Case study:
Lakeside Ceanothus decline in San Diego, Co.

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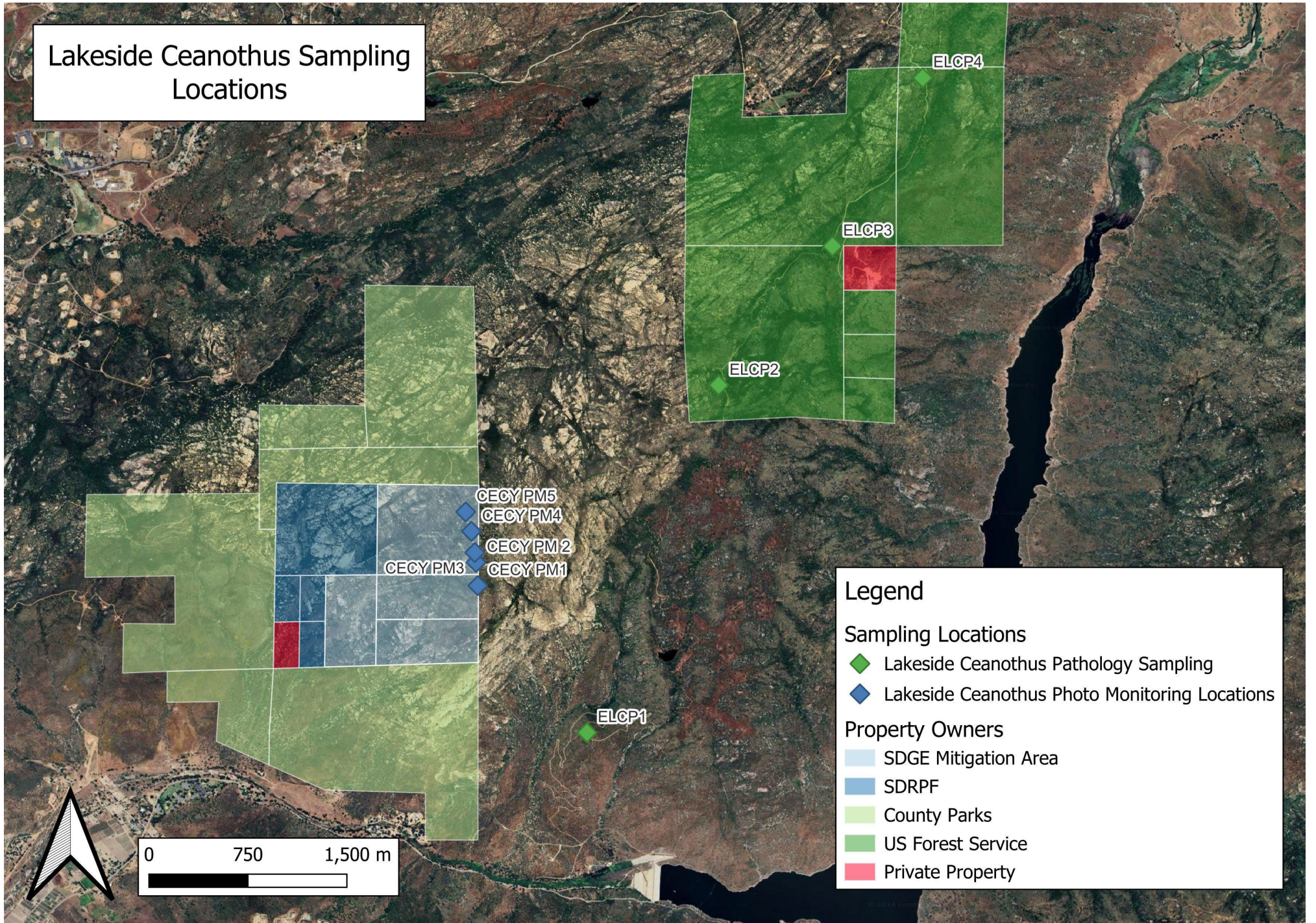
Lakeside ceanothus and habitat Value

- The **El Capitan Mitigation Preserve** is a 385 acre open space preserve with stunning granitic peak standing 3,677 feet in elevation.
- Located in El Monte Valley in Lakeside.
  - Cleveland National Forest
  - County of San Diego's El Capitan Open Space Preserve.
  - Acquired by SDG&E in 2013.
  - Ownership was transferred to SDRPF so that it could be maintained in perpetuity
- Lakeside ceanothus (*Ceanothus cyaneus*):
  - A **rare and endemic evergreen shrub** that reaches up to 15 feet in height. It produces brilliant deep blue flowers from April to June.
  - Lakeside ceanothus is only found in San Diego County and northern Baja California, Mexico.
- The El Capitan Preserve is home to **hundreds sensitive specie**s such as mountain lions, golden eagles, southern mule deer and Blainville's horned lizard and the Orcutt's brodiaea (*Brodiaea orcuttii*)

Background

- In **2024, SDRPF reported a decline** was reported in the rare and endemic species Lakeside Ceanothus (***Ceanothus cyaneus***) in San Diego County.
- At several locations, a significant decline was observed over a span of **four years**.
- Individuals exhibited general decline, with severe symptoms of **thinning and dieback**. Abnormal growths on branches were present.
- Expertise was requested from Dr. Ana Pastrana and Dr. Johanna Del Castillo from UCCE.

Photos: from Lakeside Ceanothus Comparison.docx


Lakeside Ceanothus Sampling Locations
ELCP4
ELCP3
ELCP2
ELCP1
CECY PM5
CECY PM4
CECY PM 2
CECY PM3
CECY PM1
0
750
1,500 m
Legend
Sampling Locations
Lakeside Ceanothus Pathology Sampling
Lakeside Ceanothus Photo Monitoring Locations
Property Owners
SDGE Mitigation Area
SDRPF
County Parks
US Forest Service
Private Property

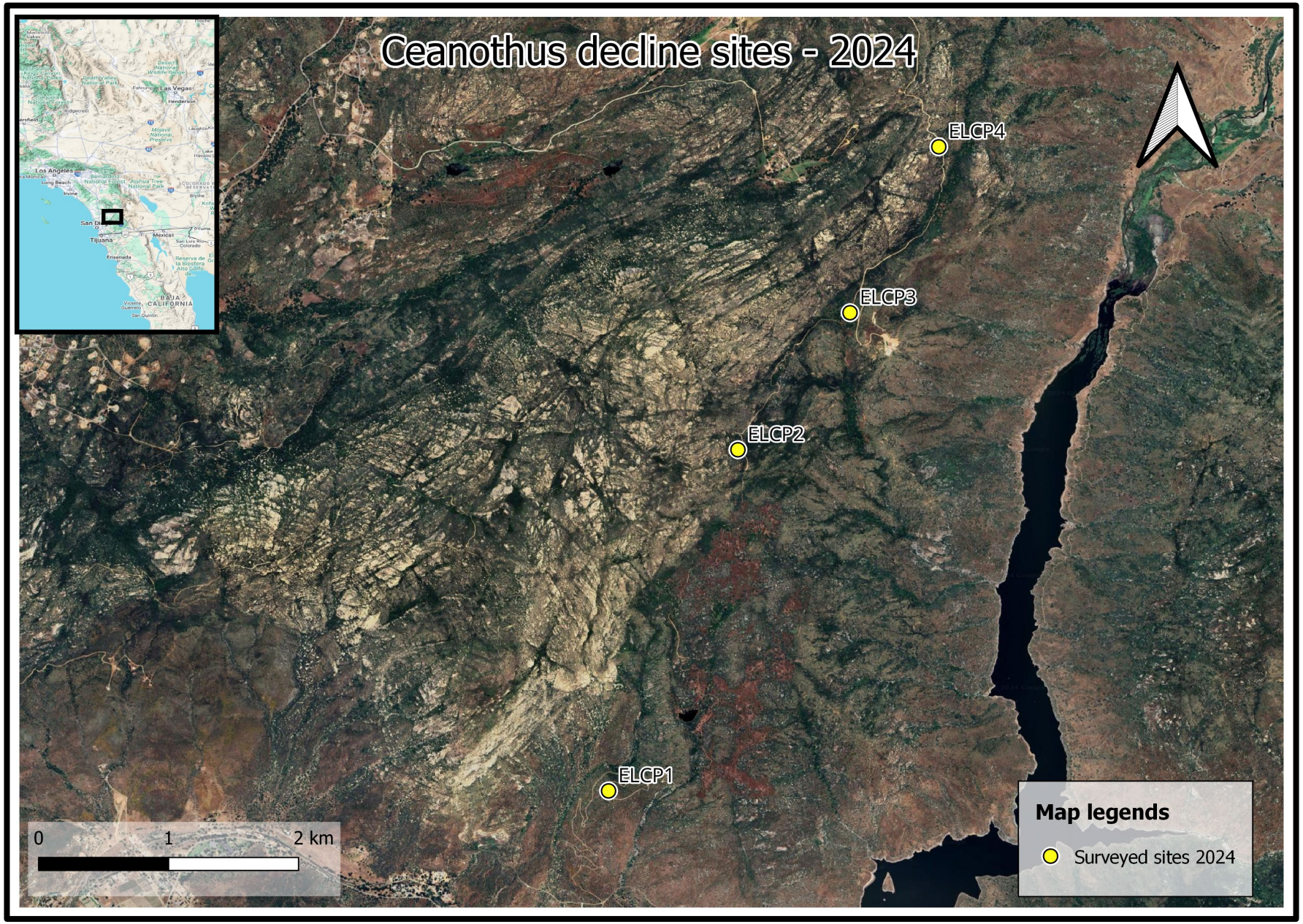
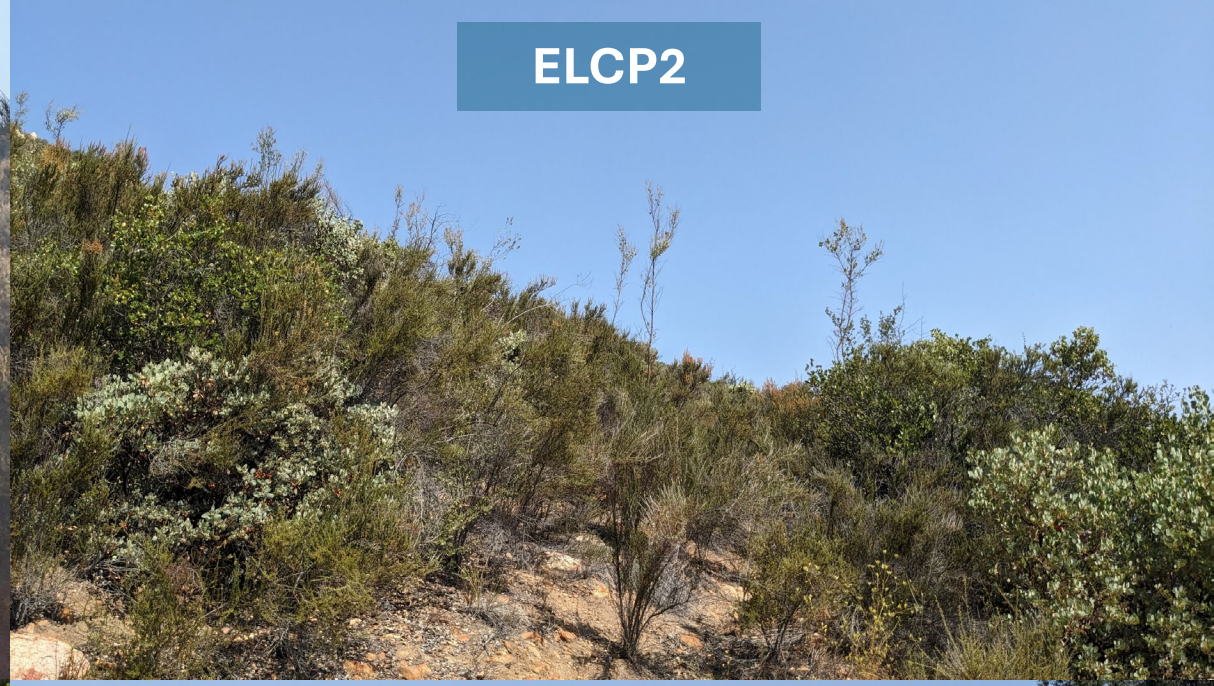


Figure. Sites visited during the July 24, 2024, survey trip to observe declining *Ceanothus cyaneus* in San Diego County.


ELCP1


ELCP2

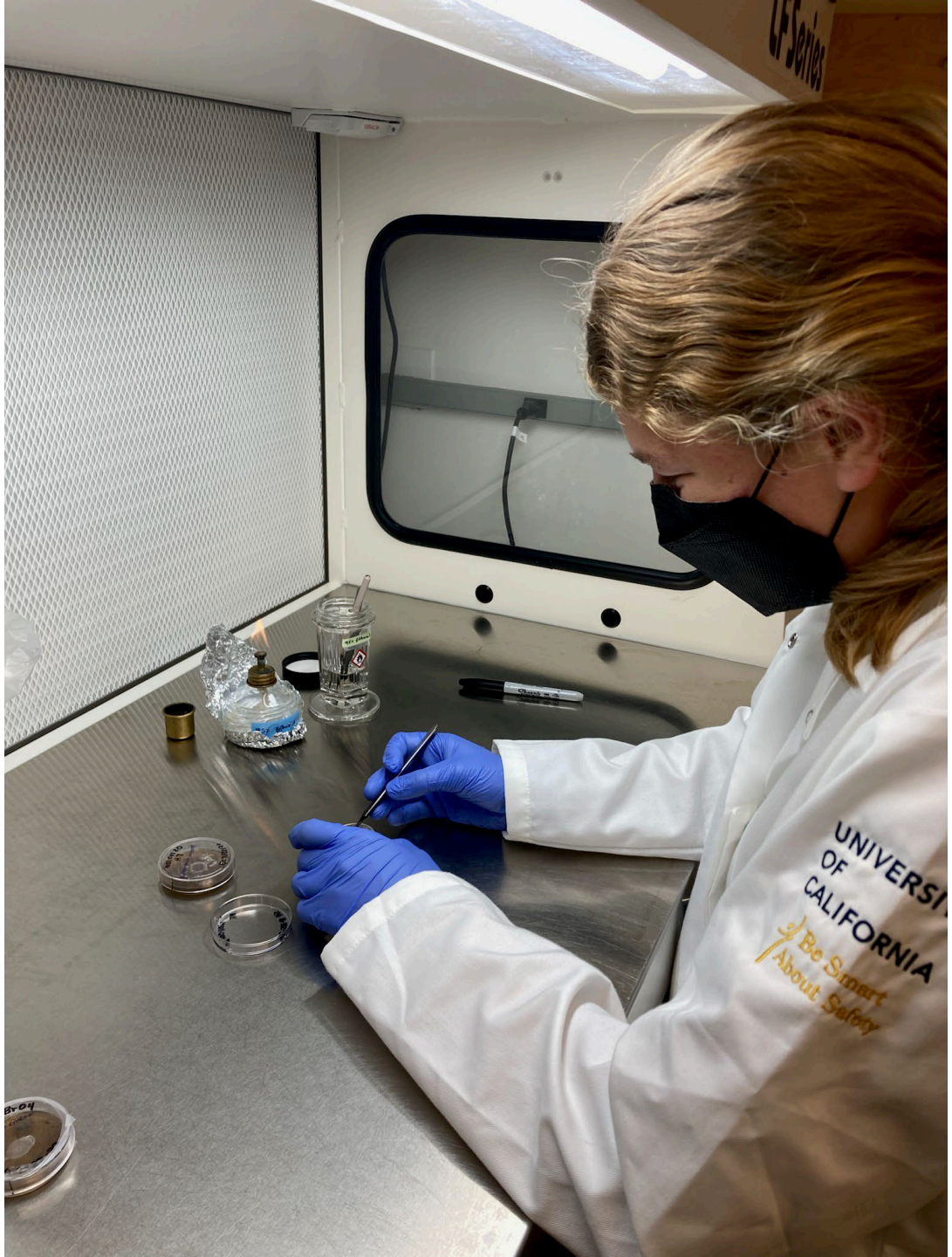

ELCP3


ELCP4

Figure. Thinning, branch dieback, basal cankers, and abnormal growth on branches were the most frequently observed symptoms in *Ceanothus cyaneus* **at all four sites** on El Capitan Mountain, San Diego County.

Sample processing

- **Plant tissue and soil samples** were transported to Del Castillo Lab at UC Davis and assessed for fungal and oomycete plant pathogens.
- Plant tissue was **surface sterilized** and plated on **1/3 PDA** (Potato dextrose Agar) with antibiotics.
- Soil samples were processed for *Phytophthora* through common **oomycete baiting techniques.**
- All isolated strains were **identified** through sequencing of the **ITS** region. Samples were sent for sequencing at Psomagen, Inc., Rockville, MD.



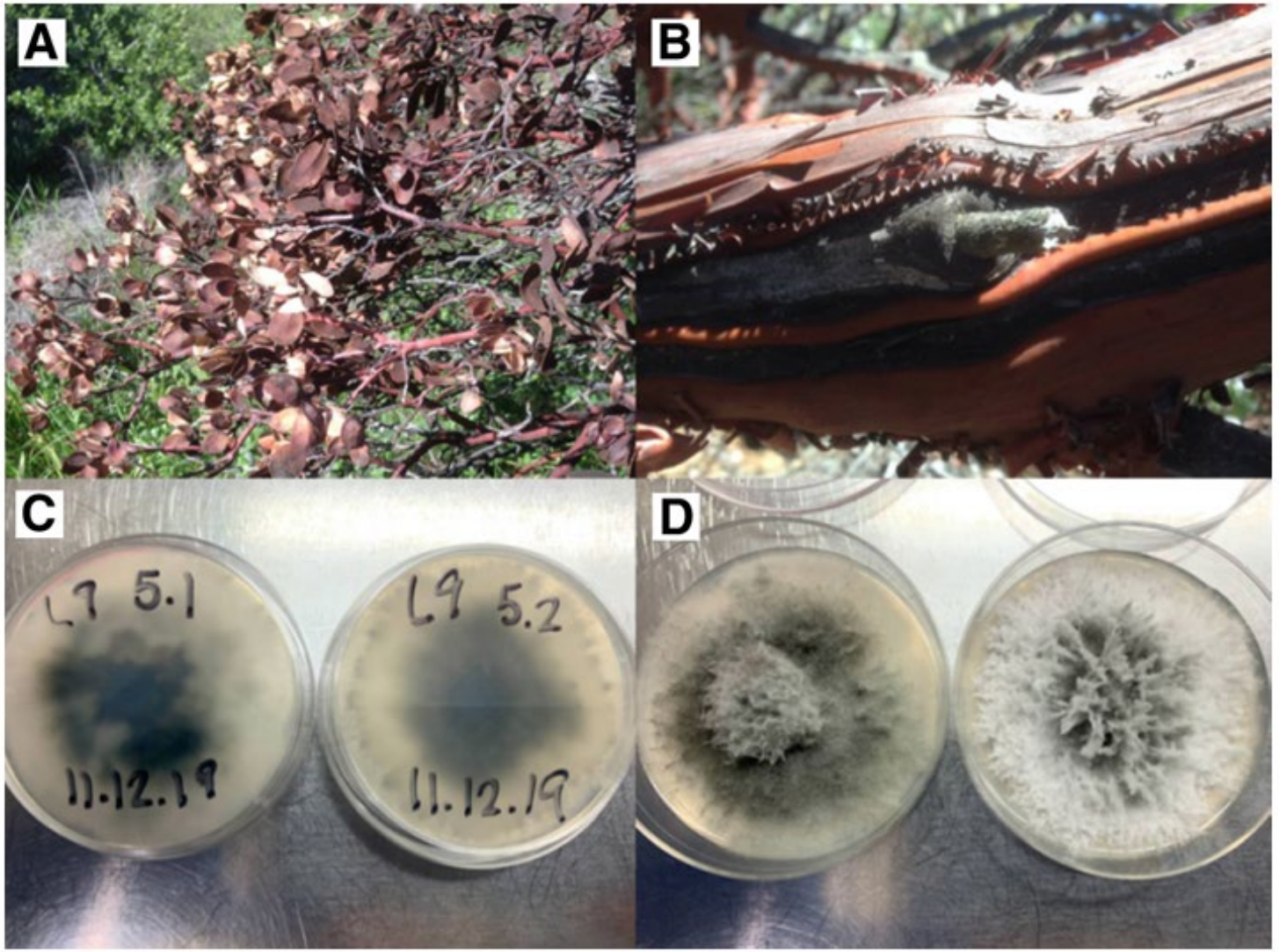
Site ELCP1, sample ELCP1-2. Sampled individual had dead branches covered in dried resin exudations and branch die back. Some branches still had a normal fruit load. This individual also had a basal canker, from which ***Neofusicoccum vitifusiforme*** was isolated.

Table. *Ceanothus cyaneus* survey summary. In total four sites were visited taking symptomatic plant and soil rhizosphere samples. An additional soil sample from a dry creek bed was taken from site ELCP3. GPS point and elevation for site ELCP1 are missing due to GPS tracker issues.

Site	Vegetation type	Lat, Long	Elevation (m)	Sample ID	Type of sample	Symptoms	Isolations
ELCP1	Chaparral	NA	NA	ELCP1-1	Plant tissue	Resin exudations, thinning, branch death	***Botryosphaeria dothidea****,* ***Neofusicoccum vitifusiforme,*** *Pringsheimia chamaecyparis*
ELCP1	Chaparral	NA	NA	ELCP1-2	Plant tissue	Resin exudations, dead branches, thinning and basal canker	***B. dothidea, N. vitifusiforme***
ELCP2	Chaparral	32.92425, -116.80422	754.86	ELCP2-1	Plant tissue	Resin exudations, dead branches, thinning and basal canker	***B. dothidea Dothiorella iberica***
ELCP2	Chaparral	32.92425, -116.80422	754.86	ELCP2-2	Plant tissue	Thinning and yellowing	***B. dothidea*** *Opportunistic molds: Stromatinia sp., Biscogniauxia sp. Paracamarosporium sp.*
ELCP3	Oak woodland	32.93551, -116.795	664.23	ELCP3-1	Plant tissue	Mechanical damage, dead branches.	***B. dothidea***
ELCP3	Oak woodland	32.93551, -116.795	664.23	CLP3-3	Soil from dry riverbed	NA	*Phytophthora thermophila*
ELCP4	Chaparral	32.94915, -116.7877	660.39	ELCP4-1	Plant tissue	Resin exudations, dead branches, thinning.	*Opportunistic molds: Roselinia sp., Soradriomycetes sp.*

Botryosphaeriaceae complex

- *N. vitifusiforme, D. iberica* and *B. dothidea* are all part of the Botryosphaeria complex.
- These fungi are almost **ubiquitous** in Mediterranean areas of the world mainly acting as plant endophytes.
- Under environmental stress they can become opportunistic pathogens, causing **severe damage to woody** agricultural hosts like grapevines and walnuts.
- In **California**, they have been associated with causing **shoot dieback** in forest settings, affecting Oaks, Manzanitas, Madrones, Redwood and others, especially during **drought years**.



Symptoms of Botryosphaeriaceae (*Bot*) infection on *Arctostaphylos glauca* include **A,** leaf discoloration and branch dieback and **B,** branch cankers. Cultures of isolates retrieved from *A. glauca* branch cankers were used to preliminarily identify *Bots* based on colors and growth rate of **C,** the underside of plates and **D,** aerial hyphae. (Drake-Schultheis et al., 2022)

Conclusions

- **Drought** in combination with **Botryosphaeriaceae** fungal species are predisposing the plant to disease.
- **Periodic monitoring** is needed to gain insights into the **risk** posed by environmental stress and Botryosphaeriaceae species.
- We recommend practicing and incentivizing **sanitary measures**:
    - To minimize human-mediated spread, sanitary protocols should be followed between sampled areas.
    - Including removing plant and soil debris from tools, boots and vehicles.
    - Avoid collecting seeds and plant material from symptomatic plants
- Future studies should include **pathogenicity tests** and **expanded surveys.**

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