on the underground fungal network is summarized in the paper from which I've quoted at: <https://academic.oup.com/aobpla/article/doi/10.1093/aobpla/plv050/201398>

For those who'd enjoy watching Suzanne Simard talk about her research in a non-technical way, please do go to: https://www.ted.com/talks/suzanne_simard_how_trees_talk_to_each_other?language=en

~Susan Goldhor

WODC Annual Meeting

We will hold our Annual Meeting on Sunday August 15 at 6:30PM in the Chapel Grove, just as we did in August 2020. We recommend that those attending the meeting bring a chair which can be appropriately distanced. The Rain Date for the Annual Meeting is Sunday August 22 at 6:30PM in the Chapel grove. There will be No Potluck in the Grove preceding the meeting.

Spring Trails Report

Despite the crazy chaos of Covid, we had a very productive year on the trails in 2020. The first two volunteer trailwork days were canceled because of limits on group size imposed by Gov Sununu's Emergency Order. We hosted the final two volunteer trailwork days after the group size limits were relaxed. Volunteers wore masks when in close contact on the trail but took them off when appropriately distanced. On the July and September trail days we cleaned drainages and performed other annual maintenance on both the Cabin and Big Rock Cave trails. What we missed in group work days, adopters more than made up for. The rest of our trail system got more individual attention, particularly from Mike Schneider, Steve Swift, Steve Lord, Will Viner and Denise Langlois. Other adopters also contributed their efforts. We performed a short relocation on the Rollins Trail. Close to the Whiteface terminus of Rollin's the glacial cirque was slowly encroaching on the trail. With guidance from Cristin Bailey of the USFS, WODC volunteers relocated the trail well away from the cirque. Reports of hikers going missing on that section of trail were greatly exaggerated.

Hopefully 2021 will be a more normal year. We are planning a major project on the Dicey’s Mill Trail this summer. Jed Talbot and his Off the Beaten Path crew will perform extensive rock work over the length of the trail. The project is currently estimated to take 10 – 11 weeks and is being funded by both the US Forest Service and the White Mountain Trail Collective.



Jennifer and Denise sporting their new WODC Trail Crew caps on Spring Trails Day

This will make the treadway of Dicey’s more akin to that of Blueberry Ledge where we have already invested approximately \$100,000 to harden the treadway. To some extent I find this disheartening. I prefer the relative comfort of hiking on forest soils rather than rock steps. Dicey’s provides a gradual, comfortable descent from a 4000 footer. But, given the high, and growing use of this trail, hardening of the treadway is necessary to prevent serious erosion problems.

We will host our usual 4 volunteer trailwork days. The schedule is as follows:

May 15	Spring Trails Day
June 5	National Trails Day
July 17	New Hampshire Trails Day
September 25	National Public Lands Day

We'll meet at 8:30AM on all our Trailwork Saturdays. Bring water, food, gloves, and clothing appropriate for the weather. Most of all, be prepared to spend a day outdoors deriving satisfaction from a job well done.

If you want more information on any of our trail projects contact Jack 323-8913, jackw@myfairpoint.net.com.

~Trails Chair, Jack Waldron

Thoughts on Winter Hiking

I just finished reading Ty Gagne’s second book: “The Last Traverse”. This book documents a winter Search and Rescue(SAR) just as his first book, “Where You’ll Find Me”, did. Gagne’s approach to the subject of SAR differs significantly from most. First, Gagne documents, as best possible, the circumstances surrounding the events and decisions that led to a call for rescue. But, just as importantly, Gagne also documents the challenges faced by SAR personnel who venture into winter conditions that approach the limits of safe winter hiking. As the experienced professionals who deal with challenging winter conditions, hikers have much to learn from SAR strategies. SAR personnel must stay safe and not become part of the problem.

Gagne’s first book relates the attempt by Kate Matrosova to do a winter traverse from Madison to Washington in a day. Matrosova, unfortunately, did not survive her ordeal so there was limited information on the conditions and decisions that she dealt with. In this book Gagne recounts an attempted winter traverse of Franconia Ridge by Fred Frederickson and James Osborne. Osborne managed to survive the attempt and was able to provide information on the critical decisions that Frederickson and he made.

I found both books to be page turners. In my younger days I was an avid winter hiker. I found the mountains of May through November to be a friendly playground with views, camaraderie, exercise and other delights. But from December through April the

scene shifted to one that was thrilling, a more exhausting aerobic challenge, immensely beautiful, but also daunting terrifying at times. What I found critical in winter hiking is the importance of good decision making and risk management. This challenge was a substantial part of the attraction of winter hiking for me. Professionally, Gagne is the CEO of Primex which is a New Hampshire Public Risk Management company. As such, he brings both a hiking perspective and a professional risk management perspective to his books.

In the chapter on “Human Factors” Gagne introduces the concept of understanding the use of heuristics to help make decisions. Gagne references two papers by Ian McCammon on “Heuristic Traps in Recreational Avalanche Accidents: Evidence and Implications”² and “Evidence of Heuristic Traps in Recreational Avalanche Accidents”³. The heuristic trap occurs when we apply trusted rules to a situation which may differ from the situations where that rule has worked in the past. The challenge is to recognize those differences before the trap is sprung and a dangerous course of action has been set in motion.

When I first began winter hiking, I made a set of rules for myself to increase my perceived safety. The first rule was to only hike trails that I had hiked in summer conditions. This seemed to be an obvious way to increase my safety. I would be dealing with a familiar environment and able to recognize dangerous conditions early. What I learned over time is this rule needs to be more general. Rather than just familiarity with a trail, I also needed familiarity with the terrain in the vicinity of the trail. Winter conditions disguise an obvious summer trail. The treadway disappears under snow and the trail’s vegetative border frequently dies back and ebbs under the increasing depth of snow. What was obvious in the summer can disappear in winter.

My four attempts to summit Mt Garfield in winter are instructive. I climbed 26 of the 48 4000 footers in winter but climbed many of those peaks numerous

2 Avalanche News, No 68, Spring 2004

3 International Snow Science Workshop, 2002

times either to finally reach the summit or to revisit a favorite winter hike. I was hiking solo on my first attempt of Mt Garfield. I never had a rule against solo hiking and always enjoyed those opportunities. The Mt Garfield Trail is an old Jeep road that gradually ascends the western slope of Mt Garfield. I was familiar with the Mt Garfield Trail and confident that I could follow it in winter conditions.

My first winter hike up Mt Garfield was an uneventful snowshoe until about 4000 feet where the trail disappeared. I wandered around, found what seemed to be a trail but this “trail” headed down in elevation not up. I retraced my steps, searched for the Mt Garfield Trail some more, and finally turned around to hike back down. I was mystified that I couldn’t follow an easy trail in winter conditions. The next summer I returned to hike Mt Garfield and find the obvious “mistake” I must have made. I hiked along carefully looking for a problematic area until I popped out at the summit, no problems detected. After further investigation, I concluded the “problem” occurred at about 4000 feet where the trail took a sharp left, heading east at the end of a series of switchbacks. That previous winter a large spruce had blown down blocking and obscuring the trail where it made the sharp left turn. The trail that I had found while searching was an abandoned trail that led to the Garfield Pond Shelter. The USFS had abandoned that trail when they closed the Garfield Pond Shelter.

Armed with a better understanding of the terrain, I returned the next winter with my winter hiking companion, Gary Chamberlain, to again attempt the summit of Garfield. Our next two attempts proved equally fruitless. We understood where the trail turned left but at that point the trail entered an area with essentially no vegetative border. When the snowpack obscured the treadway, it also obscured the trail. The trail was nowhere and the trail was everywhere. We always found a variety of snowshoe tracks but those tracks always ended where the previous snowshoers had given up and turned back. On the second of those attempts we were prepared to bushwhack our way to the summit but the depth of snow, poor visibility, and constant swirling winds finally convinced us to turn around. That proved fortuitous when we found our “deep” snowshoe tracks

being rapidly filled in by the swirling winds. Returning to the actual blazed and broken out Mt Garfield Trail was a welcome sight.

On the fourth attempt, we vicariously hoped that someone had successfully broken out the Mt Garfield Trail since the last dump of snow. When we arrived at 4000 feet we found no such well beaten trail to the summit but the usual assortment of snowshoe tracks from previous wandering hikers. This time we had 3 terrain based rules to guide our hike. First, we would follow a southeasterly compass bearing. Following such a bearing in thick spruce-fir and deep snow is difficult. Second, the Garfield Ridge Trail was located to our south. That would serve as a guard rail to keep us from hiking into the Pemigewasset Wilderness. Third, we needed to be slowly but constantly gaining altitude. Garfield is a pretty singular peak, almost monadnock like.

At 4000 feet we followed a likely set of snowshoe tracks until they inevitably stopped and we had to begin bushwhacking through 2-3 foot deep snow. We followed a southeasterly course through the thick spruce-fir forest. Whenever the forest was too thick we diverted on a southerly course until we could head southeasterly again. We plodded along gaining altitude and were lucky not to stumble into any nasty spruce traps. Visibility was marginal but winds were light. Finally, we leapt for joy. We had reached, not the summit, but the well broken out snowshoe track of the Garfield Ridge Trail. Our guard rail worked. It took us about 10-15 minutes to reach the summit of Mt Garfield via a different trail than we had started on. The peak itself was socked in but the view was marvelous. Finally, we had made the “easy” winter hike to Mt Garfield.

The challenge of winter hiking is to create a flexible set of rules or heuristics, be willing to constantly improve them, and to always be comfortable turning back. I found that both of Gagne’s books provided an insightful exploration of decision making and risk management in the context of winter hiking. His account of both the conditions that led to a call for help and the response that SAR personnel employed

to deal with those conditions provides an excellent introduction to the world of heuristic traps.

~Jack Waldron



Trail Protected

The McCrillis Path is now protected from Whiteface Intervale Road through the Ambrose Preserve to the White Mountain National Forest. The WODC is grateful to the Bates family for all their efforts to make this happen. George and Nancy Bates purchased land in Whiteface Intervale where a connecting trail could be located. George and WODC then lobbied the USFS to allow one half mile of new trail through the Sandwich Range Wilderness to connect to the Bates’ land. Due to the diligence of Stephen Bates, the final step was completed this Spring when a Trail Easement was finalized to protect the trail where it crosses privately owned land. WODC will hold the easement. Tom Masland of Ransmeier & Spellman P.C. provided his usual excellent legal advice and work.

~Jack Waldron

Qty	Description	Price	Total
	WODC Patch	\$5	
	4 th Edition Map Member	\$6	
	4 th Edition Map Non Member	\$10	
	WODC Historical Collection(CD)	\$25	
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