

GLORIA Great Basin, Update 2023

GLlobal
OBserva**TI**on
REsearch
INitiative in
ALpine Environments

Photo by Stu Weiss

8 Target Regions California & Nevada

Carson Range
2006, 2011, 2022

Sweetwater Mtns
2012, 2017, 2023

Great Basin
2008, 2013,
2018

White Mtn.
silicate
2004, 2009,
2014, 2019

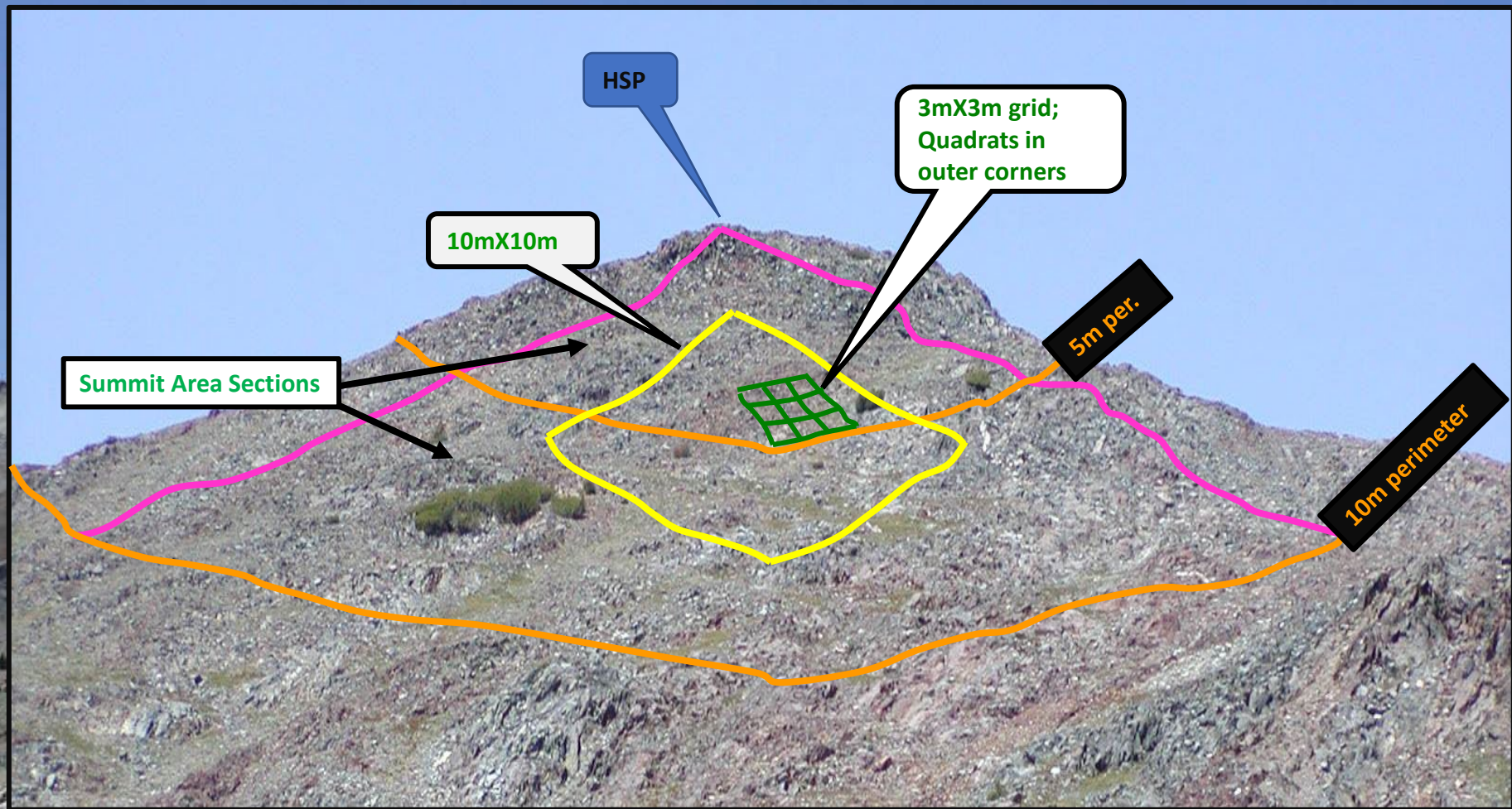
Dunderberg
2004, 2009,
2014, 2019

White Mtn.
dolostone
2005, 2010,
2015, 2021

Mt. Langley
2010, 2015,
2021

Panamint Mtns.
2013, 2018

29 summits



HSP

10mX10m

3mX3m grid;
Quadrats in
outer corners

5m per.

Summit Area Sections

10m perimeter

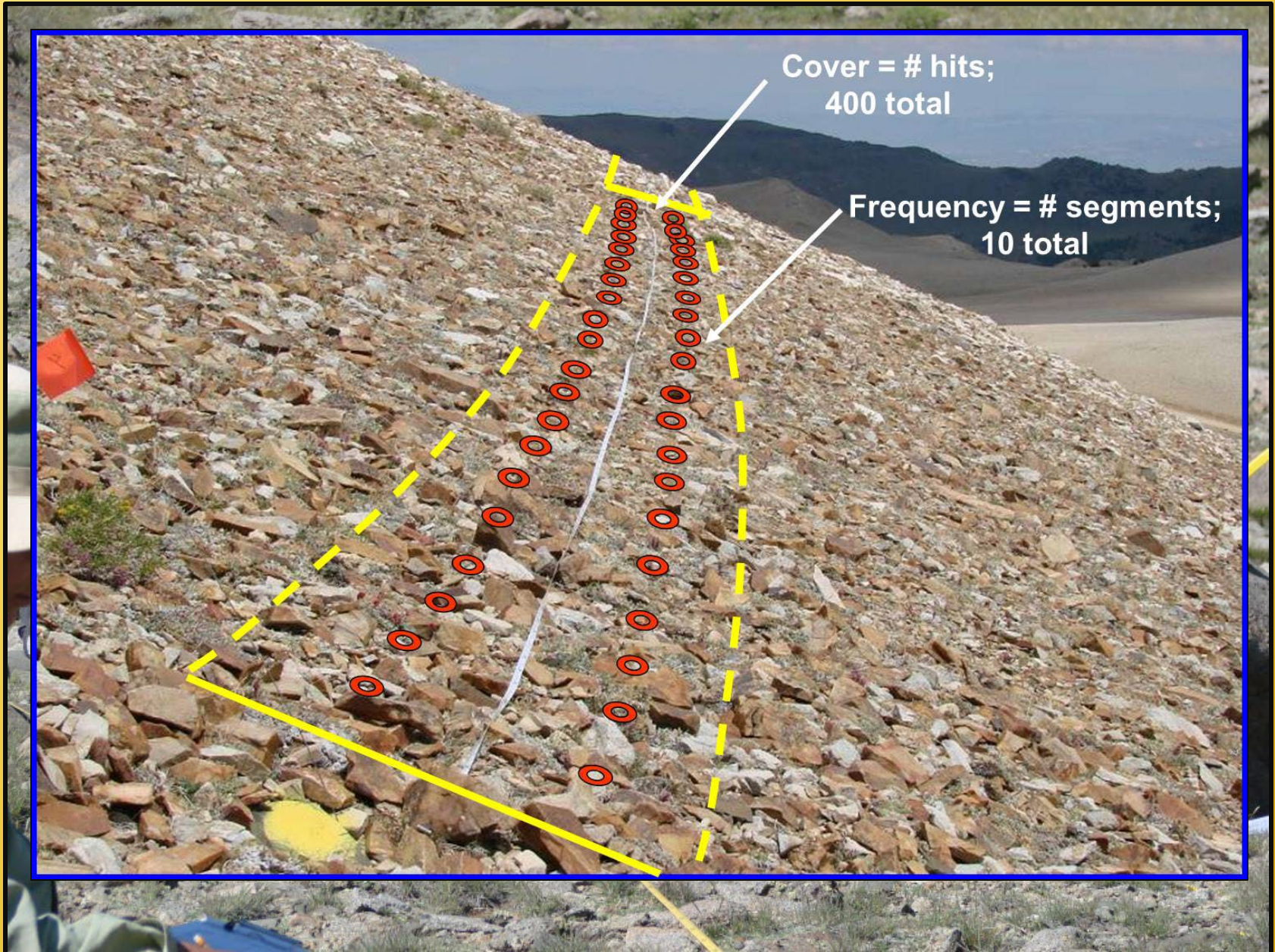
Temperature Loggers, 10 cm deep



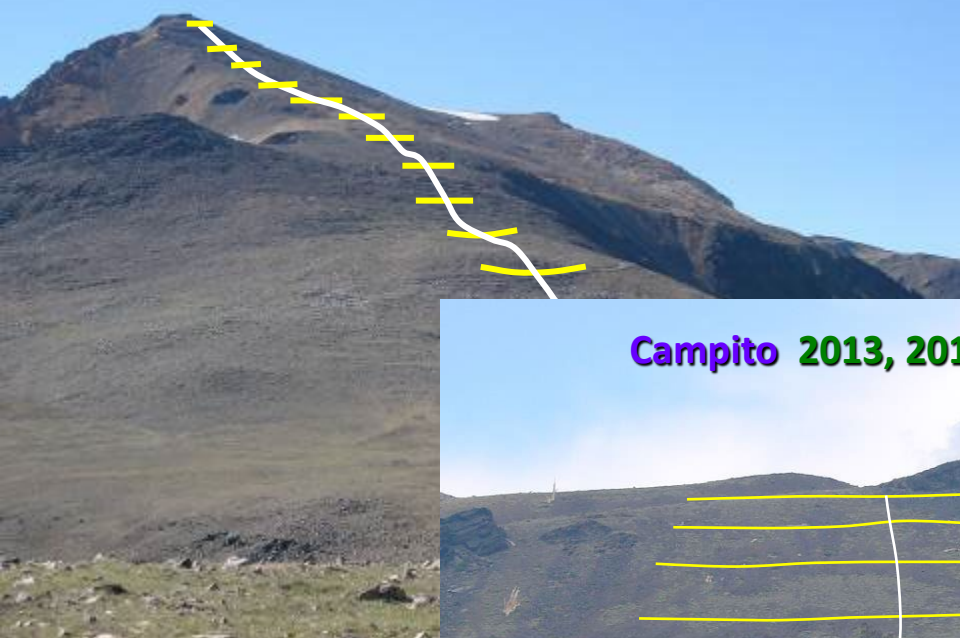
The "California Method", 10mX10m plots



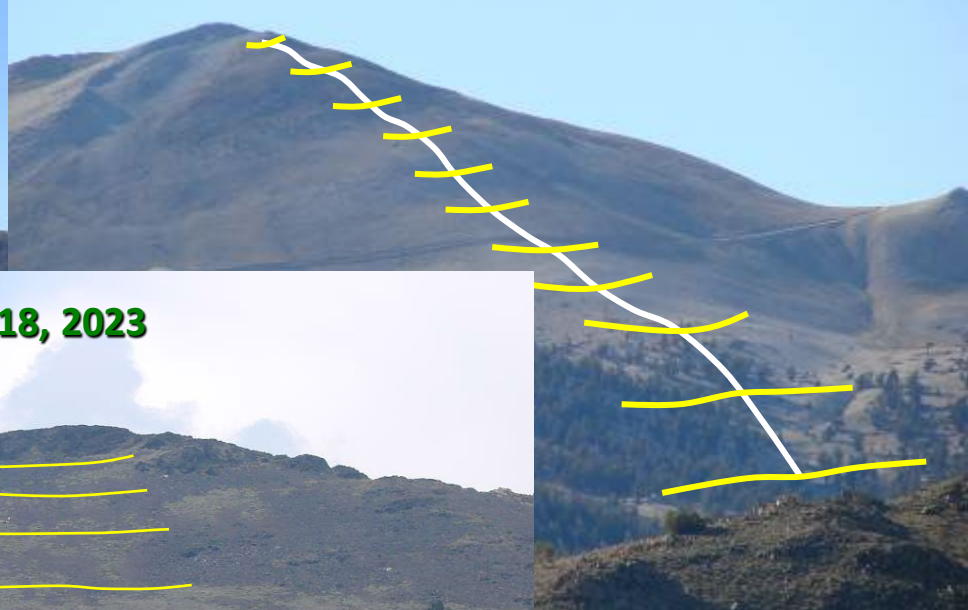
Downslope surveys



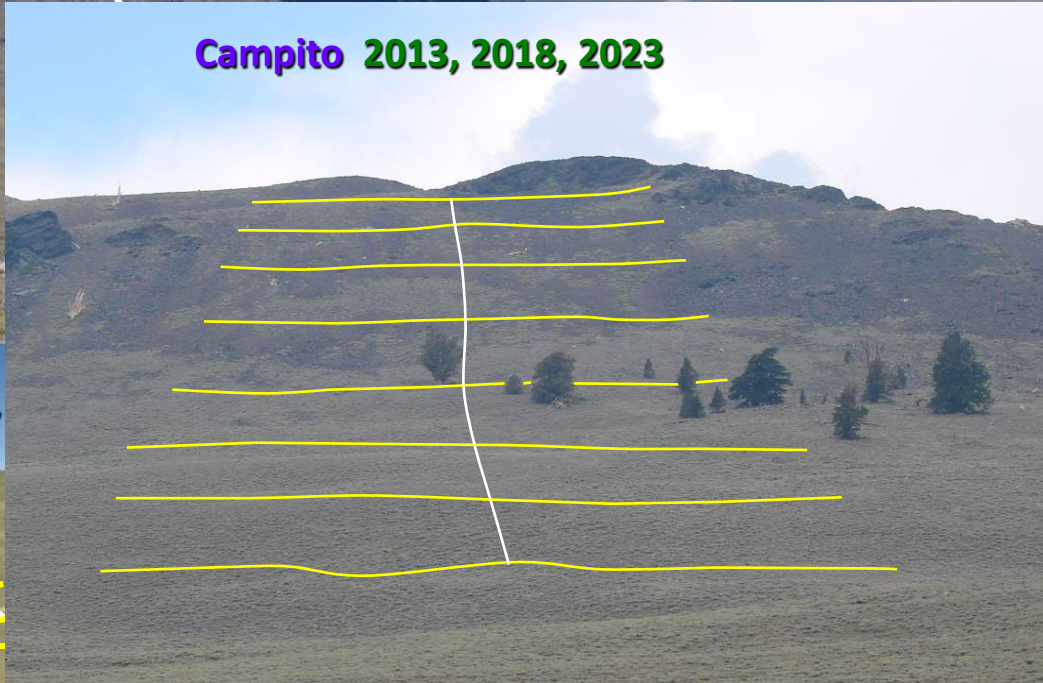
White Mtn 2008, 2012, 2017



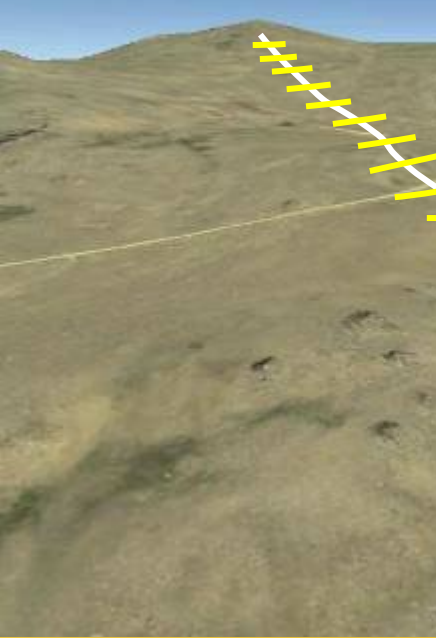
Sheep Mtn East 2007, 2011, 2016



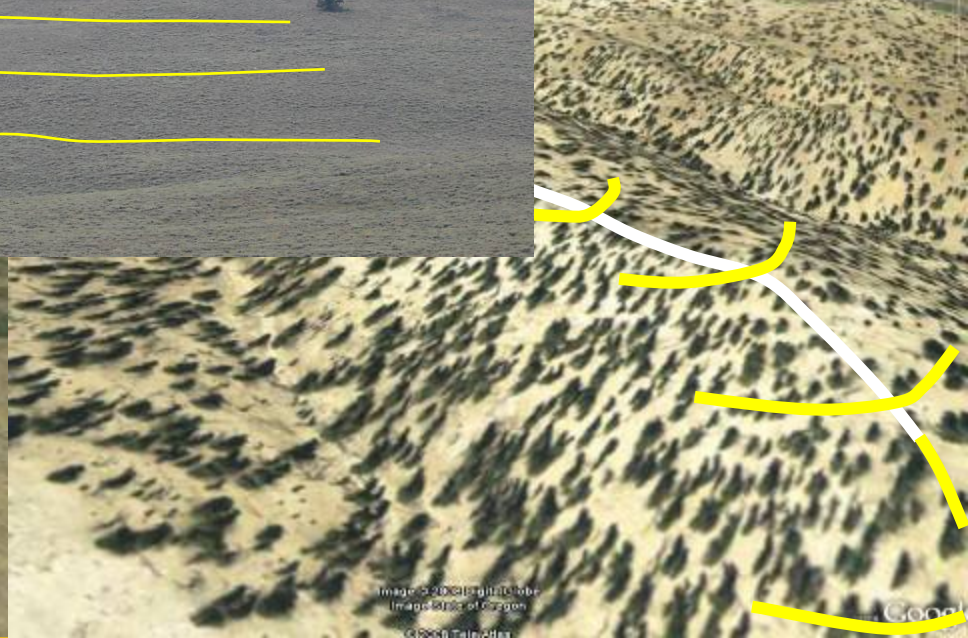
Campito 2013, 2018, 2023



Barcroft 2007, 2011,



2012, 2017, 2023



Field teams have gotten larger

Fir



Training has improved



So has Safety

Safety briefing for GLORIA Great Basin field workers

Our work involves quite a few hazards. But in spite of repeated hikes to the summits, many hours spent in field work, by dozens of workers, over many years, we haven't had (and never want) a single serious accident. There is only one way to accomplish that—to be safety conscious all of the time. There is no piece of data we can collect that is worth an injury, not even one.

We'll be exposed to strong sunlight, high elevation, wind, cloud-shade, and very possibly rain or hail, maybe lightning (though we try to avoid it). Being prepared for the conditions includes:

1. Good footwear, and extra clothing to keep you warm and dry even in rain and wind.
2. Protection from intense sunlight: sunglasses (an extra pair too), hat, sunscreen
3. Enough water to stay well hydrated...at least a couple of liters for the day
4. Enough food to keep your energy up... a solid lunch and some mid-morning and mid-afternoon snacks

Effective response to accidents. Imagine someone falls and splits open a knee to the bone, or gets a severe head injury...what could we do to help them, and how long would it take us to summon help? We need to be able to offer basic treatment for the wound, to place an emergency call within 10 minutes of an accident, and to care for the patient for hours. Early request is critical; even then we can wait 2 to 4 hours for help to arrive.

1. First aid kits, with key items, including a splint, at least available among the team members.
2. Communication between team members. We'll have small handi-talkies for several people.
3. Cell/satellite phone or Inreach, etc. to reach an emergency dispatch center.

Avoid the hazards of rough terrain and high places.

1. Step carefully and **don't get in a hurry** either hiking or working. Loose or projecting rocks and our survey strings are all tripping hazards.
2. When working near a drop-off **remain at least one step from the edge**. An accidental misstep or a bump from coworker or wind can then be countered without stepping over the edge.
3. When negotiating a steep pitch keep 3 of your 4 hands/feet on the rock at all times.
4. Be careful not to dislodge rocks, and avoid working directly above someone on a steep slope. If a rock falls yell "rock" to those below.
5. **Avoid lightning**. Heed the forecast and watch for signs of developing storms. Always leave in time to be well off the summit by the time lightning is a threat. Wet rocks can be much more slippery than they were as you climbed up, and a real hazard if you are hurrying down.
6. **Watch for altitude sickness**. If you get a headache, feel lightheaded, and especially if you feel nauseous, tell someone right away, drink more water (or Gatorade), and have a sit (in the shade if there is any!). Sometimes the feeling will pass, and you'll feel fine to carry on. By telling someone early, they can help you decide whether you should head downhill based on whether your condition is improving, staying the same, or getting worse. **The only sure cure for altitude sickness is going to a lower elevation!**

The hardest thing is to always be alert and careful, never letting inattention or impatience cause you to do something you'd regret. Try to be attentive every minute.

Everyone should know their location & the way back to base in poor visibility. Several team members should:

1. Have the simple tools, a map and compass, at least several team members.
2. Have a good GPS and input the location of camp or vehicle. And GPS coordinates (lat/long & NAD 83 datum the best) are essential when requesting rescue response.
3. If anyone is hiking separately from the group they should have: a radio, extra batteries (and know how to change them), and a check-in plan.

Wilderness 1st Responder

Our original “organization”

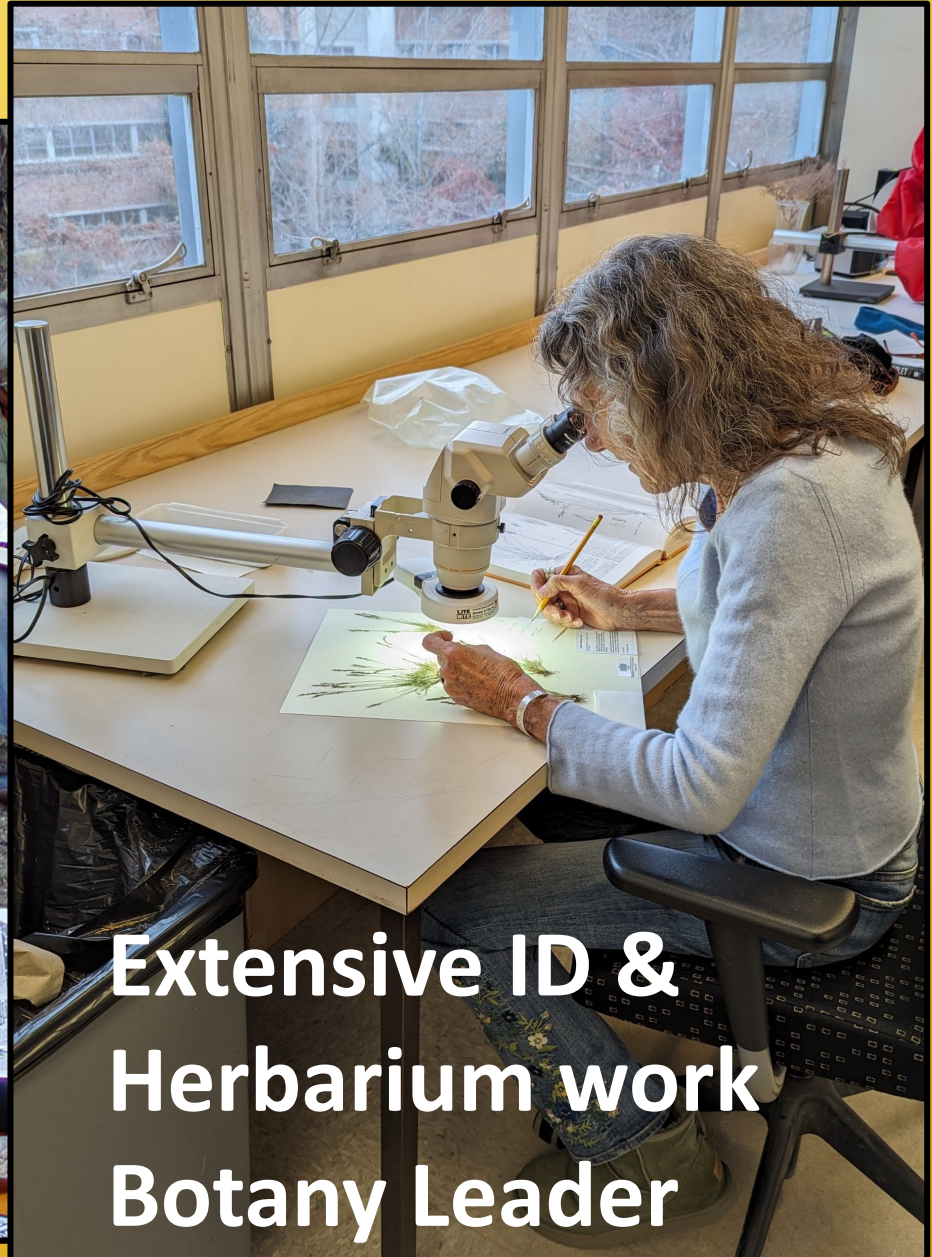
Founder/Advisor

Field Leader



Botanical data has improved and is now excellent quality

Earliest field ID
Field Ldr. & Botanist



Extensive ID &
Herbarium work
Botany Leader

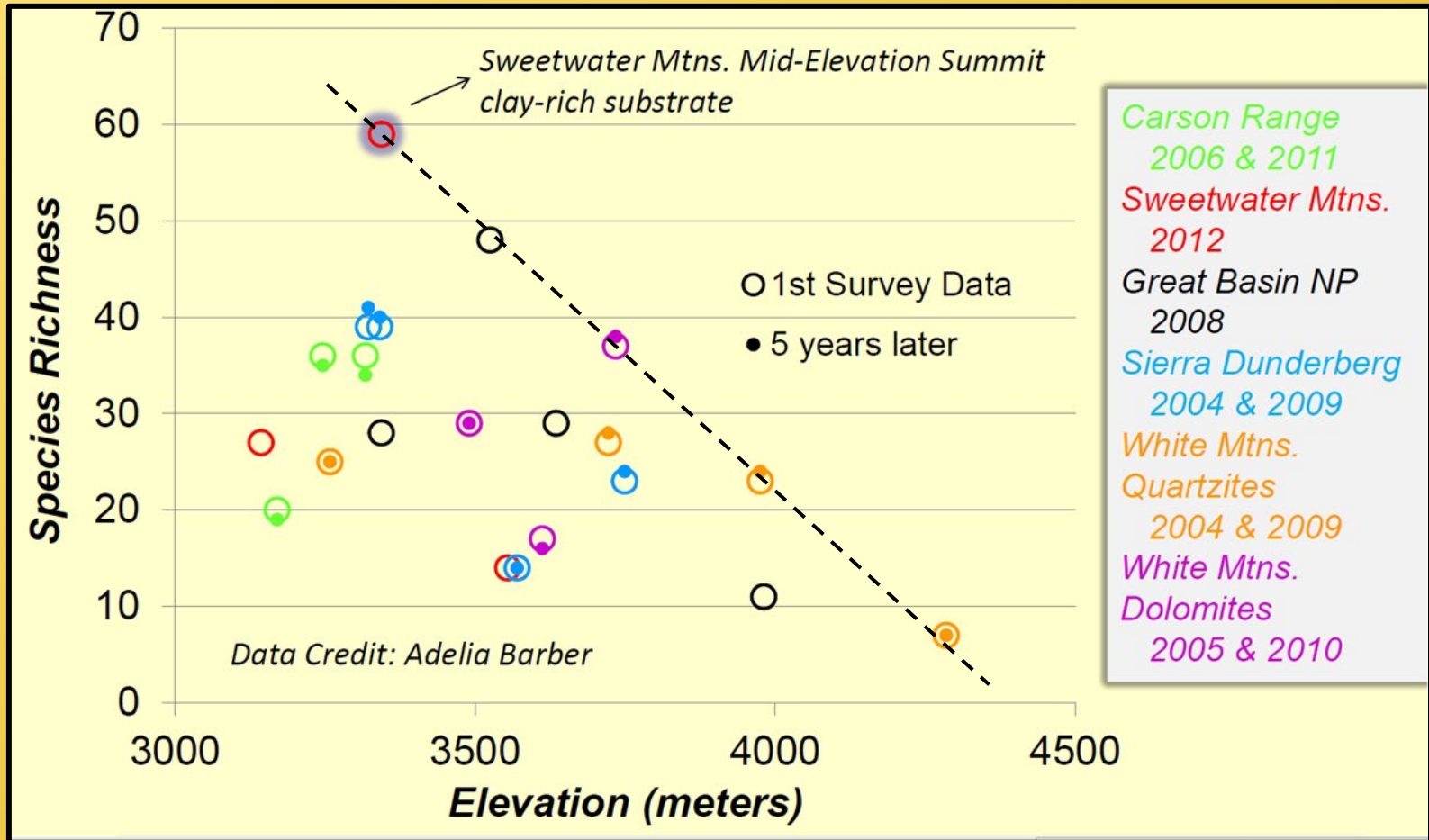
Presumed result of climate change

- With warming plants will move up enough to maintain temperature
- About 15m per 0.1 C° or 15m in 5 to 10 years

Alas, it is not that simple

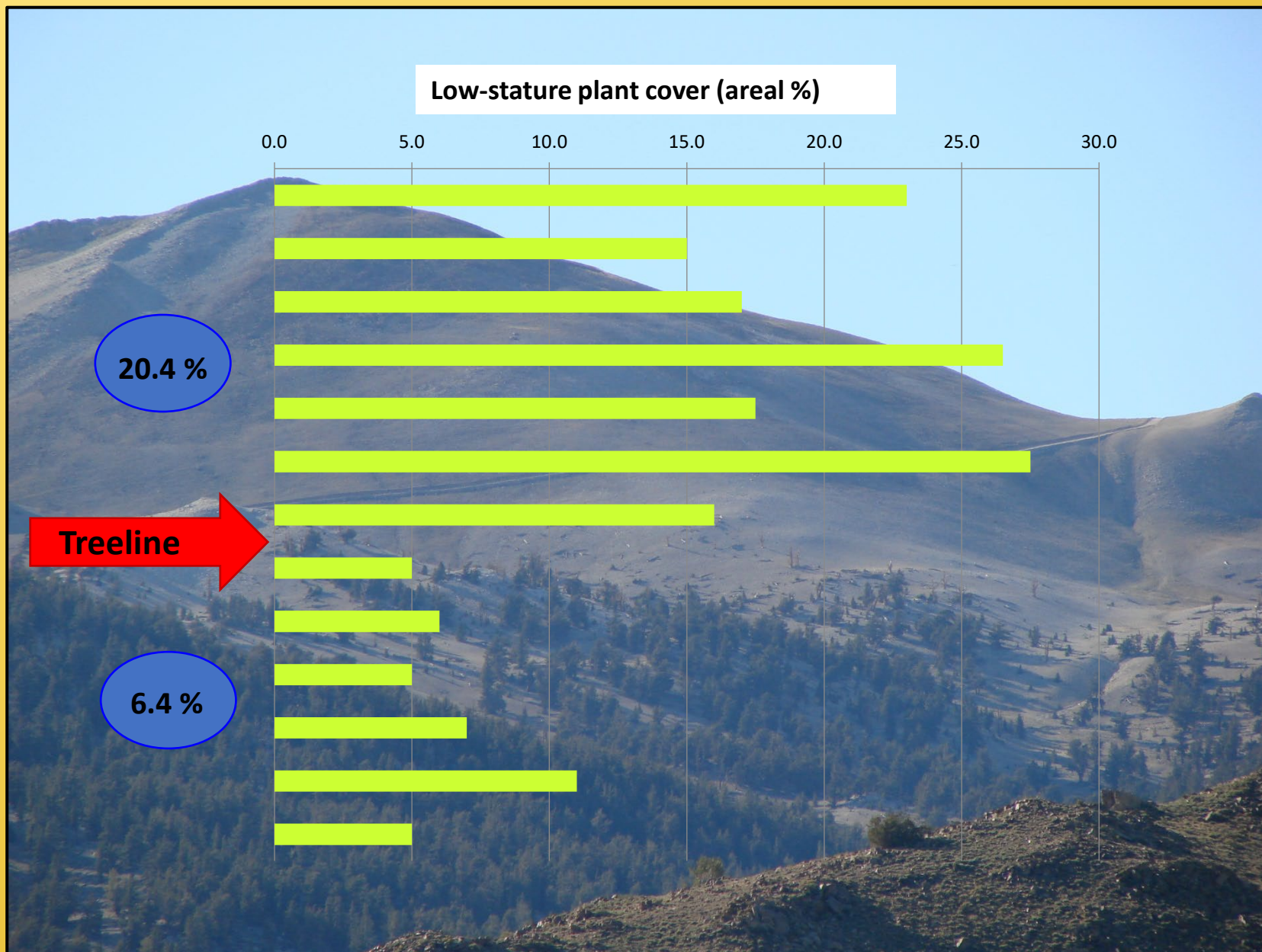
- Warmer favors more species, species richness increases
- Diversity of microclimate niches allow refuge with small shifts
- ~~Alpine plants move up, so do species from below, treelines rise~~
- Warming could dry soils & reduce nutrients, less hospitable, harsher
- Soil development is very slow at high elevations
- Mediterranean summits have not shown species increases
- Dispersal, establishment, & extinction rates differ, causing complex migration patterns and timing
- Alpine plants are tough and resilient, have handled difficult conditions already, and may persist
- Moisture effects may exceed temperature effects, different trends
- 15 years is too short for long-term temperature effects to emerge from short-term variations and “noise”

Species Richness California & Nevada GLORIA 2004-2012



**Mark Darrach, Adelia Barber, Elizabeth Bergstrom,
Constance Millar 2013**

Low-stature plant cover in alpine vs. woodland



Smithers, Oldfather et al. 2020, *American Journal of Botany*

“Community turnover by composition and climatic affinity across scales in an alpine system”

For a given species, distribution defines the climate niche mean (CNM), High & Low T, moisture

For a given location, weighted average of CNMs defines CNM for that transect, etc.

How well does CNM correlate with elevation?

Take-home messages

- Climatic filtering is stronger at broader spatial scales
- Microclimate and site-specific factors may be stronger at smaller scales
- As much variation over 100 meters horizontally as 100 m vertically
- **Need to consider spatial scale when predicting effects of climate change on alpine communities**

Goff, et al* “Stability of alpine plant communities over time in western North America”

For 29 summits species gain/losses were compared over 5-year resurvey intervals

Abundances & gains/losses were viewed in terms of functional groups, as well as individuals

Take-home messages

- No significant net change in species richness
- Species richness stability is due to offsetting gains/losses
- Some losses and gains, but no pattern clearly attributable to climate change
- Different time scales for dispersal, establishment, extinction
- Most alpine plants are resilient, persistent in the face of change
- Insufficient time for climate-change effects to predominate?

*

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So what do we have?...a long-term project

Mature, well-practiced methodology

Excellent botanical database

Good progress in data analysis and science

Dozens of study sites in a variety of environments

Good measures of inherent noise in the data

**Strong organization to sustain the resurveys,
including our Peak Opportunity Fellowships
(a week in the field with us for 3 young students)**