December 2020, No 1

Mountain Views Chronicle

In this issue...

Cover Photo: *An early winter morning over western Utah with classic valley inversions creating low-lying fog.* 📷 *Scotty Strachan*

From the Editors

by The MVC Editorial Team

Dear Friends and Colleagues,

The last issue of the Mountain View Chronicle came out a year ago, in December of 2019. As you may recall, that particular issue announced some changes in the Chronicle's future, with the MVC's longtime editor and graphic designer, Connie Millar and Diane Delany, respectively, announcing that they would be stepping aside into new roles with the MVC over the coming year. Little did we know at that time how many other uprooting changes would also be occurring in the coming months.

2020 has been a strange, unprecedented, difficult, even devastating year. While recognizing the personal and professional challenges this year has brought, we thought some comfort might be taken through continued connections and storytelling across the mountain climate research community. For this reason, the editorial team chose to publish an issue of the Mountain View Chronicle this December. Considering the pressures many of us are facing on time and mental bandwidth, we formatted this particular issue of the MVC more informally than prior issues, creating an abridged version of the publication. This abridged issue features 10 "Voices in the Wind" style snapshots of work carried out this year. These stories offer glimpses of data discoveries, observations, ongoing concerns not put on hold by COVID-19, or moments of refuge found in the peace of wilderness.

Next year, the MVC will more fully introduce the new editorial team and begin to return to the MVC's prior structure, with multiple content types. A short notice at the end of this issue announces the spring topic, "Disturbance and Transition", so that you may begin planning and writing early, if you would like to submit. In the meantime, we hope that the postcards of science shared in this edition will help bring you your own few moments of rest and reflection.

Questions, comments, or submissions for future issues can be submitted to us at: **MtClimMVC@gmail.com**

With sincere wishes for your wellness and safety in the coming year,

The MVC Editorial Team

Postcards of Science from 2020

A Brief Escape to Normalcy: A Summer at RMBL

by Marshall Worsham, *Energy and Resources Group, University of California, Berkeley*, Thomas Powell, Mary Thomas Powell, Sarah Hettema, and Lara Kueppers

No one needs reminding that these are not normal times. At the end of 2019, when things were ordinary enough that we didn't need to call them ordinary, our research team made plans to spend a few weeks of the coming summer at the Rocky Mountain Biological Laboratory in western Colorado's East River watershed to collect data on the subalpine forest. Scientifically, we aimed to characterize how the structure and composition of these forests vary by topographic position in order to improve predictions of how their role in the water budget may be impacted by perturbations related to climate change. And then...a global pandemic happened.

Come May, our field campaign was looking like a dim prospect. But after navigating three separate institutional approval processes, devising a set of COVID safety protocols that would make some hospitals blush, and waiting four weeks for a green light from the Department of Energy, we were able to send four crew members from the Bay Area for six weeks of field observation. Infinite thanks are due to RMBL, UC Berkeley's Office of the Vice Chancellor for Research, and Lawrence Berkeley Lab (LBL).

Three of the crew at work on Avery Peak in Colorado's East River watershed. 📷 Tom Powell

We were the first team this year to get LBL's go-ahead for out-of-state research, and the effort we put into getting approval—and staying healthy in the field—paved the way for other researchers to be able to go out safely. Over six weeks, we tagged, identified, girthed, hypsomeasured, and geolocated 4,200 trees. Our time in the East River—an ordinary field season by any other measure—was extraordinary for the respite it offered from coronavirus woes. To learn more about our story, follow **this link to a video** filmed and produced by Mary Thomas Powell. This story should look familiar to many readers of this newsletter during other years—but in these unusual times, it reveals how a field campaign offered a brief and inspiring escape to normalcy.

We are grateful for the support of Susan Hubbard, Bill Collins, Ken Williams and the leadership of Lawrence Berkeley National Laboratory in establishing a safety protocol for traveling during a pandemic. We wish to thank the Rocky Mountain Biological Laboratory for logistical support, use of their facilities, and their leadership on establishing safety protocols for the scientific community to visit Gunnison County. This field campaign was supported as part of the Watershed Function Scientific Focus Area.

Alpine Photographs of the Alpine Tundra and Data Sculpture

by MARTHA APPLE, *Department of Biological Sciences, Montana Tech* AND CHARLIE APPLE, *School of Visual and Media Arts, University of Montana*

The field season of 2020 brought collaborative outdoor research for our small, careful group of researchers from Montana Tech and various Apples. One field site is on the alpine tundra of the Pintler Mountains of southwestern Montana at Goat Flat (≈2835 m, 46° 3' 17" N, 113° 16' 43" W), where we study plants and their functional traits on the microhabitats of periglacial patterned ground.

Martha Apple photographed the variable and visually compelling landscape of Goat Flat and its approach trail, which begins along Storm Lake but soon ascends through the subalpine zone across a steep, rocky trail cut into a cirque to reach the alpine zone. Martha used FLIR (Forward Looking Infrared) thermal photography on the patterned ground (Figure 1). Charlie Apple, a graduate student at the University of Montana (and Martha Apple's son), created data sculptures using the photographs, machine learning and computer graphics software.

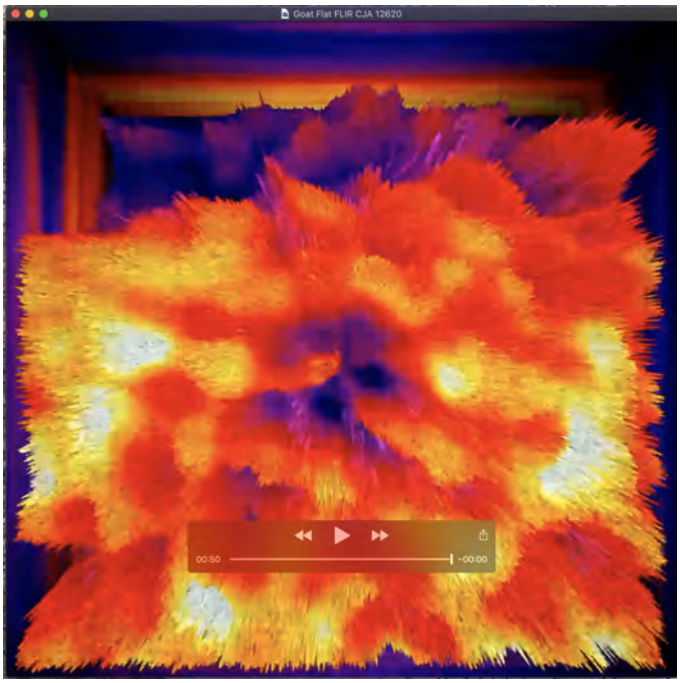

Figure 1: *Fifty FLIR (Forward Looking Infrared) thermographic images taken by Martha Apple of the periglacial patterned ground on the Goat Flat alpine tundra in the Pintler Mountains of Montana were made into a data sculpture with machine learning by Charlie Apple.*

Figure 2: *This work was made by Charlie Apple with machine learning from 652 photographs by Martha Apple of the Goat Flat alpine tundra in the Pintler Mountains of Montana.*

StyleGAN (Style based architecture for Generative Adversarial Networks) are trained on a set of images and

instructed to create their best replicas. For this experiment we trained the StyleGan on 652 high definition images for Goat Flat Landscape and on 50 FLIR images for Goat Flat FLIR using techniques inspired and pioneered by data sculptor and painter **Refik Anadol** to convert sets of research photographs into data sculptures (Figure 2). In Goat Flat Landscape, we looked at plants in the landscape of periglacial patterned ground (the wavy brown lines are the sampling frame), and in Goat Flat FLIR, temperatures were higher inside the polygons of periglacial patterned ground, with white, yellow, and orange representing higher temperatures and pink, purple, and blue signifying lower temperatures. Still, we did not know what these experimental data sculptures would look like when we began. The Goat Flat data sculptures can be used to generate awareness of alpine environments and climate change. You can view our resulting videos on the AppleWorks Montana YouTube Channel at: (Goat Flat Landscape) and (Goat Flat FLIR).

RMBL Research in the Time of Covid-19: Magical Realism?

by IAN BILLICK, *Executive Director of RMBL*

Despite Gunnison County ranking as the third most infected county in Colorado at one point, RMBL still opened for summer, and we had no recorded infections from summer or fall activities! Our focus was on early career scientists as well as long-term projects.

Undergraduate researchers eating lunch and talking science outside, socially distanced, and with masks.

To pull it off we required people to isolate upon arrival, there were no shared bedrooms, people had to monitor symptoms daily, and masks were required in general use buildings as well as when people were in proximity outdoors. Perhaps the biggest surprise was the success of our undergraduate research program. Not knowing whether we would even open until late May, we designed a hybrid online/field program with students designing their own experience. About equal numbers participated fully online, participated entirely at RMBL, lived in proximity to RMBL and conducted field work, or did a mixture of online/living at RMBL. Distant students either conducted computational projects or were matched with other students or research teams collecting data, so everybody had an authentic research experience. The program was so successful that we anticipate accommodating several online students in the future.

Ironically, while the local area experienced record-breaking numbers of tours, many scientists were under travel restrictions and unable to come to RMBL. To bridge the gap, we created a list of trained individuals living locally and matched them to scientists. As needed, scientists hired assistants through RMBL.

The undergraduate research program was vital for some scientists who did not have funds to pay remote research assistants. We received a grant from NSF to support two local scientists and 10 local college students attending Western Colorado University or marooned at home from a distant institution (e.g., Williams, Middlebury). Some of these students and scientists had previous experience working at RMBL. These returning students, as well as the new students with the help of local scientists, kept research programs going.

Overall, RMBL had about 60% of the previous year's research activity. We hope to see you here, joining the Mtn. Clim community in Gothic in the fall of 2021!

Wild Hollyhocks

by LISA TASKER, *Colorado Natural Heritage Program*

We were "bush-bashing," as my friend from Australia would call it, sweating and straining in a particularly thick area of toasted tall shrubs on the two-year-old Lake Christine Fire area when we walked into a spectacle of dense flowers. We were awe-struck. My field assistant, Emma Balunek, and I were suddenly rescued from ourselves. That feeling of too much heat, too much exertion, and too much more ground to cover was forgotten within moments as the splendor of the site enveloped us. Before us were thousands of Largeflower Wild Hollyhocks or Iliamna rivularis (synonym I. grandiflora) covering an impressive stretch of previously crisped, open ground.

Pre-fire, a mixed mountain shrubland gave way to a mixed conifer aspen woodland in this area of the burn just off the main road half way up Basalt Mountain's north side. Here formerly was a mature, lush forest. My strongest pre-fire memory was of an unusual low elevation occurrence of Avalanche Lilies (Erythronium grandiflorum ssp. grandiflorum) spilling out of a wet, dark understory onto a north facing road cut not too far from our newly discovered Hollyhocks. After human caused ignition at a shooting range, 12,588 acres burned here over 13 weeks in 2018 during single digit relative humidity levels, forest fuel ratings of "extremely dry", and erratic outflow winds.

How remarkable, the contrast from scorched to this jaw-dropping site two years later, a glorious spectacle of native, pinkish white flowers amongst still-standing, blackened trees and tangled dead shrubs, and, well, those few noxious weeds we were there to document. Oh yes, the weeds. The other good news here was the noxious weeds had some serious competition.

How these tall forbs fulfill their life cycle is remarkable too. Seeds of Iliamna rivularis can literally wait centuries to germinate (Huggins, 2004), holding out until that seemingly catastrophic fire burns through the area and finally breaks their dormancy. Between the restrictive, dominating theme of Covid-19 and the unrelenting drought and heat of 2020, the relief and cheer from the encounter with this impressive stand of Largeflower Wild Hollyhocks has become an indelible memory. A moment of grace with a dose of surprise. While the 2018 Basalt area Lake Christine Fire was a fierce and a terrifying local story, one now magnified and repeated just miles away and across the state, these patient local beauties had opportunistically taken up real estate. Their presence was nothing less than a reminder of possibilities of renewal-pandemic, drought, fires and all.

For Further Reading:

Ackerfield, J. 2015. Flora of Colorado. Botanical Research Institute of Texas Press. Fort Worth, TX.

Huggins, J.L. 2004. Wild at Heart: A Natural History Guide. WHO Press. Basalt, CO

Of Covid, Cats, and Kazakhstan

by KATEY DUFFEY, *Independent researcher and zoologist, Canton, OH*

As an independent researcher, I'm no stranger to having a year full of uncertainties and project fall-throughs. This year is not the first year where fieldwork had to be pushed back over several months. I cope by taking things one day at a time, staying as occupied as possible through keeping in touch with field partners, carrying on writing projects and hobbies, and having at least a part-time job. However, this particular year has been especially frustrating as a whole new project, with new colleagues, in a new study site has been put on hold due to the pandemic.

Last year, I teamed up with a new colleague, Andrew Wood, a wilderness expert and owner of an expedition and TV support company, Taffs TV, to visit Altyn-Emel National Park, Kazakhstan where there had been zero data on snow leopard presence in the reserve. Andrew had worked in the reserve on a TV shoot and was told by rangers that a snow leopard had been seen. Once he informed me, we set up a trip to visit. Altyn-Emel National Park had not yet been deemed significant enough for the government or other researchers to be able to invest in for snow leopard research, because of the geography of the mountain range and lack of hard evidence of the cats being there. The mountain environment in that location is more like a narrow peninsula coming down from a larger, known snow leopard range area. The majority of the reserve is primarily steppe and desert. This site sits as a blank space on the overall snow leopard range map between Kazakhstan's main population around Almaty and the region north of the reserve.

During our Spring 2019 reconnaissance, we assessed the habitat quality and if it had ample prey. We observed that the habitat is relatively pristine with no overgrazing by free-ranging livestock, and there is a healthy ibex population. We also built a rapport with the reserve staff to help support their efforts to determine if snow leopards actually could be using the reserve's mountains as a corridor or even possible home range. There had been sightings of snow leopards by herders and rangers, but since no photos could be captured and no other sign had been considered definitive, Altyn-Emel could not persuade the government or other snow leopard researchers for extra aid to investigate snow leopard presence more efficiently, despite the potential for exciting findings.

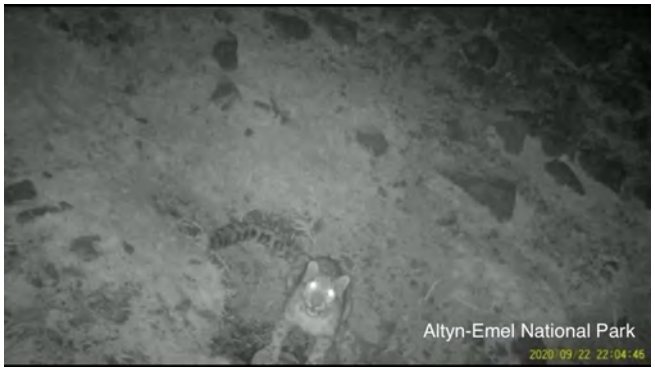

Figure 1: *The first camera trap image of a snow leopard in Altyn-Emel National Park.*

Last December, Andrew and I joined rangers to set camera traps where the cats may have been or areas they might use for marking territory and navigating the terrain. Although the lithium batteries in the cameras should be good for a year, the original plan was to return this autumn to retrieve the cameras and make a baseline report for future planning. Unfortunately, the pandemic made international travel impossible and rangers are unable to retrieve for us some of the cameras that are further up valleys and higher up than they typically work. In the meantime, though, rangers were able to check some of the more accessible cameras and sent a few images of wolves and ibex.

Figure 2: *Video footage of this camera set confirmed this cat is a male. It is not yet known if this is the same individual as in the first image, but he's using this spot to regularly scent mark.*

Then in September, we received an update that confirmed the local knowledge that there are snow leopards in the reserve! The evidence was recorded as the first official observation of the species in the reserve in a century (Figure 1). If that isn't exciting enough, another camera trap recorded a snow leopard in the area as well (Figure 2). While the images are being compared to determine if the cats are two different individuals or not, more long-term survey work is being planned to gather more information on this new location of occurrence. The findings from this preliminary survey already emphasizes the importance of all potential habitats for a species, even the underestimated corridors or transboundary regions. Not being able to continue fieldwork this year has been disappointing, but the rangers are still out there monitoring the wildlife and staying in contact until it is safe to travel again. The discovery of snow leopard images on camera traps still makes this year a success and will make finally returning feel much more purposeful.

A Field Scientist...Has to Be in the Field!

by CONNIE MILLAR, *retired(!)*

In past years I have been fortunate to migrate in summers from my Bay Area office to our home in the Sierra Nevada, which serves as a base for my field research. A field biologist knows she needs to observe on a regular basis to deeply understand the systems she studies, and I have been grateful to be within daily reach of my study sites. The unusual events of 2020, however, awakened me to what I have been missing, and what it could be to fully embed with the greater seasonal flow each year.

In mid-March this year, when the Bay Area lockdown was announced, my husband and I packed up and drove to our Mono home, where we have been since. This gave me access to my study sites during times of the years I haven't been able to visit in the past and opened my eyes to important aspects I have been missing.

An example comes from Silverpine Lake, a high-elevation tarn where I have been studying cryogenic patterned ground (PG) in the sill of the lake. Given that PG doesn't form underwater, there would have to be times (Holocene or prior) when the sill was exposed yet cold. My prior observations indicated that the annual lake level drops only slightly, even during record low snow years. This year, I was able to see the lake in spring, when the level was high, and in late autumn, when the sill was fully exposed. This doesn't provide all the answers, but observing this annual flux is an important key to my inquiries.

Typical summer condition, Silverpine Lake.

Spring, 2020, high lake level.

November, 2020, extreme low lake level showing patterned ground after a warm and dry summer.

Field Research in the Time of the Pandemic

by David W. Inouye, *Rocky Mountain Biological Laboratory*

Our research group was fortunate to get our normal quota of field data this summer at the **Rocky Mountain Biological Laboratory**. Because three of us own cabins near RMBL we weren't subject to some of the restrictions the county put on non-residents in late spring, although our other two co-PIs never got to the field site this year. The field station was able to house our two RAs and an REU student, despite the restrictions of only one person per bedroom, which greatly limited the capacity for researchers this summer.

Cancellation of the seminar program, restrictions on the number of residents, and the availability of only take-out meals in the dining hall made it a strange field season. After the mandatory quarantine period following their arrival, our RAs were able to use our lab space when needed, although most of our work involved data collection outdoors.

An unexpected consequence of the pandemic was the two co-PIs from Florida were able to get to Colorado earlier than expected as their spring field season in Florida was shut down by university restrictions. They also then stayed about 10 weeks longer than usual as they could do their teaching online, rather than returning to campus in August. The fact they are my son and daughter-in-law made for a good opportunity for a pandemic social pod, and more time with our granddaughter than usual.

The bee crew ready for census work at RMBL (taking precautions not to infect the bees). 📷 Rachel Dickson

My early arrival at the field site made it possible to collect some data for a colleague who wasn't able to get there in time to census seedlings that were already senescent by the time she got there, later than originally planned. We were lucky to have a productive field season this year, although it will be nice next year to get back to a normal experience (we hope!) with the full complement of field researchers and the extraordinary opportunities for interaction that RMBL typically provides.

Lisa Tasker's image of Wild Hollyhocks was so remarkable it deserved a full-width spread.

Did You See It?

An inversion above Lake Tahoe

by BENJAMIN HATCHETT, *Western Regional Climate Center*

Mid-winter dry spells in the Sierra Nevada often translate to fine spring-like corn skiing weather. Although inversions are common in mountain basins during high pressure, persistent (i.e., all day) cloud cover is somewhat rare. Shallow stratus, or fog, that burns off by mid-morning, on the other hand, is commonly observed (see cover photo by Scotty Strachan). On this February day following several days of quiescent weather with clear skies allowing ample radiative cooling, strong cross-mountain flow generated downslope winds that mixed out the inversion in leeside valleys of the Sierra Nevada. Dry conditions and adiabatic warming (temperature increases with decreasing elevation) persisted across an elevational gradient in both valleys and at summit locations with a notable deviation towards cold and saturated air in the Lake Tahoe Basin. Here, the winds failed to mix out the stably stratified air, leaving a stratus deck trapped just above the lake. If you didn't look at all the observations (or forgot to go skiing) on this day, such an interesting situation might be missed! To create the infographic, I used sub-hourly temperature and relative humidity data from regional weather stations accessed via **MesoWest**. Personally, I like the concept of key points as required by AGU journals, finding them worth incorporating into all forms of communication.

Infographics offer a fun way to communicate data, context, and humor. Normally, there is a big blue lake visible down below! Skier: B. Young, 📷 B. Hatchett

Art

Desolation in the Fall (Birch Trees), Mixed Media

by VALERIE P. COHEN, *California Watercolor Association and San Diego Watercolor Society*

This late autumn, I walk along the banks of rivers and streams that flow from the Eastern Sierra into the Great Basin. There are Fremont cottonwoods, quaking aspens, and water birches – although the birches are dying out because they aren't getting the water they need every month of the year.

Leaves drift down silently, like snowflakes, and land on my head and shoulders and hands. From the ground I gather freshly-fallen yellow leaves, and brown ones that have been down for awhile, ones fragmented into lace, chewed by insects, writhing.

I take handfuls of leaves home, only one species at a time. The flat yellow ones I position between layers of paper towels, weighted by my immensely heavy Spanish dictionary. Days later, I sort out my favorite yellow and brown shapes, and start to paint. I focus only on design, pigment, and technique. While I work, I don't have to think about what is coming next.

Data Report

Long-term Drought and Recovery of the Missing Water in California

by EUGENE R. WAHL, *NOAA National Centers for Environmental Information, Boulder, Colorado (retired)* AND HENRY F. DIAZ, *University of Hawai'i at Mānoa, Honolulu, Hawai'i*

Although this has been a disruptive year in many ways, research on important issues such as the ongoing decades-long drought in the western US, and particularly its impacts on California, still carries on. Here are a few of our findings from this year.

A two-decades long drought (1999 through 2020) in the US state of California has resulted in a cumulative deficit of nearly one and one-quarter years' worth of average precipitation1 (1). Recent studies [2-4] suggest that complete recovery of the lost precipitation from a deficit of this magnitude could take many years to several decades, based on both instrumental records and water year (WY, October-September) precipitation reconstructions, with less than a one-in-five chance estimated for recovery within ten years [2]. The speed of recovery depends on a sequence of a few very wet years (ranking in the upper decile) or the occurrence of several substantially above average seasons (ranking in the upper tercile). The merged WY precipitation record for California [1-2,5] includes a few cases of multi-year pluvials: for example WYs 1740-1747, the longest and strongest continuous wet period in the span of the merged record (Figure 1). However, reversions to the mean or interceding dry years make the probability of a quick recovery substantially unlikely within the overall white noise-like character of California precipitation [2,5].

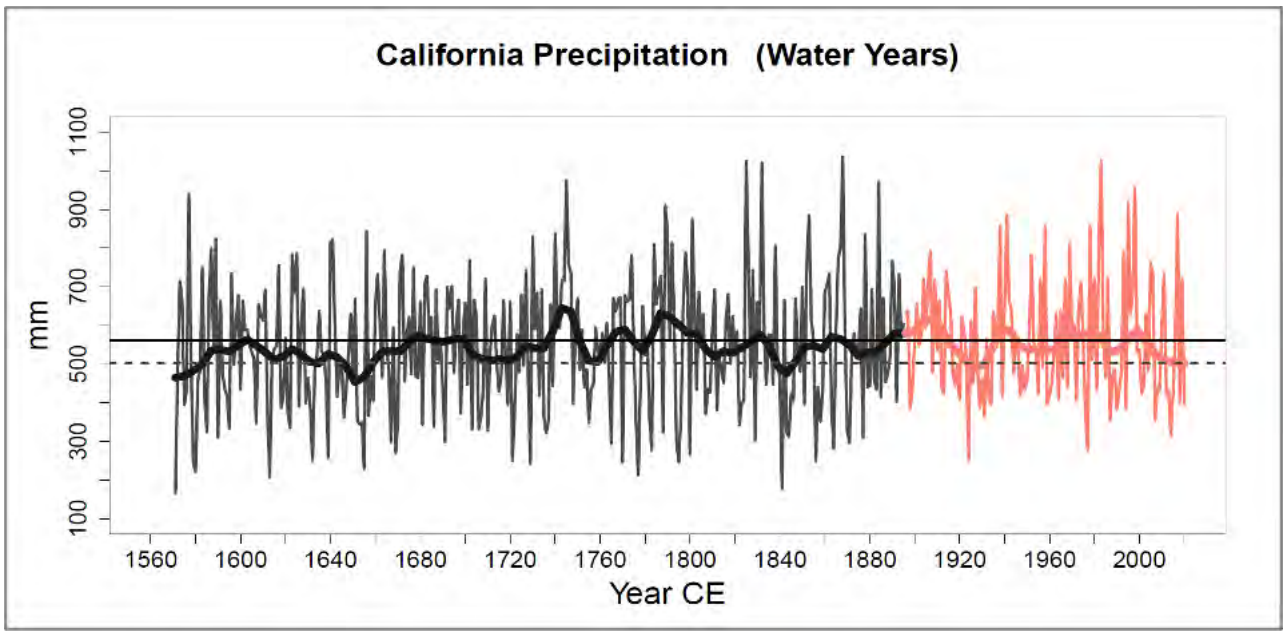

Figure 1: *California water year (WY, October – September) precipitation from 1571-2020 CE. Gray represents paleoclimate reconstruction from 1571 to 1895 [2,5], salmon represents instrumental values from 1896 onward [1], thick lines represent approximately two-decade loess smoothing. Horizontal solid line indicates mean value of time series, horizontal dashed line indicates smooth value for 2020.*

The twenty-two WYs from 1999 to 2020 have seen fourteen years with below average precipitation and eight above, creating the nearly 1.25-year cumulative deficit of 27.1 inches (689 mm) against an annual mean for California of 22.1 inches (562 mm) [1]. At the same time, long-term warming has taken place [6], which has exacerbated this two decades-long drought [4]. The leading modes of tropical Pacific sea surface temperature variability—the shorter time scale El Niño/Southern Oscillation (ENSO) and its longer time scale version, the Pacific Decadal Oscillation (PDO)—additionally have a significant influence on the amount of precipitation in California [5,7]. Since a La Niña event is currently occurring and is predicted to last through the normal California wet season [8], continuing

dryness is likely for the current WY (2021), especially in Southern California, increasing the cumulative deficit and thus prolonging the timeline for recovery.

In summary, unless California is fortunate to receive a several-years' period of well above average precipitation, representing a return to more humid conditions, the cumulative loss of moisture due to the current decades-long drought is unlikely to be made up over the short term, requiring a number of years, to even decades for full recovery.

References:

1. NOAA Climate at a Glance, California water year precipitation, accessed 9 November, 2020.
2. Wahl, E.R., Diaz, H.F., Vose, R.S. and Gross, W. S. J. Climate 30, 6053–6063, (2017).
3. Swain, D., Langenbrunner, B., Neelin, J.D. and A. Hall. Nat. Clim. Change 8, 427–433, (2018).
4. Williams, A.P., and Coauthors. Science, 368 (6488), 314-318, (2020).
5. Wahl, E.R., Hoell, A., Zorita, E., Gille, E. and Diaz, H.F. J. Climate, 33, 10221–10237, (2020).
6. NOAA, Climate at a Glance, California annual average temperature, accessed 9 November, 2020.
7. Biondi, F., Gershunov, A., and Cayan, D.R. J. Climate, 14, 5-10 (2001).
8. NOAA/NCEP, ENSO: Recent Evolution, Current Status and Predictions, accessed 9 November, 2020.

Spring 2021 Call For Submissions!

For the Spring Issue of the Mountain View Chronicle, we will be returning to the long format style of publication, with classic submission types including: Articles, Interviews, Brevia, News & Events, and Voices in the Wind. The theme will be "*Disturbances and Transitions*". Article submissions should cover research on spatial or temporal transition zones, recovery from disturbance, species range shifts, or other similar topics. A formal call for articles will go out early next year, and we look forward to seeing your submissions at that time. Of course, all other mountain science is welcome, so don't hold back!

Feel free to inquire about potential submissions or just to straight-up submit your contributions in the meantime by contacting us at: **MtClimMVC@gmail.com**.

Mountain Views Chronicle Editorial Board

Last Light

While I was studying plants near the edge of the Sperry Glacier at Glacier National Park on September 10, 2020, a mountain goat, Oreamnos americanus*, crossed the Sperry Glacier Basin and I wondered what role they have in dispersing plants of glaciers and snowfields.* 📷 Martha Apple