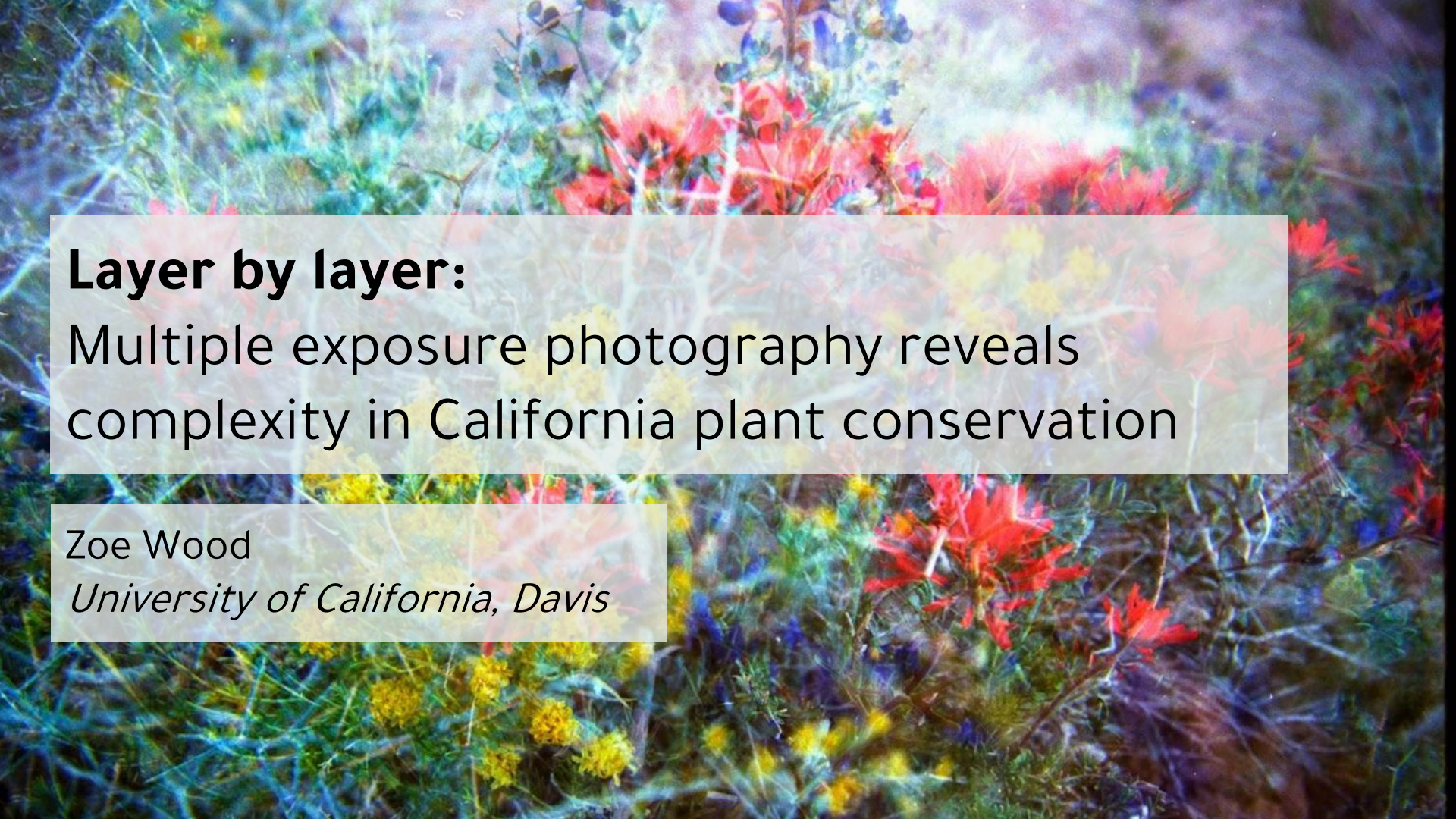


Layer by layer: Multiple exposure photography reveals complexity in California plant conservation

Zoe Wood
University of California, Davis

Still Life with Fruit Basket – Paul Cezanne

What is an accurate depiction of an ecosystem?

Still Life with Fruit Basket – Paul Cezanne

What is an accurate depiction of an ecosystem?

How might this depiction change over time?

Still Life with Fruit Basket – Paul Cezanne

What is an accurate depiction of an ecosystem?

How might this depiction change over time?

How can curiosity offer a bridge between concrete goals and embracing complexity in plant landscapes?

Still Life with Fruit Basket – Paul Cezanne

framing

snapshots

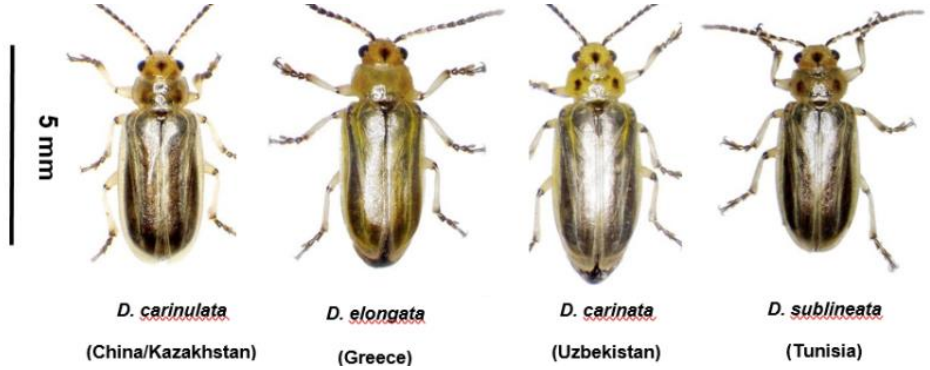
shifting to a new lens

Classical biocontrol

The intentional introduction of an exotic biocontrol agent for permanent establishment and long term suppression of the invasive organism.

Classical biocontrol

The intentional introduction of an exotic biocontrol agent for permanent establishment and long term suppression of the invasive organism.



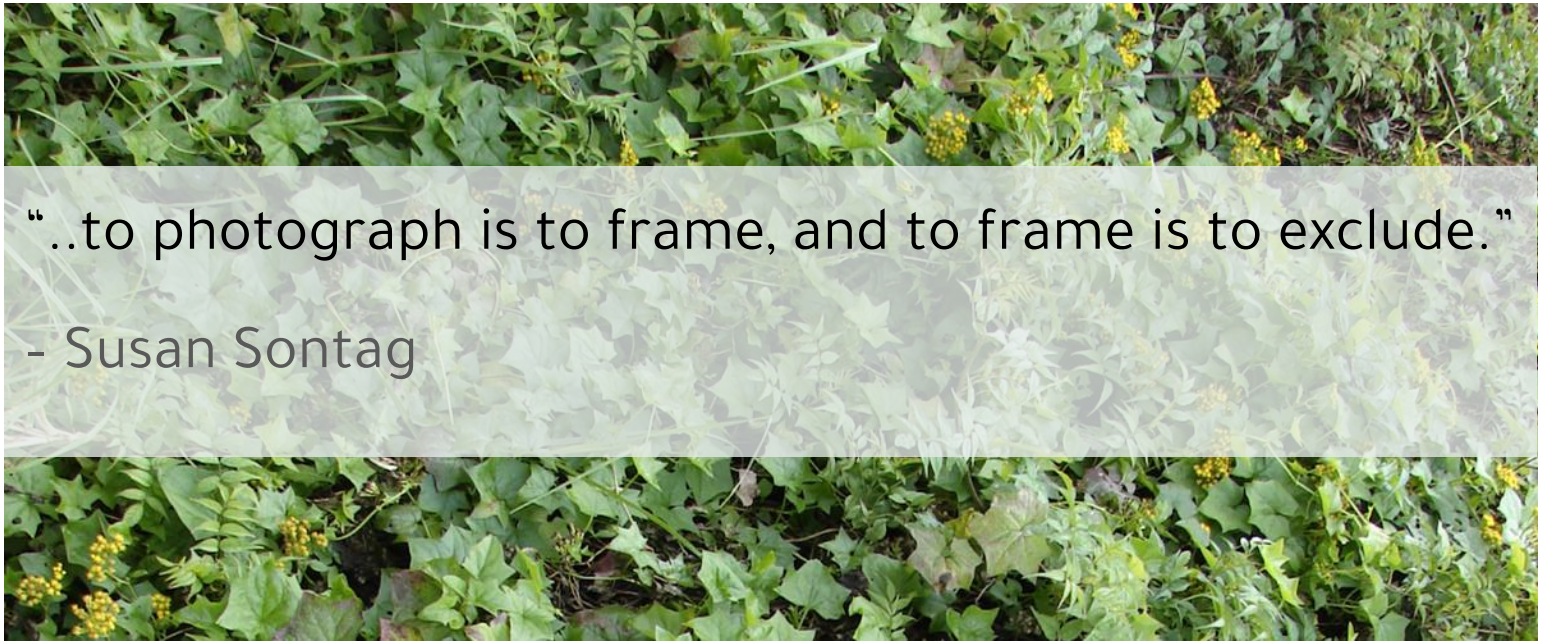
Left: RIVR Lab, right: James L. Tracy

Delairea odorata, Cape-ivy

Parafreutreta regalis (Tephritidae)

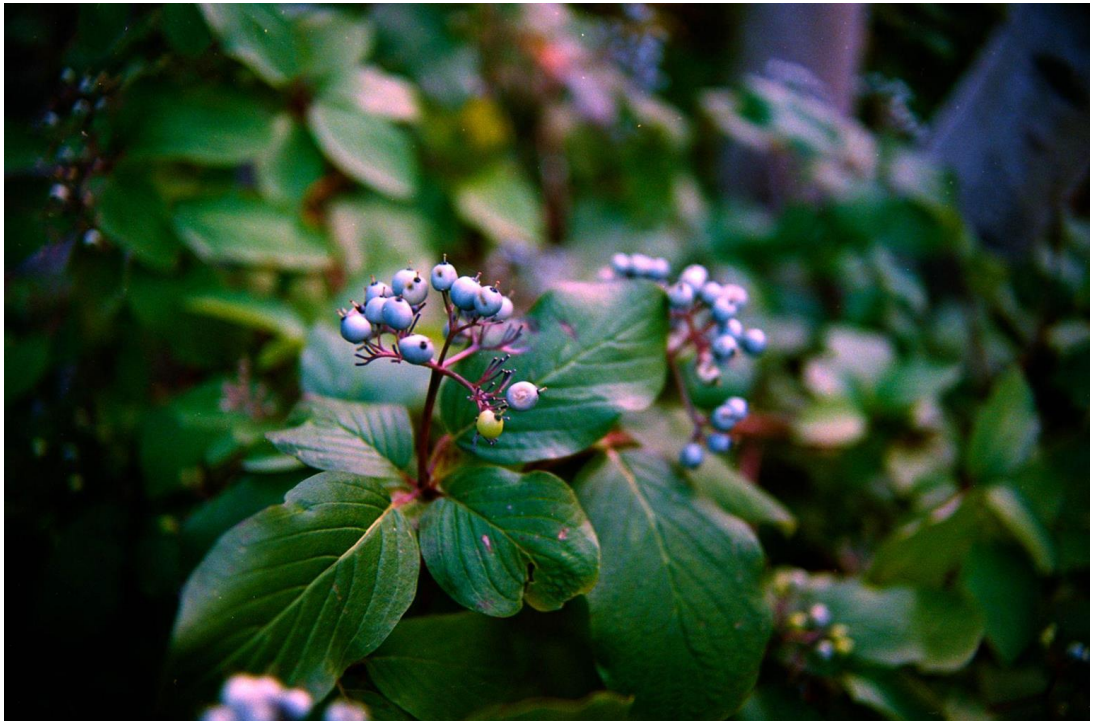
- Gall-forming fly
- Field releases of first approved biocontrol agent for *D. odorata* (2016)

Treated Untreated



"..to photograph is to frame, and to frame is to exclude."

- Susan Sontag



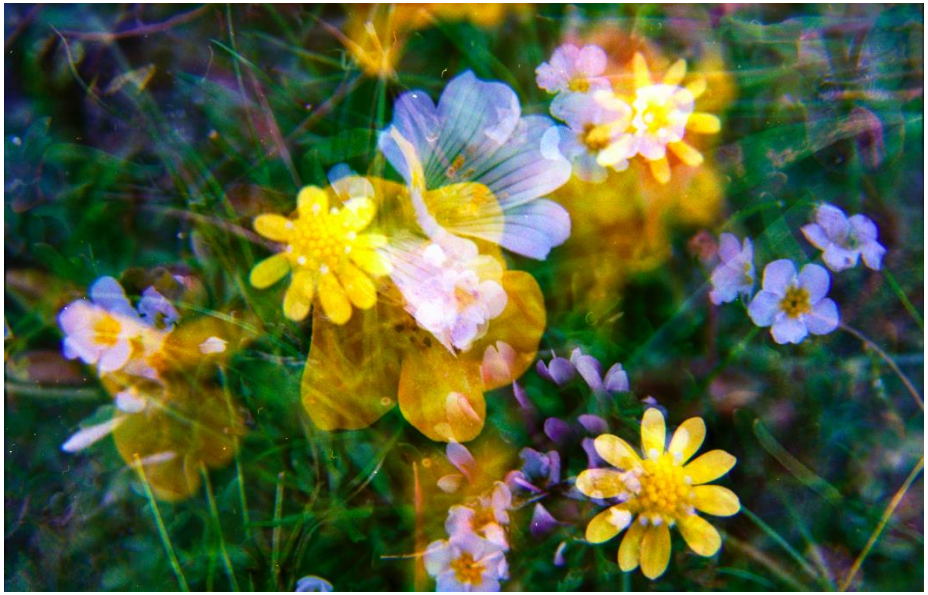
Phenology: the timing of life history events

Feb 2023: *Dichelostemma capitatum, Streptanthus tortuosus, Eschscholzia californica*

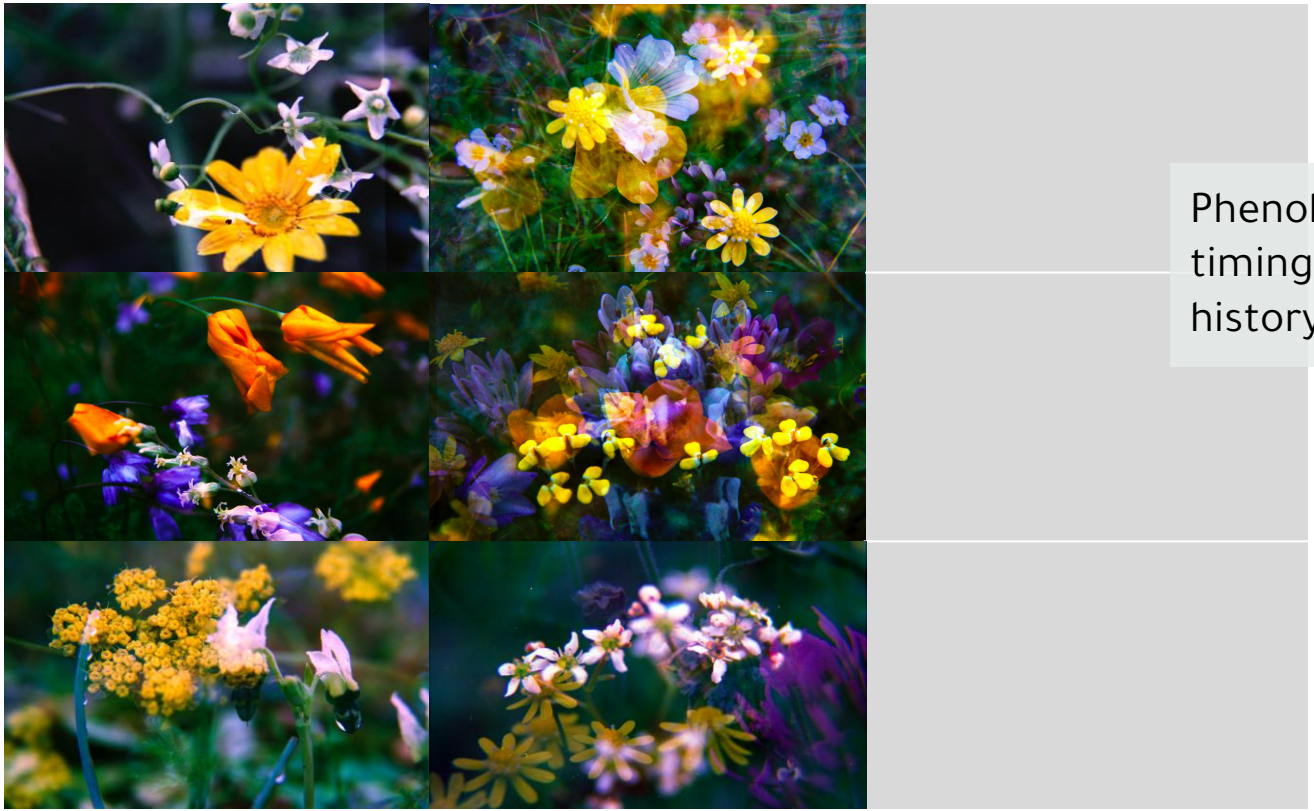
April 2023

Phenology: the timing of life history events

Diplacus kelloggii, Triphysaria eriantha, Eschscholzia caespitosa, Lupinus nanus, Lasthenia spp.



Erythranthe guttata, Limnanthes douglasii, Blennosperma nanum,



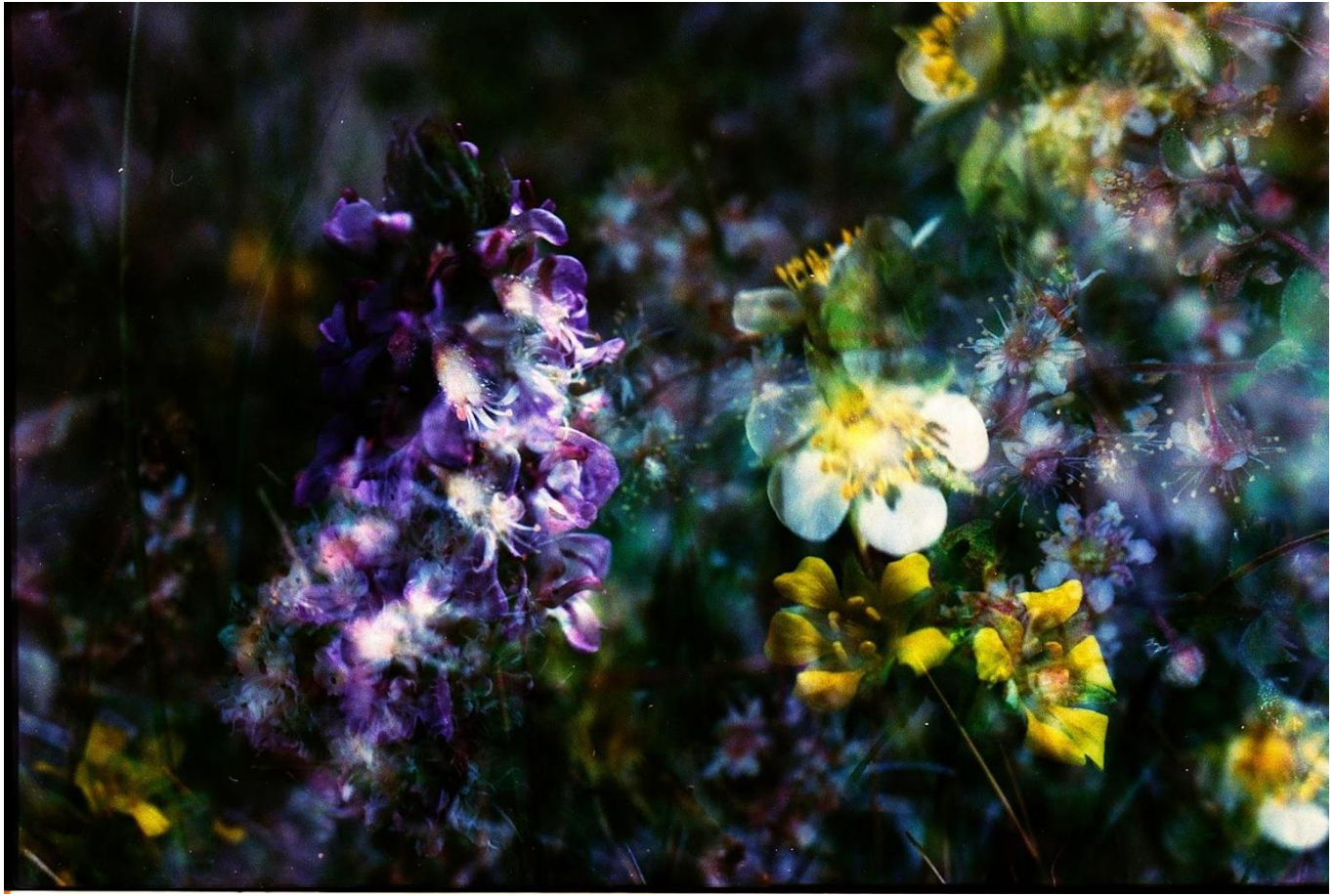
Phenology: the timing of life history events

Early season

mid season

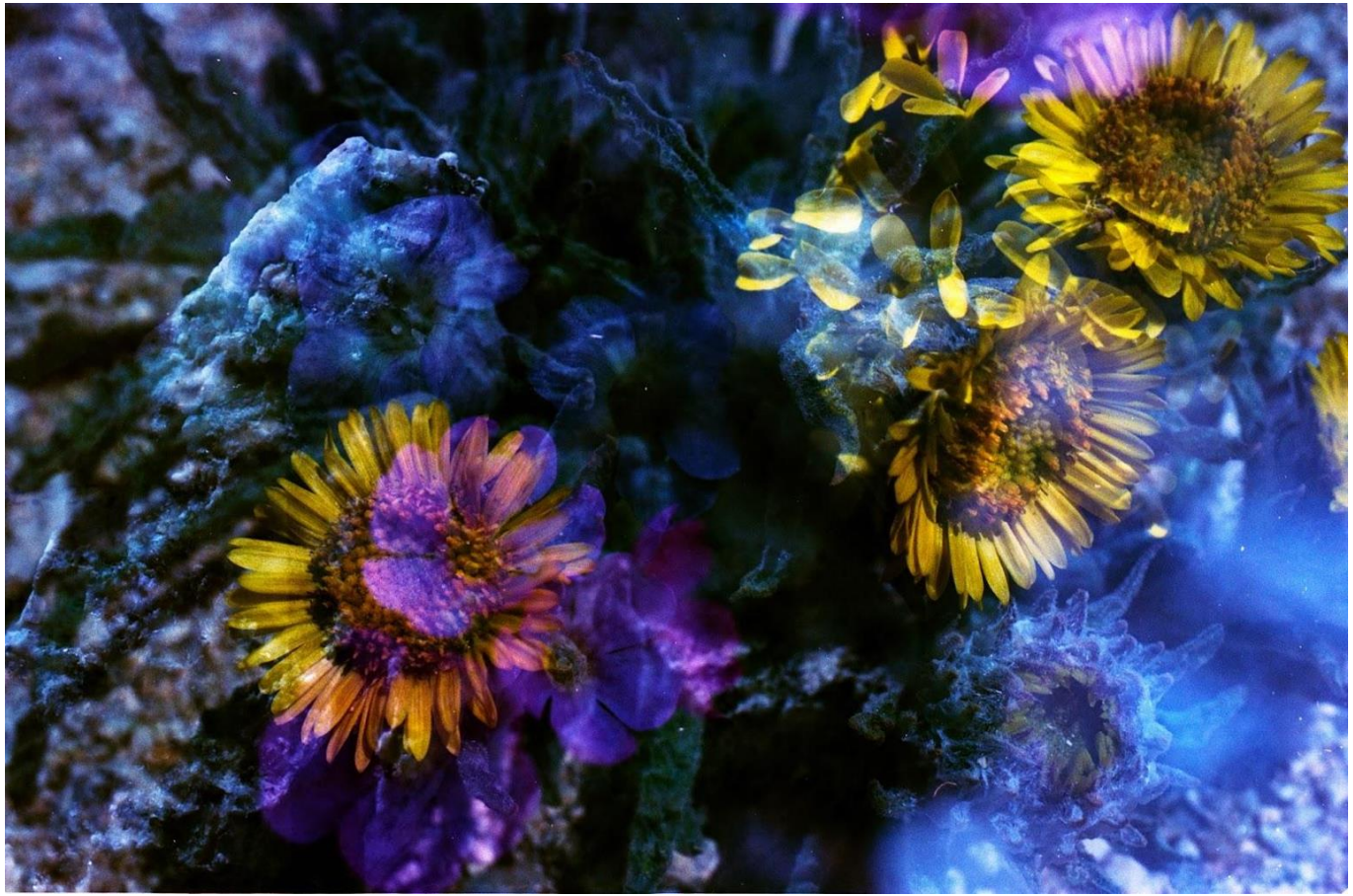
late season

Desert superblooms: threatened by human activity and climate change



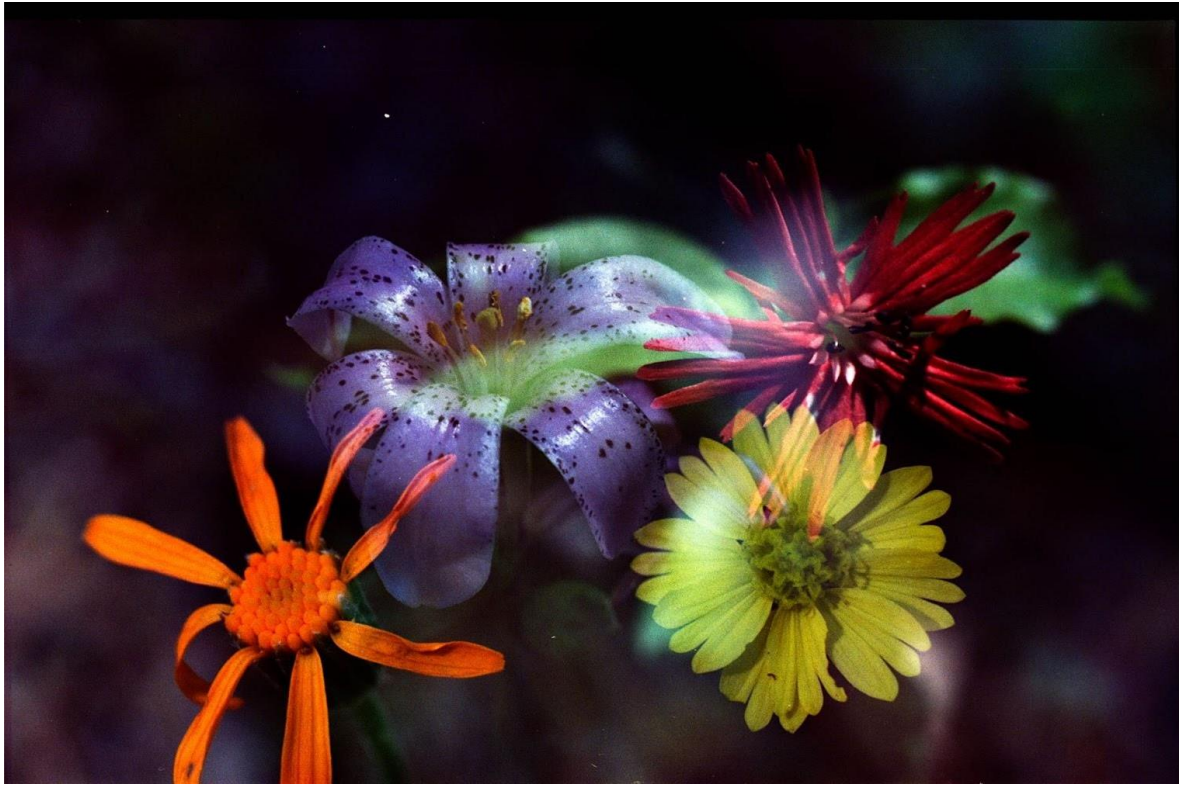
Alpine and subalpine meadows are disappearing

near Mt. Langley, Inyo County
~13,000 ft



High alpine specialists are threatened by climate change

near Mt. Langley,
Inyo County
~13,000 ft



Shifting fire regimes in the Klamath

Indigenous perspectives have been obscured

Rosa woodsii fruits, **sungabü** (*Populus fremontii*), *Euthamia occidentalis*, *Rubus ursinus*

Payahuunadü, Bishop, Inyo County

- Paiute place of the flowing water, Owens Valley, Eastern Slope of the Sierra Nevada
- Deepest valley in the US, elevational range from 4,000 ft -- Mount Whitney, 14,505 ft.
- Floral diversity

FOREST SERVICE US DEPARTMENT OF AGRICULTURE

CALIFORNIA NATIVE PLANT SOCIETY

Bristlecone Chapter

Updating SCC checklist

- Cross-referencing 106 Species of Conservation Concern (SCC) checklist with CCH2 herbarium records
- Increasing Forest Service understanding of value contained in their collection
- Focusing future conservation efforts

Inyo National Forest Herbarium (INF)
4,461 specimen records
99% with images

Herbaria bridging the past and present

Herbaria bridging the past and present

Encelia actonii
21 May 2023

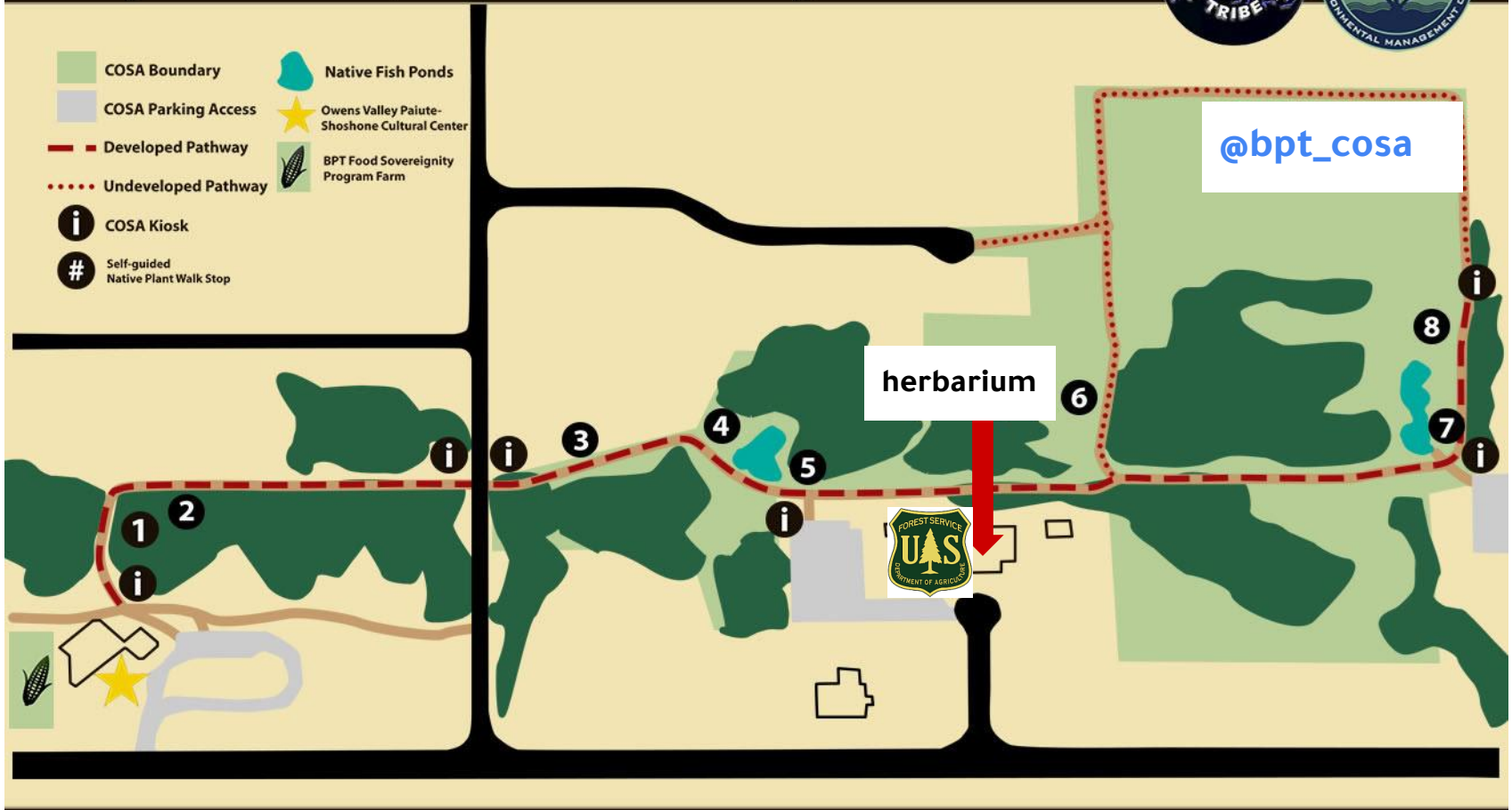
INF00447 *Reveal, Jack L.*
13 May 1962

Herbaria bridging the past and present

Argemone munita
9 April 2023
DAV307062, 12 sep 1974
(Inyo co)

Conservation Open Space Area (COSA)

Bishop Paiute Tribe / Environmental Management Office



Dogbane, Coyote Willow, and Suga...

Stop here for a moment just before the path rounds the bend, to the east of the path is a...

Freemont Cottonwood and Woods' ...

Stop for a minute under the tall Fremont cottonwoods to the south of the path here. Re...

West Pond- Pupfish and Sunflower

You have arrived at the COSA's West Pond. This pond was originally dug out for the purpose ...

Creeping Wild Rye and Saltgrass

Just to the north of the path here, there are two types of native grasses. See if you can tel...

Polly's Pollinator Garden- Owens Va...

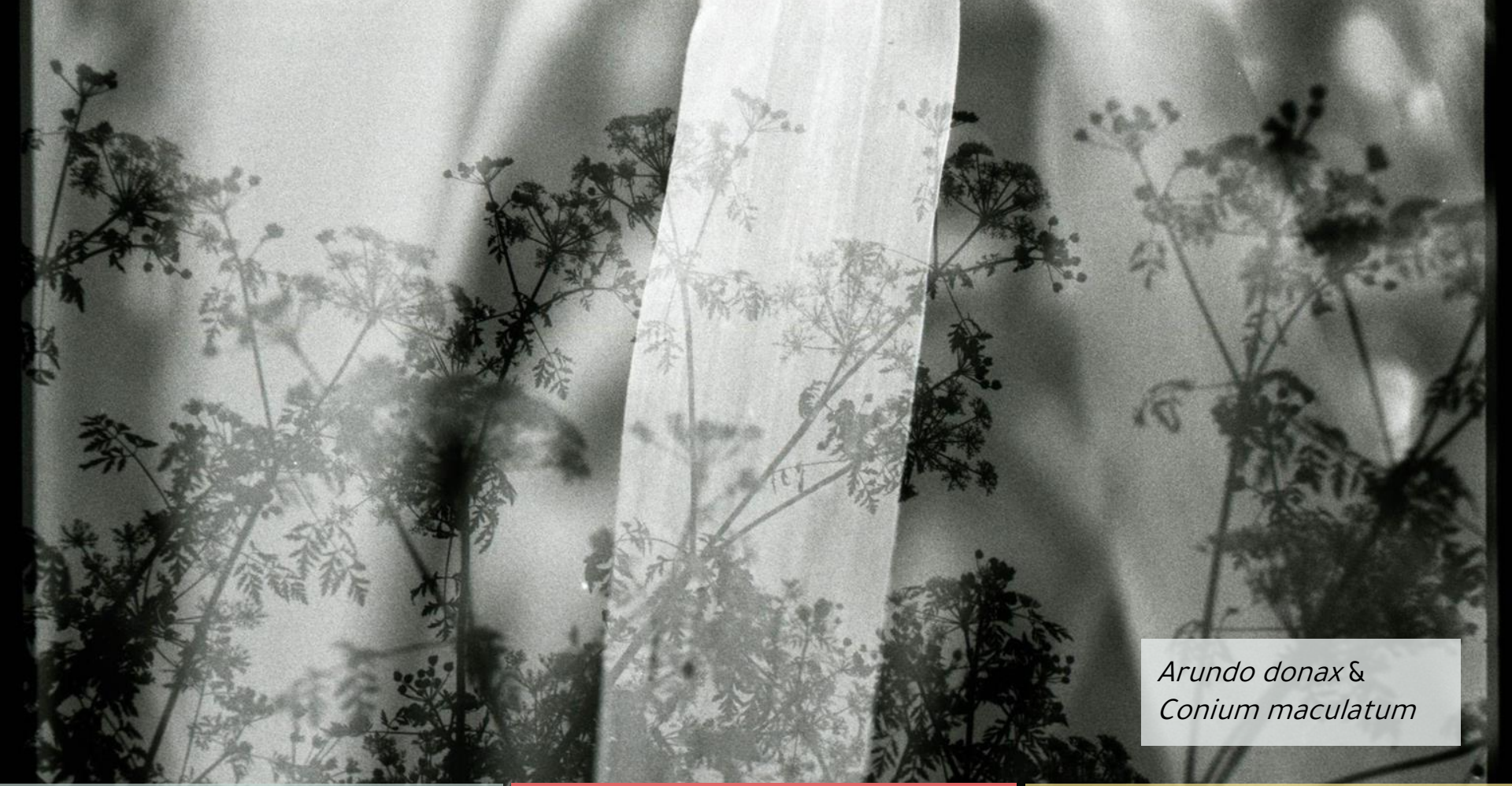
You have arrived at Polly's Pollinator Garden, protected by a low willow fence on the north...

East Pond- Cattail and Tule

Here at the COSA's East Pond you will notice many tall reeds growing around the perimet...

Indigenous perspectives have been obscured

Paakü (*Helianthus annuus*), *Lepidium latifolium*, *Rubus ursinus*, *non-native mustard*



Arundo donax &
Conium maculatum

Plant communities are complex and dynamic

Fish Slough

Indigo Bush (*Psorothamnus arborescens var. minutifolius*), **Sigupi** (*Chrysothamnus viscidiflorus*), paintbrush (*Castilleja sp)*

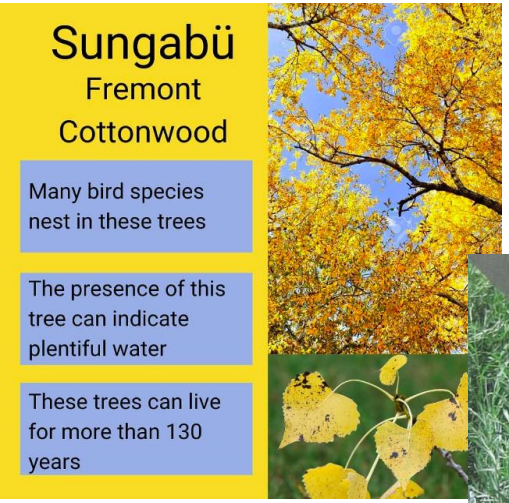
Plants and People

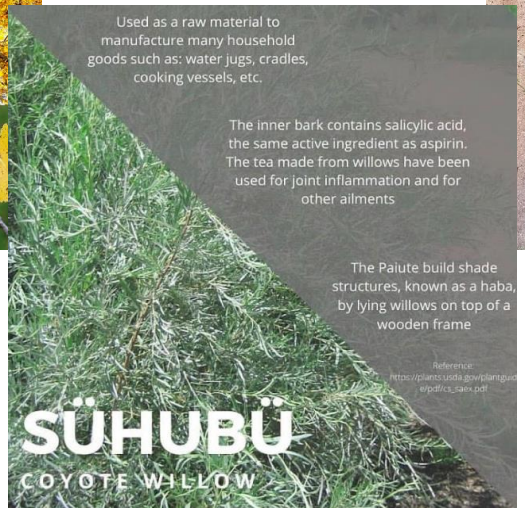
Fish Slough's botanical and faunal resources provided a real abundance for Native Americans. Food sources included wetland bulrush species (*Schoenoplectus* spp.) as well as desert scrub plant resources such as Indian ricegrass (*Stipa hymenoides*) and Great Basin wildrye (*Elymus cinereus*), which were harvested and transported in baskets woven from willow branches.

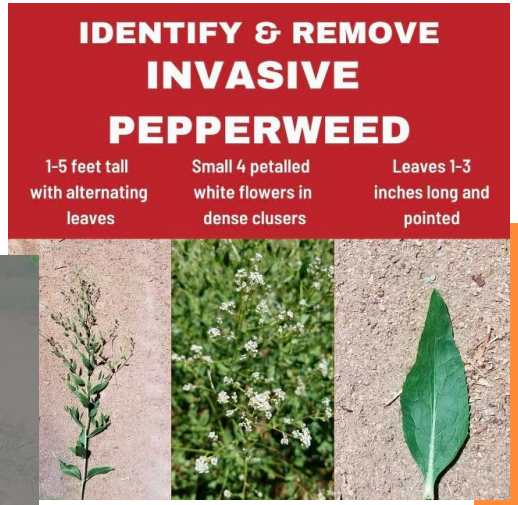
Plants, people, and photos

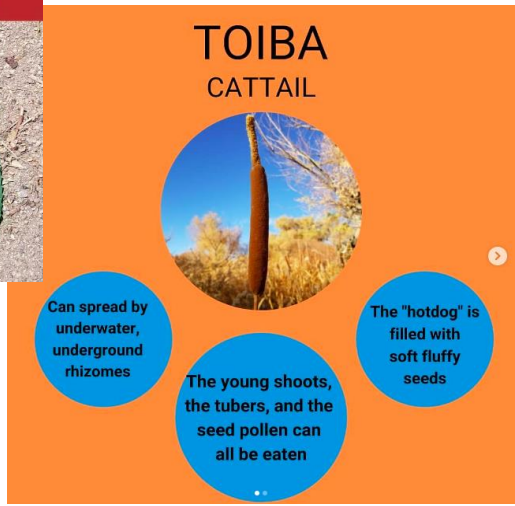
National Forest Service Wildflower Walk
Lower Bishop Creek, 5/20/23

5/20/23
unip (*Purshia tridentata*), *Coleogyne ramosissima*, *Grayia spinosa*)



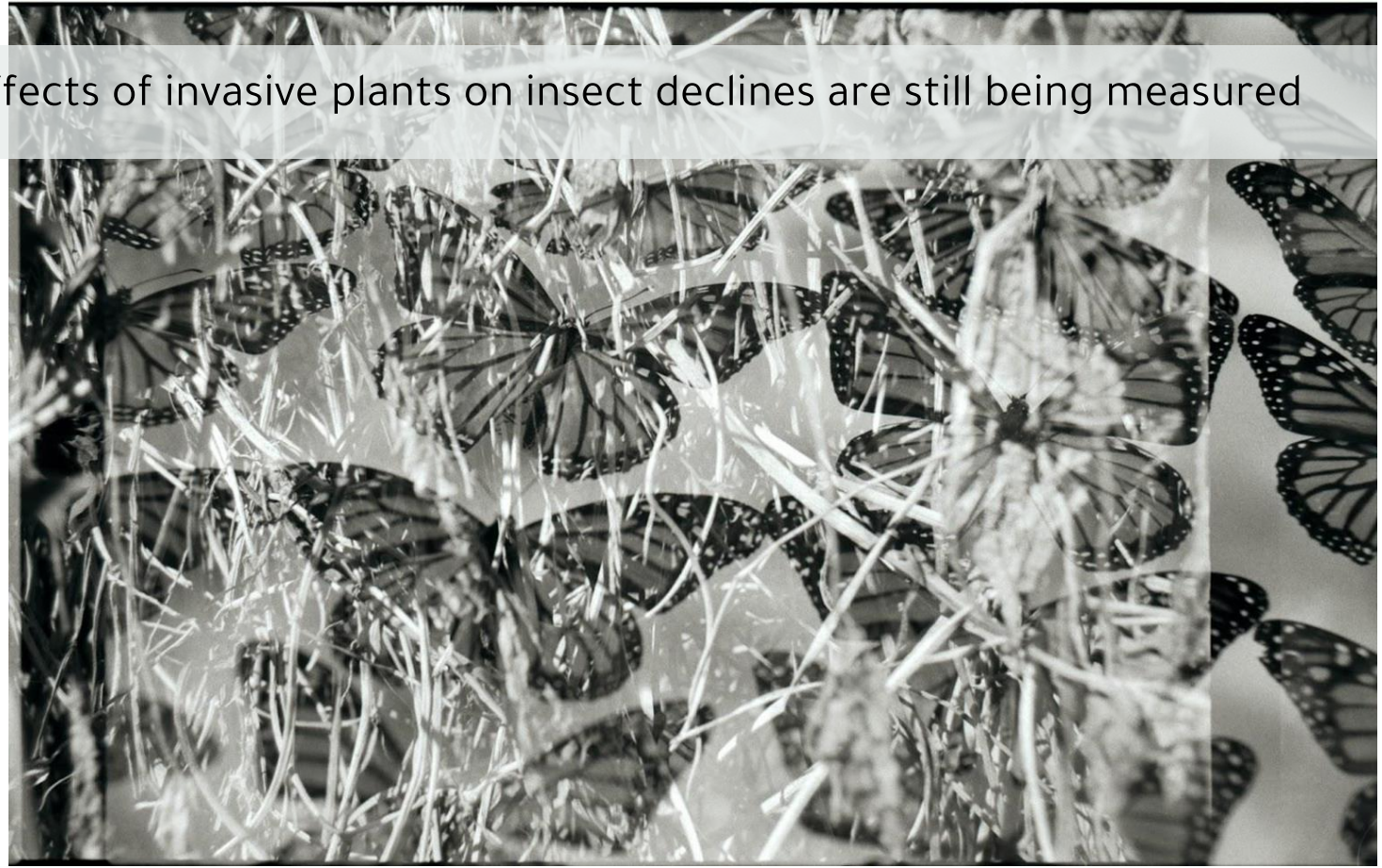






Source: @bpt_cosa (IG)

The effects of invasive plants on insect declines are still being measured



The effects of invasive plants on insect declines are still being measured

Conclusion

- Multiple exposures offer multiple ways of knowing

Conclusion

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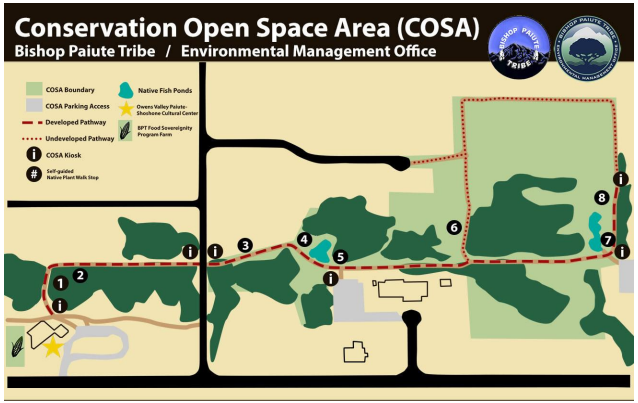
- An artistic lens is complementary to a scientific one

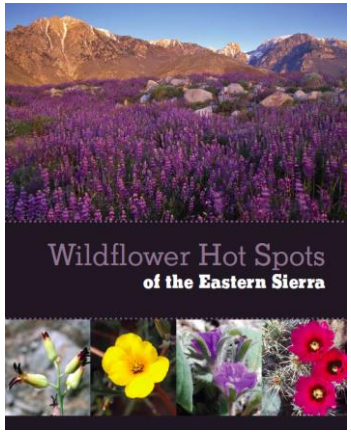
Conclusion

- Multiple exposures offer multiple ways of knowing
- An artistic lens is complementary to a scientific one
- Celebrating complexity can help us embrace the complex challenge of studying and managing invasive plants

(above) Greg Aragon, (below) Zoe Wood



Acknowledgements



Anne Halford,
Kathleen Nelson, Sue Weis

Blake Engelhardt
Katja Seltmann
Ken Yamazaki
Yang Lab members
Meineke Lab members

Bishop Paiute Tribe Conservation Open Space Area
Owens Valley Paiute-Shoshone Cultural Center
Eastern California Museum (Independence, CA)

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Research questions	Herbarium data	Hypotheses	Keywords	Citations
Invasive species				
Is invasive plant spread facilitated by genomic change?	plant DNA (allele frequencies); locality, date collected (time of introduction, spread)	New mutations or gene combinations enable invasive species to overcome dispersal barriers, perhaps via gene surfing on expanding population fronts.	"Invasive" or "Non-native" & "Genome" & "Adaptation" or "Genomic change"	12; Buswell et al. (2011), Vandepitte et al. (2014)
Have invasive plants demonstrated greater phenological advancement with climate warming than native species?	flowering; leaf-out	Greater phenological advancement of nonnative compared to native species facilitates invasions.	"Invasive" or "Non-native" & "Phenolog*" or "Flower*" or "Leaf-out" or "Fruit*" or "Seed*"	46; Calinger (2015)
What are the physical pathways of invasive plant spread?	plant, leaf miner DNA; locality, date collected (time of introduction, spread)	Natural pathways, such as waterways, were historically more important for invasive plant and insect species spread, but increasingly roads and railroads are key.	"Invasive" or "Non-native" & "Spread" or "Railroad" or "Road"	80; Barney (2006), Joly et al. (2011), Saltonstall (2002)
In novel habitats, does release from natural enemies promote invasive plant spread?	herbivory; insects and their damage that can be assigned species identity, e.g., leaf mines, galls; pathogen lesions, DNA, RNA; plant defensive compounds	One mechanism by which species become invasive is escape from co-evolved natural enemies. (Enemy Release Hypothesis).	"Invasive" or "Non-native" & "Natural enem*" or "Natural enemy release"	2; Zangerl and Berenbaum (2005)
What roles do plant diseases play in invasions?	pathogen lesions, DNA, RNA; locality, date collected (time of introduction, spread)	Diseases carried by nonnative plants can facilitate their invasions via apparent competition.	"Invasive" or Non-native" & "Pathogen" or "Disease"	8; Malmstrom et al. (2007)
Does exotic plant relatedness to natives determine invasiveness?	herbivory; insects and their damage that can be assigned species identity, e.g., leaf mines, galls (time of introduction, spread, host shifts); plant defensive compounds; locality, date collected (time of introduction, spread)	Exotic insect herbivores and pathogens are more likely to establish on novel host plants closely related to their co-evolved host plants. Exotic plant/pathogen/herbivore relatedness to native plants reduces the probability that they become invasive. (Darwin's Naturalization Hypothesis).	"Invasive" or "Non-native" & "Naturalization Hypothesis"	0; though this search returns no references, see Park and Potter (2013) and Schaefer et al. (2011)

Meineke et al. 2018

Journal of Biogeography

The historical spread of *Ambrosia artemisiifolia* L. in France from herbarium records

Bruno Chauvel, Fabrice Dessaint, Catherine Cardinal-Legrand, François Bretagnolle

First published: 28 March 2006 | https://doi.org/10.1111/j.1365-2699.2005.

Weed invasion in East Africa: insights from herbarium records

J. STADLER[1*], G. MUNGAI[2] and R. BRANDL[1,3]

[1]*Centre for Environmental Research Leipzig-Halle Ltd, Department of Community Ecology, Hallesche Str. 44, D-06246 Bad Lauchstädt, Germany,* [2]*National Museums of Kenya, East African Herbarium, Nairobi,* [3]*Centre for Environmental Research Leipzig-Halle Ltd, Department of Ecological Modelling, Permoserstr. 15, D-04318 Leipzig, Germany*

Original Paper | Published: 13 September 2012

A new comprehensive database of alien plant species in Chile based on herbarium records

Nicol Fuentes, Aníbal Pauchard, Paulina Sánchez, Jocelyn Esquivel & Alicia Marticorena

Biological Invasions **15**, 847–858 (2013) | Cite this article

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Can Herbarium Records Be Used to Map Alien Species Invasion and Native Species Expansion over the past 100 Years?

Author(s): Priscilla H. C. Crawford, Bruce W. Hoagland and Jon Sadler

Source: *Journal of Biogeography*, Apr., 2009, Vol. 36, No. 4 (Apr., 2009), pp. 651-661

Published by: Wiley

Stable URL: https://www.jstor.org/stable/20488396

Journal of Biogeography

Reconstructing the spread of invasive plants: taking into account biases associated with herbarium specimens

Fanny Delisle, Claude Lavoie, Martin Jean, Daniel Lachance

First published: 24 June 2003 | https://doi.org/10.1046/j.1365-2699.2003.00897.x | Citations: 150