Press Release | Field Spectroscopy in the Rocky Mountains

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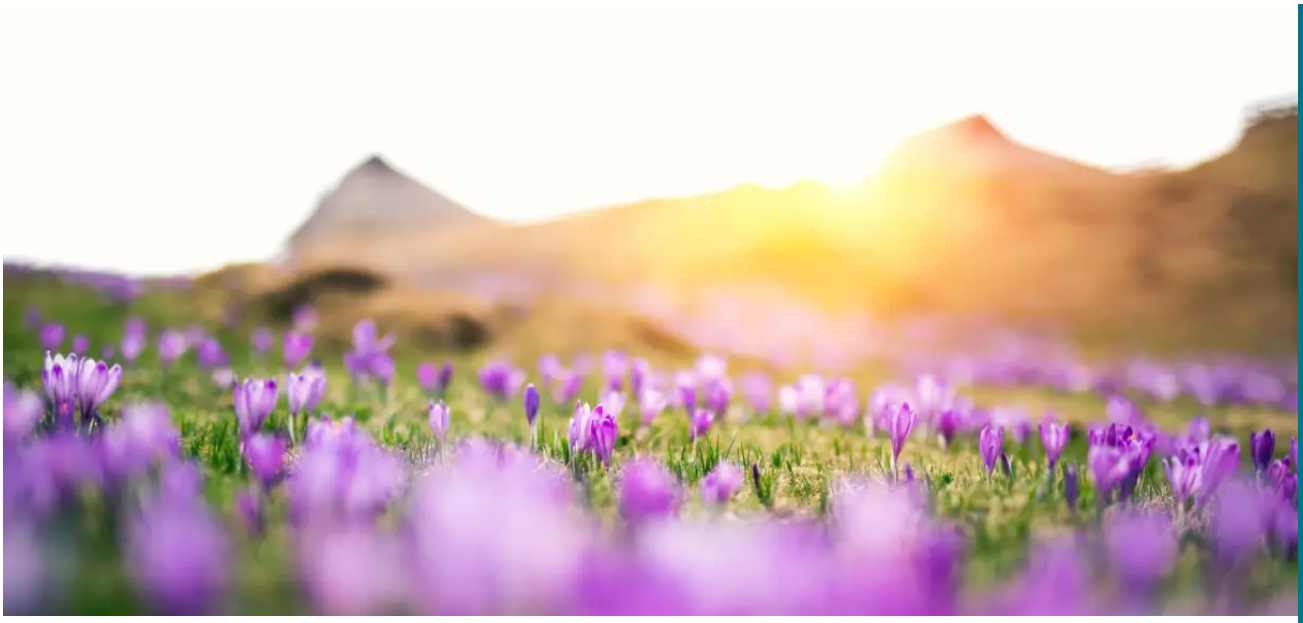
Measuring the interaction of light in the world



By Avantes

Measuring the interaction of light in the world does not happen only in the labor on the industrial floor. When your research takes you into the great outdoors, you need instruments that are rugged and portable. Avantes' modular design and portability were a great advantage to researchers working out of the Rocky Mountain Biological Laboratory in Gothic, Colorado near Crested Butte, elevation 2,889 meters.

The Pollinator/ Floral Characteristic Relationship

Understanding the relationship between pollinator and floral display could unlock important answers in agriculture as well as conservation and ecology. The team lead by Dr. Kenneth D. Whitney at the Rocky Mountain Biological Lab (RMBL) looked at this relationship along altitude gradients at sixty-seven sites around the West Elk Mountains surrounding the RMBL across an altitude range of 1,300 meters. These scientists sought to quantify variations in community-weighted mean floral color across three essential components, hue, saturation, and brightness. They hypothesized a shift in color values with the transition from bee-dominated to fly-dominated pollination at higher elevations.

Bug Vision

It is well understood that bees use their color vision to locate flowers at a distance. They have a larger visual range than humans do, extending further into the ultra-violet range. Bee's vision is trichromatic, meaning

they have three color receptors for ultraviolet, blue, and green. Foraging bees are color discriminate and demonstrate strong wavelength-dependent preferences. Bee vision has been studied in great detail along with bee preference influence on flower evolution.

Flies, alternatively, have limited color vision with only two kinds of photoreceptors and a short visual range. They are far less discriminating in flower selection and appear to have far less influence on flower evolution.

Biotic and Abiotic Evolutionary Mechanisms

Pinpointing drivers of evolutionary changes is complicated, biotic factors such as pollinator preference compete with abiotic factors like Average Daily UV dose and average temperature. To test this, the researchers made a series of predictions about floral expression using the assumption that pollinator preferences would be one of the principal mechanisms. First, they predicted that as elevation rose (and bee pollinators became scarcer), hue and saturation in the Bee visual range would diminish. They also believed that hues perceived by flies and brightness in fly preferred wavelengths would increase.

Community Weighted Mean Color Data

In order to investigate patterns of community-wide shifts in floral expression, the RMBL researchers devised a method using the percent of ground coverage of each identified species in their study over each study area to calculate the weighted average of the raw spectra reflectance measurements to determine by the average reflectance of each species. This data was arbitrarily classified into 8 spectral bands named for their appearance in the human visual range UVB (300-315nm), UVA (315-400nm), Violet (400-440nm), Blue (440-500nm), Green (500-565nm), Yellow (565-590nm), Orange (590-625nm), and Red (625-700nm). Raw diffuse irradiance spectral data was collected with the AvaSpec-ULS2048 spectrometer. Today, U.S. customers have the option of adding a waterproof protective case (AvaTrek) for rugged portability and a wider selection of cutting-edge instruments, including the new EVO electronics and CMOS detectors.

Results & Analysis

The RMBL team demonstrated a well-defined elevation gradient in floral color expression in the visual ranges of the dominant pollinators as well as visual-independent objective analysis. The shorter wavelengths favored by bees (equivalent to human UVB, UVA, and Blue) decrease with elevation, however hues perceived by flies did not demonstrate the same relationship. In the visual ranges of both pollinator species, saturation increases with elevation while brightness increases to a point and then drops off again.

Their results provided evidence for predictable shifts in floral hue expression in wavelengths preferred by bees supporting the hypothesis that bee preference is a major evolutionary mechanism. The lack of

correlative elevation trends in fly hue ranges, however, suggests that fly preferences do not have as strong an effect, or that abiotic drivers have a larger influence at higher elevations.

Geographic Effects

The team working in the Rocky Mountains considered the work of previous researchers in forming their predictions, however, the effects of elevation might not be consistent across all latitudes. Floral response at 3000 meters in the sub-alpine Rocky Mountains could be vastly different from floral expression at the same altitude in a more tropical location. Understanding these relationships between pollinators and floral display could be an incredibly important line of inquiry as pollinators around the world face ecological pressures on their populations.

The Avantes Commitment

The applications for spectroscopy extend far beyond the normal confines of the lab. Anywhere in the world where light shines, spectroscopy is at work helping us make sense of the world around us. In addition to our line of portable spectrometers, we also offer a variety of sampling interface accessories which facilitate field measurements, and Avantes is by your side with cutting-edge instrumentation, system development expertise, and application support to put the power of spectroscopy in your hands. To learn more about Avantes spectrometers and discuss your unique system requirements, speak with an Avantes sales engineer today.

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99/532 Rat Phattana 22 Rd., Rat Phattana,
Saphansung, Bangkok 10240 Thailand.
Tel : 02-729 0927 Fax : 02-729 1348

Email : info@spectralinstrument.com
Web : www.spectralinstrument.com