Dr. Dan Buonaiuto--- currently a postdoc in the Department of Environmental Conservation at The University of Massachusetts-Amherst, USA--- discusses his recent *Commentary* “Experimental designs for testing the interactive effects of temperature and light in ecology: the problem of periodicity”.

**About the Paper:**

Experiments in growth chambers are powerful tools for assessing organisms’ responses to contemporary environmental variation or predicted environmental change. These experiments are supposed to be simplifications of ecological systems that allow researchers to isolate the unique effects of specific environmental variables on patterns or processes of interest. However, when surveying the literature to prepare for my own growth chamber experiments on the influence environmental cues on the timing of spring flowering and leafout (phenology) in trees and shrubs during my PhD, I quickly learned these experiments are anything but simple.

Researchers using growth chambers must walk a fine line between simplifying the environment enough to make clear inference about the mechanisms driving observed responses, while maintaining enough complexity that their experiment can roughly match the environment that their study organisms would face in nature.

One common way to do this in phenology studies is to allow temperatures to fluctuate over the course of a 24-hour day, so that plants experience cooler temperatures at night than in the day---just as they would in nature. However, we realized that if researchers are interested in the effect of daylength as an environmental cue (which many phenologists are), these background changes in daily temperature, or thermoperiod, can overshadow---or at least complicate---our ability to estimate of the true effect of day length treatments.

But there is good news--- there are several paths that researchers who are interested in the effects of daylength and temperature on ecological processes can take to deal with these issues that range from simple statistical corrections to more elaborate experimental arrays. We present some of them in the paper, but I would also love to hear other creative solutions that you have tried in your work.

**About the research:**

Preparing this paper required me to read scientific literature about growth chambers studies far beyond the world of tree phenology that consumed most of my time during my PhD. I learned that trying to estimate the individual effects of temperature and daylength and their interactions is a common problem in ecology broadly, and from flies to frogs and fish--- many subfields have their own best practices for doing so. This was an important reminder for me that reading (and collaborating) broadly across disciplines is important for finding innovative approach to solve your own experimental challenges. I am hopeful that researchers outside of phenology will read this paper and it will help them in their own experimental pursuits.

One lesson I came away with from this study is that thermo-periodicity should more than just a background condition for adding biological realism to studies---it is an axis of temperate that can have big effects of phenology, and one that is shifting in nature with climate change. We don’t have a lot of experiments to anticipate how much these changes to these diurnal-scale temperature patterns will matter compared to coarser trends in mean temperature. It turns out that experiments that compare responses to temperature treatments with and without thermo-periodicity are more common in other study systems (e.g. turtles and frogs) than in phenology, and conducting some experiment like these will really help our ability to forecast the effects of climate change on plant phenology.

**About the author:**

I started learning how to identify plants during time spent as a hiking guide to try and make long treks more interesting for student participants. I am not sure how much the children appreciated stopping every few minutes to “key out” a new species, but I was hooked. Once I started noticing the subtleties of plants, I started wondering about them all the time, which put me on the path to research.

At the same time, I was watching these landscapes that I loved change rapidly and was learning more about the losses still to come with global change. I think this growing awareness that inspiration from nature can be motivation for meaningful engagement with conservation, restoration and climate change adaptation led me to my current work in conservation research, where I spend a lot of time thinking about how basic ecology and evolution and inform applied needs in the field of conservation.

I still try and spend most of my free time in nature---and lately I’ve been trying something new that was recommended to me by a few senior colleagues. As an ecological researcher, sometimes I find it all to easy to turn my time in nature into an ecological thought experiment—questions like “how could I test that” or “is that interesting thing I just saw going to be my next big grant proposal?” can dominate my time outdoors. That’s not a bad thing, but it’s just another way to always be working. So lately, I try to spend a few moments remembering back to the days before I knew plants. I try to appreciate the shades of green leaves around me without thinking about their photosynthetic rates or feel the wind on my face without thinking about measuring pollen dispersal distances. Just *being* in nature helps me appreciate all that I (and we as a scientific community) have learned and is an important reminder of how much remains a mystery.