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October 2024

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Please note that our monthly meeting is on **October 14th** which is the second Monday in October.

Overwintering native Colorado conifer bonsai

By Mike Britten, Artist of the Year 2023

One of the biggest challenges for the bonsai practitioner, especially in the S Rockies region, is protecting trees from extreme conditions including hail, high winds, and extreme temperatures. High temperatures during the growing season and low temperatures during the winter are problematic; worse perhaps are extreme temperature swings we experience in spring and fall transition periods when our trees are especially vulnerable. Early cold temps in fall, before trees develop cold hardiness, can kill our trees. In the spring, if trees have already started to metabolize, sub-freezing temperatures can kill new growth.

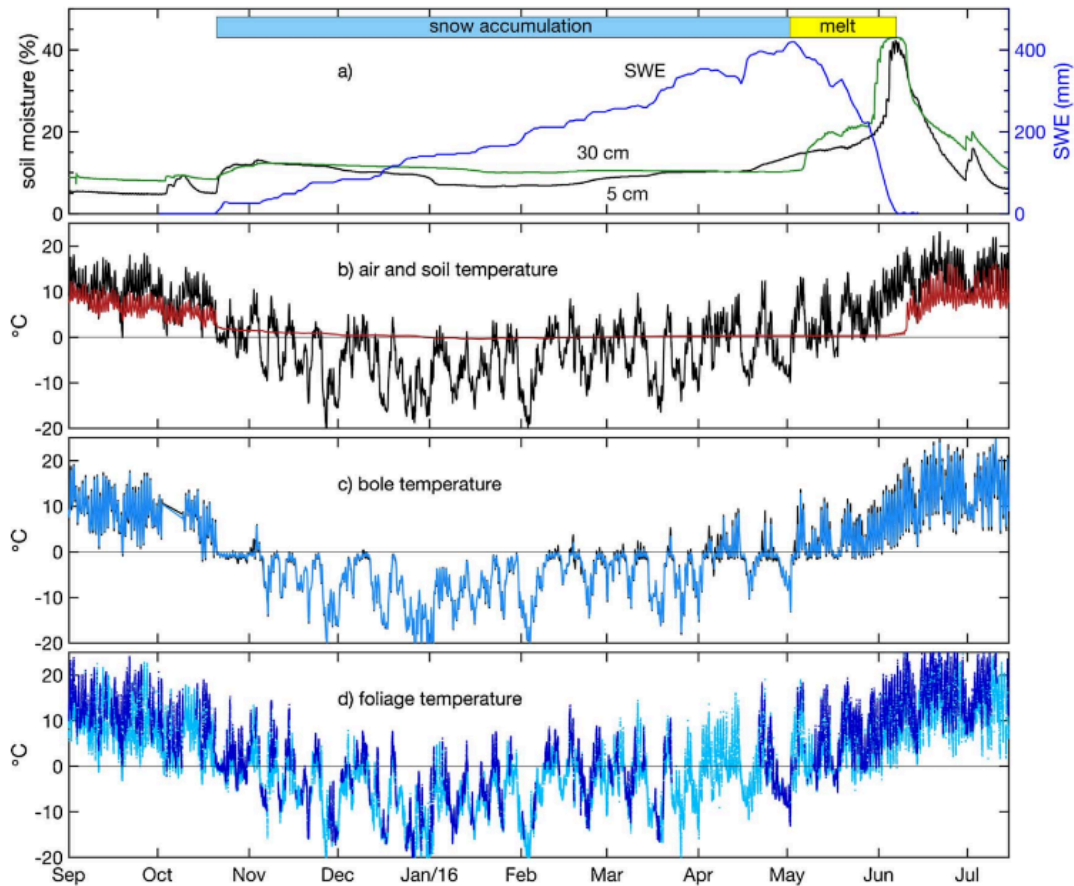
Even native conifers well adapted to our Colorado weather and climate face these challenges in a small bonsai container. Bonsai (compared to wild trees) have limited root systems and usually sit on benches. Their roots don't benefit from the temperature buffering effect of the ground. In winter, out trees, including the containers, may freeze solid which can be fatal if the tree has not developed cold hardiness.

Two publications I recently read helped me to better understand conditions that wild trees contend with in Colorado and how both wild and domestic bonsai trees move physiologically from active growth in summer to cold hardiness and winter dormancy and back to active growth in spring.

The first article is a study done at the University of Colorado's long-term ecological research site at Niwot Ridge NW of Nederland (Bowlinga, et. al. 2018. Limitations to winter and spring photosynthesis of a Rocky Mountain subalpine forest. *Agricultural and Forest Meteorology*, Vol. 252. <https://doi.org/10.1016/j.agrformet.2018.01.025>).

The authors were interested in whether warming winters were causing subalpine forests to increase overall photosynthesis and carbon

sequestration and how this might factor into global warming. They measured soil, trunk, foliage, and air temperatures in a lodgepole pine/Englemann spruce/subalpine fir forest at ~10,000-12,000 feet at Niwot Ridge. This graph shows results that were interesting to me as a grower of these species as bonsai.



The month is on the x-axis and temperature on the y-axes. Soil moisture and the amount of water in snow ("snow water equivalent") is shown on the y-axis in the top panel. Soil moisture % was relatively constant through the winter at only 5-10+ % (this surprised me, I thought soil moisture would be higher).

Air and soils temperatures are shown in the second panel. Air temps varied from -5 to 50 deg. Celsius in winter, but soil temperatures were stable and just above freezing for most of the winter due to the insulation provided by snow cover.

Trunks (boles in the third panel) remained at or below freezing from late October through early February, preventing water transport through the xylem during that time. The foliage temperature pattern (fourth panel) was similar to the air temperature pattern.

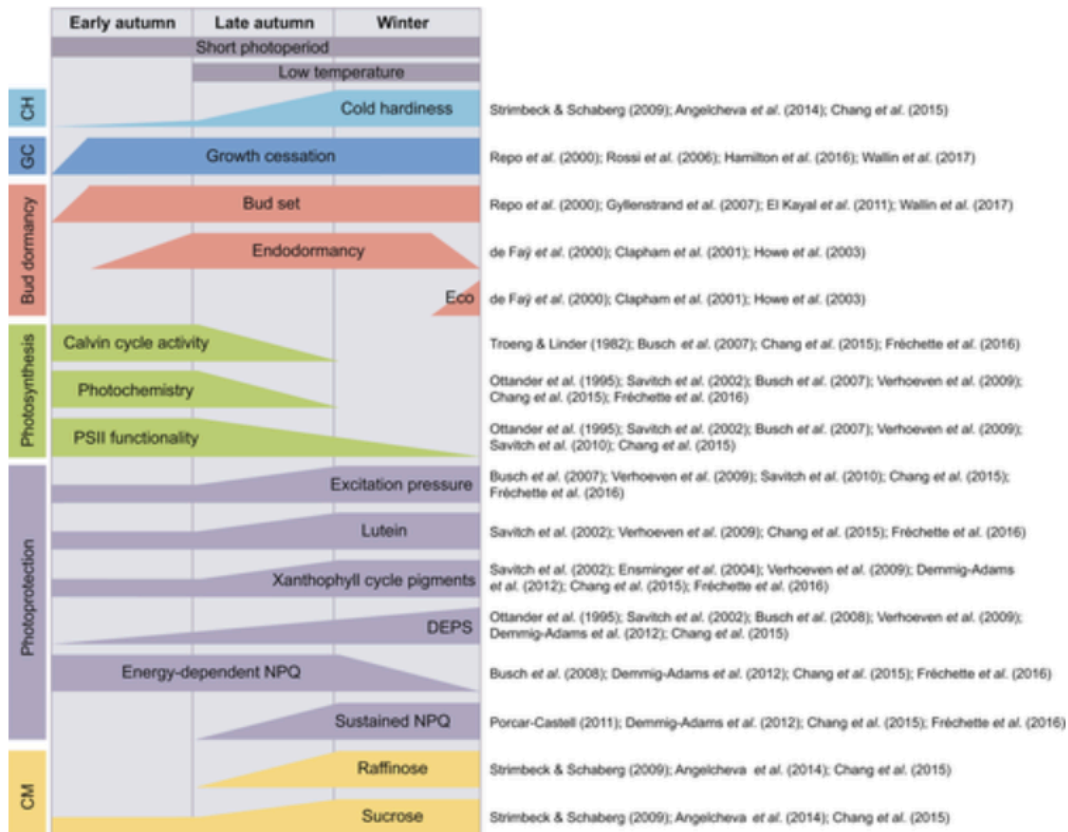
The authors also measured photosynthesis and found that it was insignificant during winter. Photosynthesis requires water and foliage is at risk if it occurs when the vascular system can't provide it. The trees at Niwot Ridge (and likely most northern conifers) could not transport water through their trunks/xylem to support winter photosynthesis.

This result leads to the question of why would these conifers retain foliage if winter photosynthesis is harmful. It is likely a complex situation that requires more study to understand but perhaps the main reason is that

retaining needles gives evergreen conifers an early jump on spring photosynthesis and allows them to continue to photosynthesize in the fall during favorable conditions.

I've wondered about winter photosynthesis for my Colorado native conifers for years: is it important and does it improve the health and vigor of my trees? After reading this article (and observing trees that I overwinter outdoors), I believe that it is minimal and could do more harm than good if I can't keep the foliage hydrated.

The second article (Chang, C.Y., et al. 2021. Champions of winter survival: cold acclimation and molecular regulation of cold hardiness in evergreen conifers. *New Phytologist*, 229: 675-691. <https://doi.org/10.1111/nph.16904>) summarizes the stimuli and physiological responses that conifers experience as daylength changes and temperatures fall to below freezing. The article is a challenging read if you are not up on plant cell physiology (I am not), but some basics are well summarized and described in this key figure.



The x-axis is time from early autumn through winter. Two gray bars at the top represent the stimuli that trigger trees to prepare for winter: shortening days and decreasing temperatures. Well before temperatures begin falling, trees respond to photoperiod by ceasing growth and forming buds to protect the apical meristems during winter. (After reading the article, I paid close attention to my trees and noted that my pines, spruce and sub-alpine fir began forming buds in early July.)

Cold hardiness (light blue bar) starts developing in early autumn but doesn't gain steam until temperatures get cold. As I understand it, cold temperatures kill plants by freezing the water within the cells which expands and ruptures the cell membranes. In developing cold hardiness, plants move water out of cells into spaces between cells where it doesn't

break cell membranes. The water remaining in the cells is concentrated with solutes that act as antifreeze, preventing intracellular freezing. As the figure indicates, this is a slow process that begins in early autumn and accelerates in response to cooling temperatures.

Photosynthesis (which slows during the heat of summer) accelerates in late summer and continues well into the fall (light green bars in the figure). It tapers off in response to cooling temperatures; presumably it would continue as long as it stayed warm-ish.

However, photosynthesis is problematic for foliage if there isn't enough water. A tree with a frozen trunk and a non-functional water transport system is at risk. Trees have several means to inhibit photosynthesis and prevent the foliage from drying out and overheating. In the figure this is labeled "photoprotection." Check out the article if you want to get detailed information on the physiological processes trees employ to prevent photosynthesis.

After reading these articles and based on my experience overwintering bonsai in Colorado; here are some recommendations for ensuring overwinter survival of your native conifers:

- Pay attention to bud formation in your trees, next year's buds begin to form in late summer. This protects the apical meristems over winter (from the cold, desiccation and abrasion (e.g. from blowing snow or sand/dust). Bud formation at this time is a good sign that your tree is healthy and "on schedule."
- Buds of cold hardy conifers must undergo a cold period or they won't open the following spring. Don't keep cold hardy trees in warm conditions (50 deg. F plus) all winter. I've heard that some bonsai practitioners in S California move their conifers to the mountains in winter for a month or so to allow the buds to break dormancy in the spring.
- Do the bonsai shuffle by moving your trees to a warmish location (above 32 deg. F) if we get a strong cold snap in August or September. You can move them back outside once temperatures moderate.
- Once your trees have developed cold hardiness, you can winter Colorado native species outdoors. You can place them on the ground (or better, sunk in gravel or mulch to the level of the top of the container) to moderate temperature swings in the root systems.
- **However**, if you have a weak tree (e.g. a recently repotted tree or one that has pest issues) protect them by placing them in a cool hoophouse, unheated garage or similar protected location.
- In spring, do the bonsai shuffle again if we get a cold snap after the buds have opened and are starting to photosynthesize. I lost all the new foliage on my first subalpine fir during an April cold snap believing a native tree collected at 11,000 feet could handle a 25 deg. freeze in Longmont.
- Don't give the trees much direct sunlight to prevent the foliage from overheating (and breaking dormancy early) on warm days/during warm spells.
- Protect them from high winds.
- Temperature, light and water recommendations:

- Treat the rootmass and tops differently:
 - Rootmass temperature: I believe it is ideal to keep the rootmass at ~35 deg. F. That said, once the trees are cold hardy, healthy bonsai can survive a frozen root system, in my experience. (I know some RMBS members keep their bonsai rootmasses quite warm in heat beds. I haven't tried this and wonder if it is a good long-term solution?).
 - "Tops" (trunk, branches and foliage) temperatures: the apical buds must experience cold temperatures for several weeks or a month during winter. I believe it is ideal for the tops to get to the mid-20 degrees F. They can get survive colder temperatures but I don't think sub-20 degrees is ideal.
- Light:
 - Minimize exposure to direct sunlight. You can place your trees on the N side of a structure or fence or under a large conifer in the landscape. You can also use shade cloth (but place it vertically to block midwinter sun; if you place it horizontally over your trees, it may collapse under snowload.
 - Do not place your bonsai in a completely dark location; they need to be able to sense daylength. In my experience, even a little light works (e.g., the light from one small window in an unheated garage).
- Snow is a great insulator and humidifier for bonsai wintered outdoors. As long as the snow is not very heavy and wet (weighing branches down and possibly breaking them), snow is a plus. In fact, when we have a light powdery snow, I shovel as much as I can onto my trees even covering them completely.
- Water: check your trees weekly, make sure the soil is not completely dried out, water as needed. If the rootmass is frozen, don't water.
- If you winter your trees outside on/in the ground, protect them from pests. I've had problems with voles, squirrels, rabbits and deer.

My approach to overwintering bonsai is based on advice from others and 30+ years of experience but it continues to evolve as I seek more information and gain additional experience. I would love comments and input from anyone who has more information and/or different perspectives.

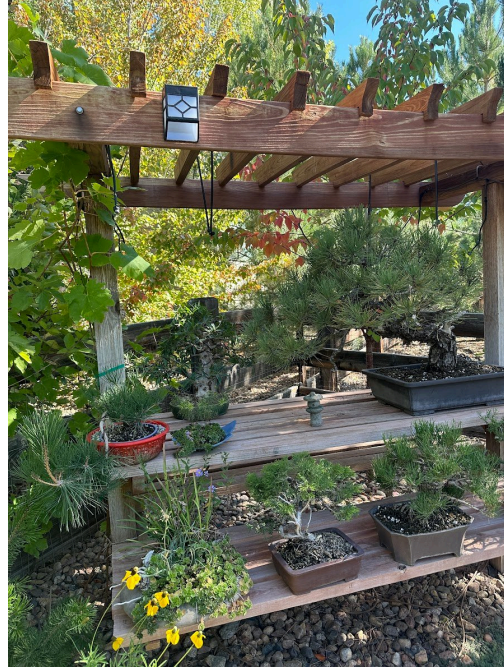
Annual Show Survey

Don't forget to fill out the survey about the annual show if you haven't already!

[Survey](#)

Event Highlight

Garden tour at Josh Stewart's home!



Upcoming Events

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October Meeting

Monday, October 14th
Mitchell Hall, DBG 7:00 PM
A History of Bonsai and the
Evolution of Styles

Yannick Kiggen, Yama Bonsai

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stay up to date on upcoming events!

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Membership

Individual: \$50/year
Family: \$75/year

rmbonsai.org/join

Welcome to our new members!

Chris Campbell
Bryan Carr – Colorado Springs
James Gardner – Denver
Alexandra Hasui – Pueblo
Clay Lauerman – Denver
Adrian Martinez – Fort Collins
Catherine Quintero
Dustin Schulten – Littleton

Total Membership - 260!



Shop



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