California Ecosystem Management Database

Understanding the interactive effects of environment and management on multiple ecosystem services in California's grasslands, oak woodlands and their riparian areas

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UC CE | University of California Agriculture and Natural Resources | Cooperative Extension

Project team:

Funded by:

- UC ANR
- Western SARE

Database development:

- UC ANR IGIS (special thanks to Shane Feirer, Robert Johnson)
- UC ANR CSIT (Steve Edberg, Steve Krause, David Krause)

Project guidance:

Adina Merenlender

Collaborating organizations:

- California Climate and Agriculture Network
- California Farm Bureau
- California Invasive Plant Council
- California Native Grassland Association
- California Rangeland Conservation Coalition
- Center for Natural Lands Management
- Putah Creek Riparian Reserve
- Solano RCD

Collaborators: Project Design

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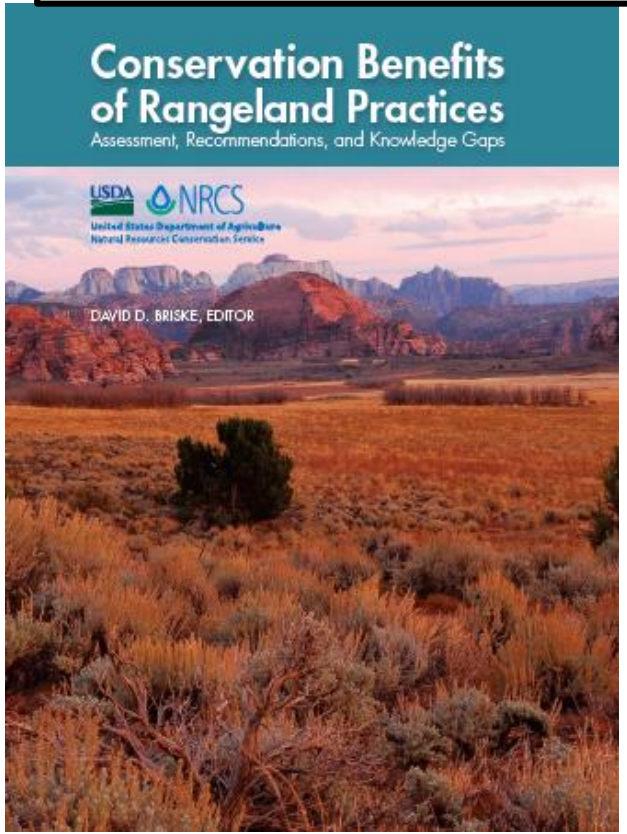
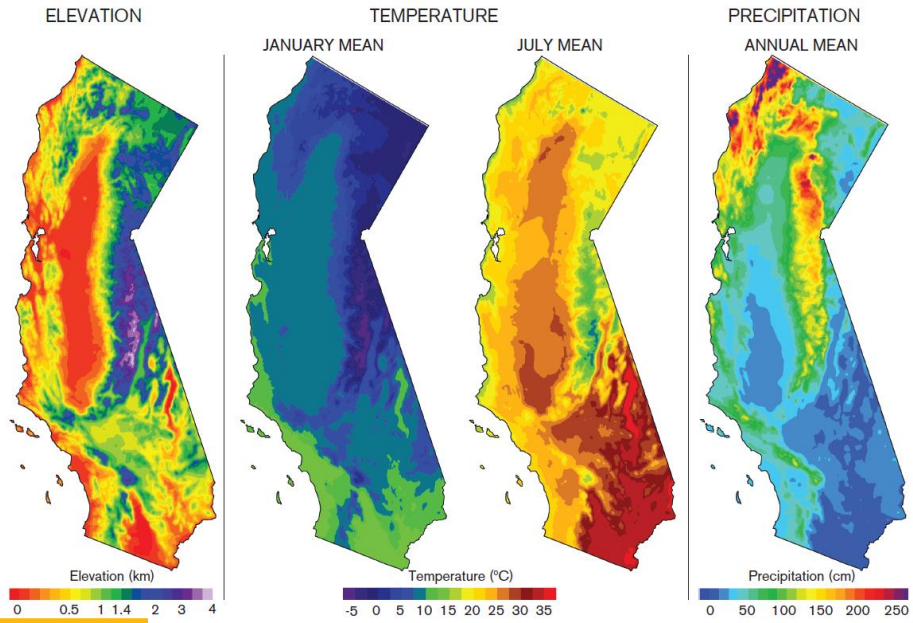
Our current scientific understanding falls short of addressing key management and policy needs:



2011 NRCS report: While management practices are based on sound ecological principles:

- **Don't know how effective many management practices are**
  - **Lack of monitoring data- especially at scales most relevant to management (e.g. pasture/watershed scale in 5-10 year time periods)**
- **Where do have data (mostly weed management): 80% of conservation management projects fail to accomplish goals**
- **Generalized management recommendations have limited effectiveness – recommendations need to be site-specific**

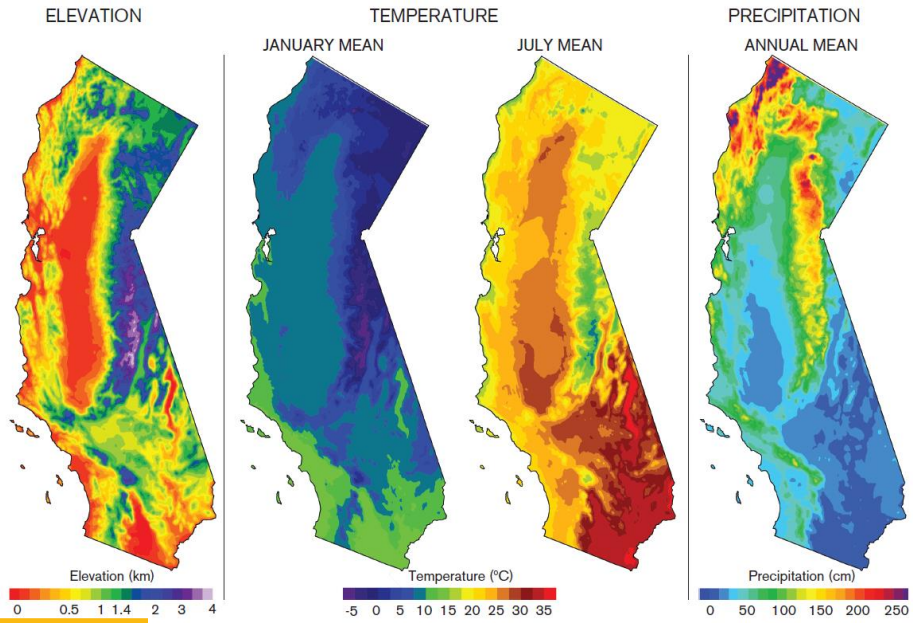
http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1045792.pdf



Iacobellis et al. 2016

Site-specific approach is particularly important in California

- Diverse climate conditions, soils, topography, management history



Iacobellis et al. 2016

Site-specific approach is particularly important in California

- Diverse climate conditions, soils, topography, management history

- Need to understand how sites vary in:
  - Baseline provisioning of ecosystem services
  - Which ecosystem services are sensitive to management
  - Best management approaches to obtain a given goal
  - Suites of services and tradeoffs across multiple goals
  - Year to year variation in goals

http://ucanr.edu/sites/RestorationEcology/

Focus on California's grasslands, oak woodlands, and the riparian areas within them

Multiple management goals:

- Plant production and quality
- Vegetation composition (native species, control of noxious weeds)
- Soil fertility
- Soil carbon storage
- Soil water infiltration and storage
- Water quality
- Soil erosion control
- Soil compaction
- Wildlife habitat

A. Diverse stakeholder groups:
Provide: Thousands of short-term to long-term management trials: (a) across environmental conditions and (b) with diverse sets of goals

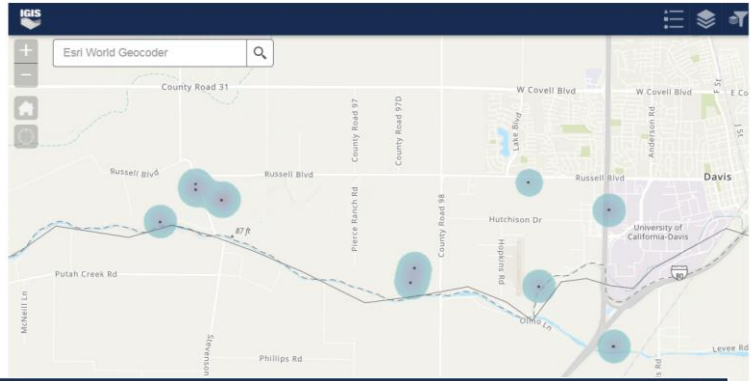
B. UC ANR professionals:
Provide: Quantitative research on multiple ecosystem services across decades, and across the diverse environmental conditions.

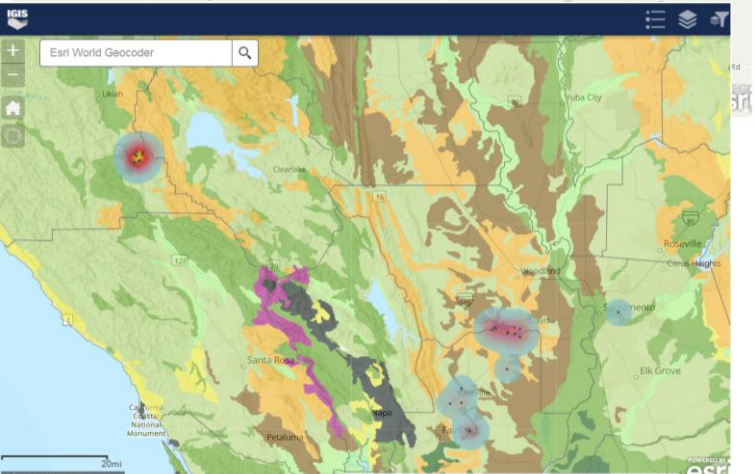
C. Development of ***web-based searchable database*** which links with GIS model to provide site-specific information on soil, topography, climate, vegetation type, land use, etc.

Multiple platforms to search for case studies:

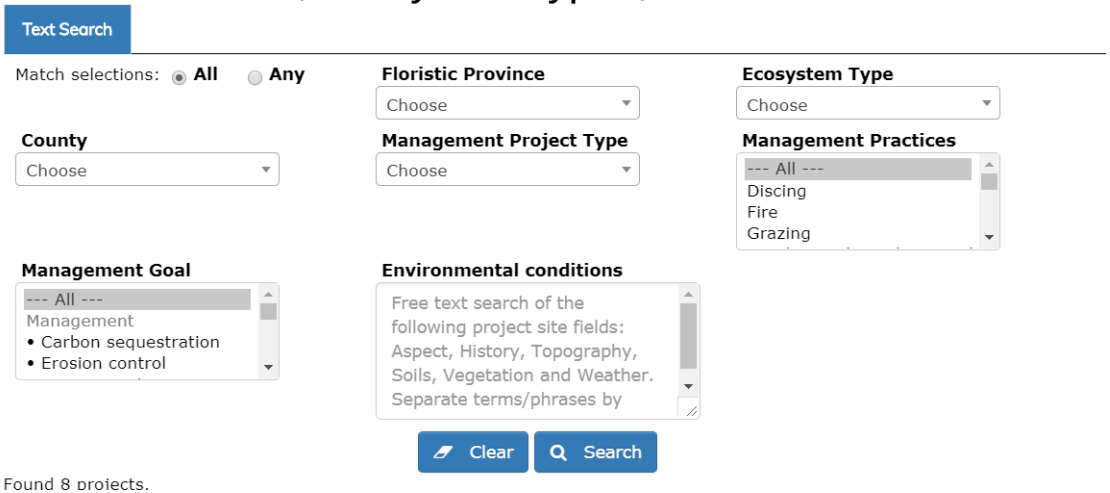
Click on sites on the map (by location or GIS layers such as soil, vegetation type):

http://ucanr.edu/sites/RestorationEcology/





Search by goals, practice, environmental conditions, ecosystem types, etc.



Management practices	Geographical distribution	# Years of sampling	# plots
Grazing practices (variations in seasonality, intensity, duration, type of livestock)	Spanning S to N (Santa Clara to Shasta County), from coast (Sonoma, Mendocino, Alameda, Contra Costa) to valley (Yolo, Solano, Sacramento) to foothills (Yuba, Nevada, Butte, Placer, El Dorado)	Single sampling to 5 years	803
Mowing/clipping/ RDM	Coastal to valley to foothills	Single sampling to 4 years	876
Fire impacts	Alameda, Sacramento, Lake	Single years	92
Invasive species control	Coastal to valley to foothills	Single sampling to 4 years	618
Fertilization, compost, ash additions	Coastal to valley to foothills	Single sampling to 4 years	516
Irrigation/ precipitation manipulations	Coastal (Mendocino) to valley (Yolo) to foothills (Yuba)	Single sampling to 4 years	560
Planting practices (rangeland seeding, restoration seeding)	Coastal to valley to foothills		648
Effects of native restoration into exotic sites	Coastal to valley to foothills		564

A. Stakeholder management trials

B. UC research trials

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D. Stakeholders and UC personnel input data into database

F. ***Meta-analysis and Synthesis***

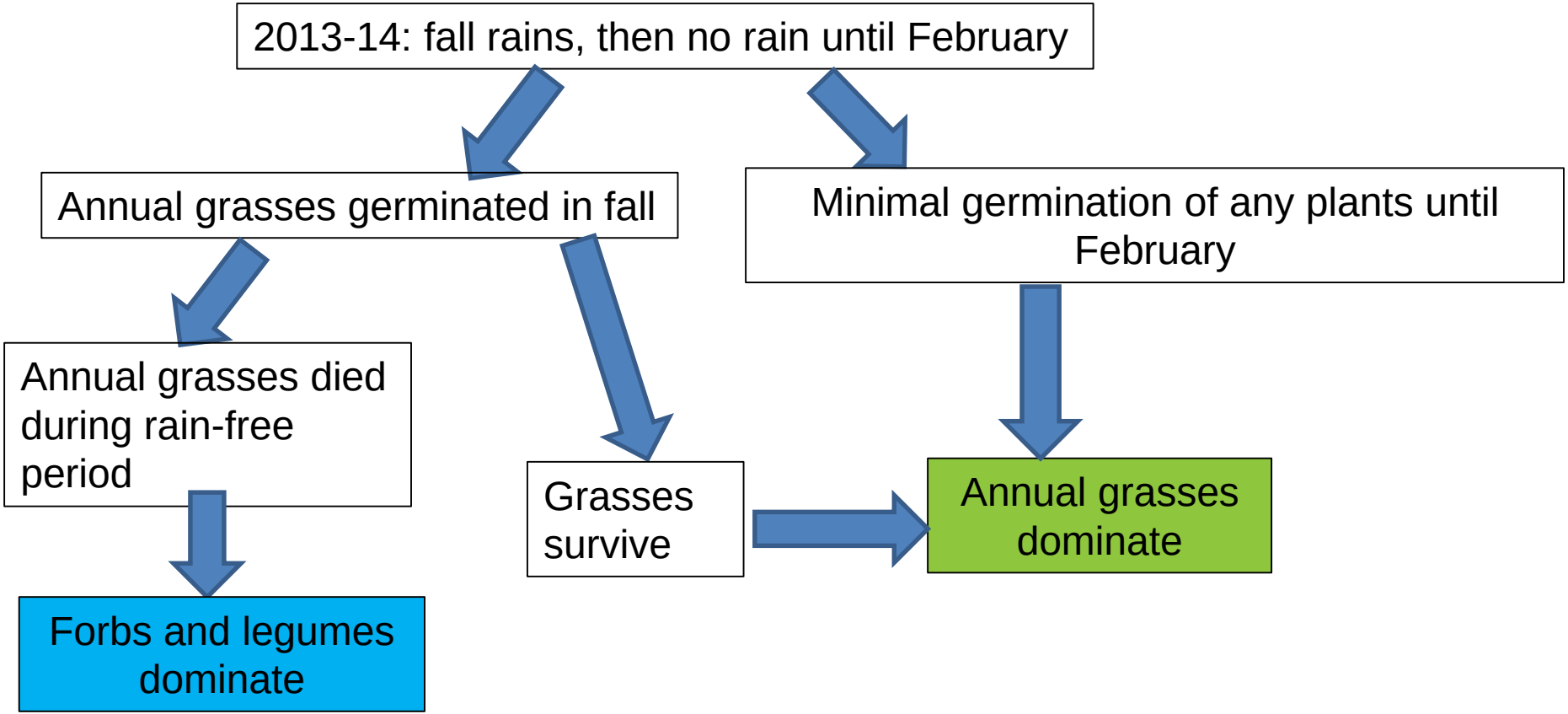
- Impacts of site conditions
- Impacts of climate variability
- Impacts of management
- How these interact

Drought effects on vegetation (2012-16):

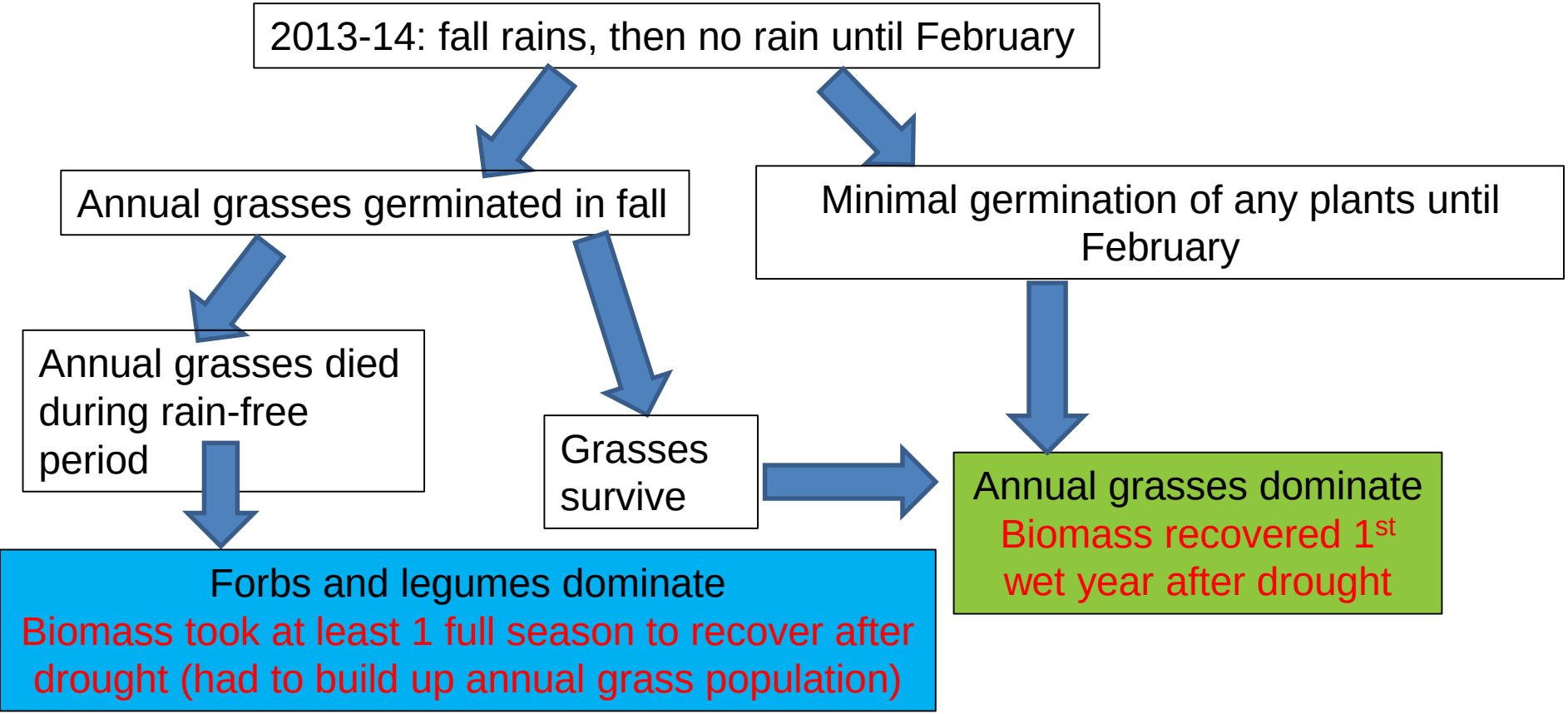
Assessing 80 sites from Northern California, including coastal, foothill, and valley sites:

- Plant composition:

Drought effects on plant composition was strongly affected by 2013-14 rainfall distribution



Plant community responses to drought influenced speed of recovery of biomass post-drought

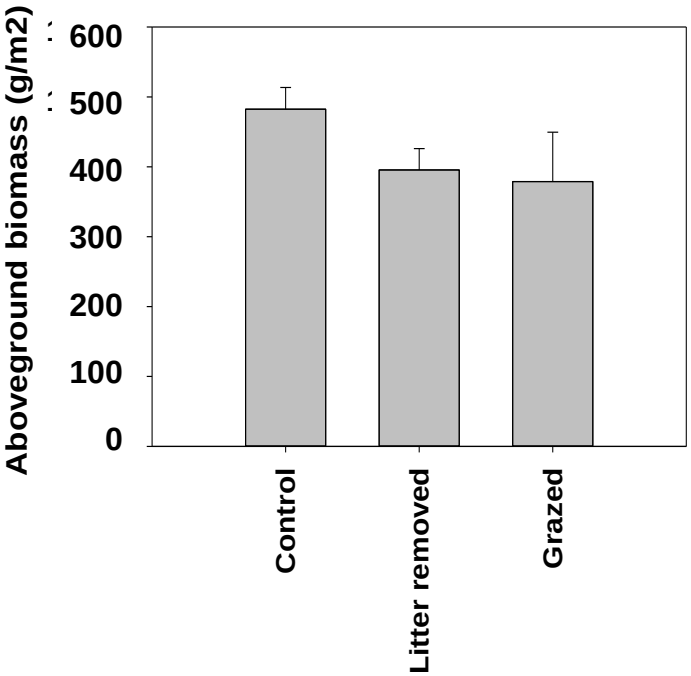


Drought increases standing litter, which enhances plant biomass:

Standing litter: Standing dead biomass doubled during the drought because decomposition was suppressed.

Impacts of litter on green biomass accumulation:

- During drought conditions, the presence of thatch increased aboveground biomass production by 22%.
- Thatch removal by clipping and grazing had the same magnitude of effect (but the effect of grazing was more variable)



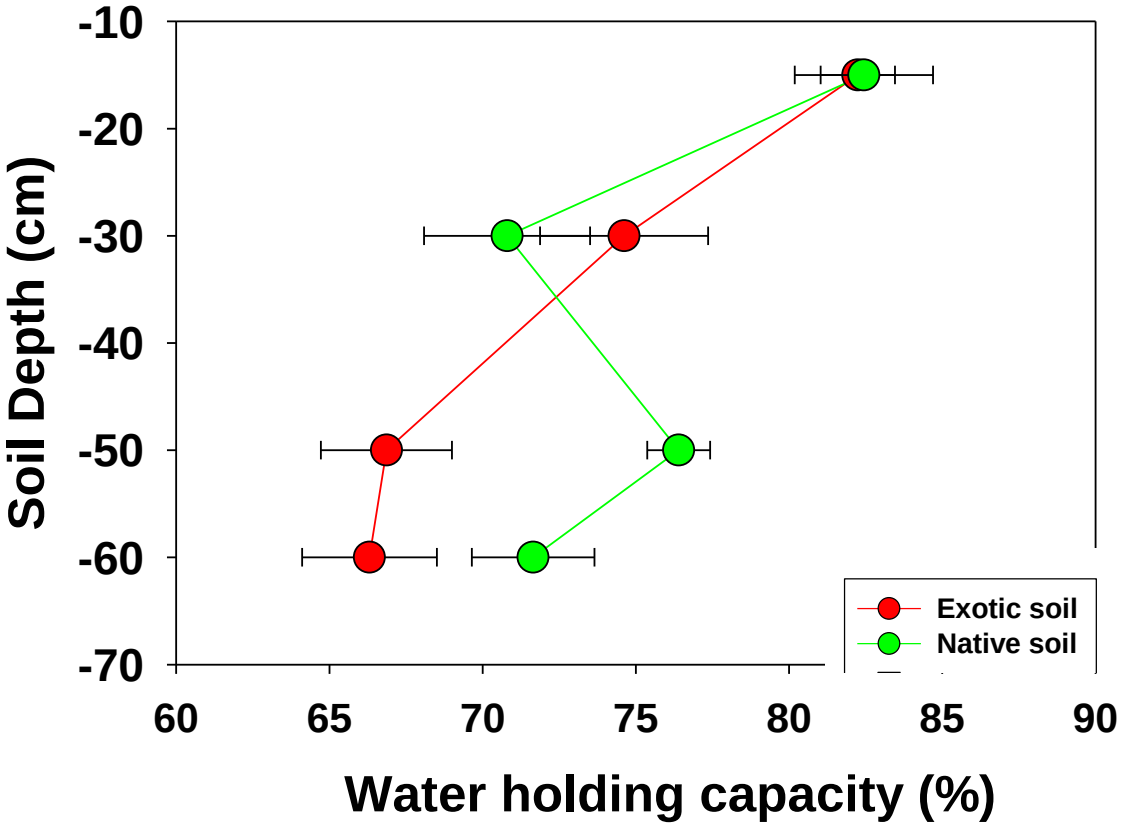
Native perennial grass restoration increases annual grass resilience to drought

Even a low cover of native perennial grasses (15-20% cover)

→Higher deep roots

→Higher deep soil C

→Higher deep soil water holding capacity



Native perennial grass restoration increases annual grass resilience to drought

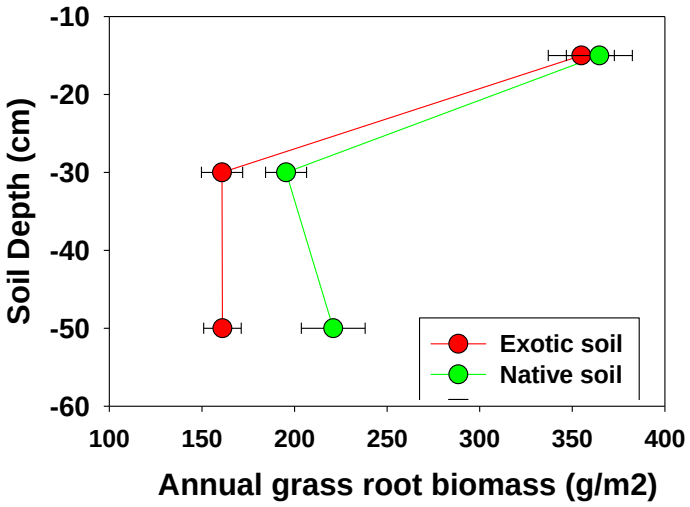
Natives increase deep-soil water holding capacity

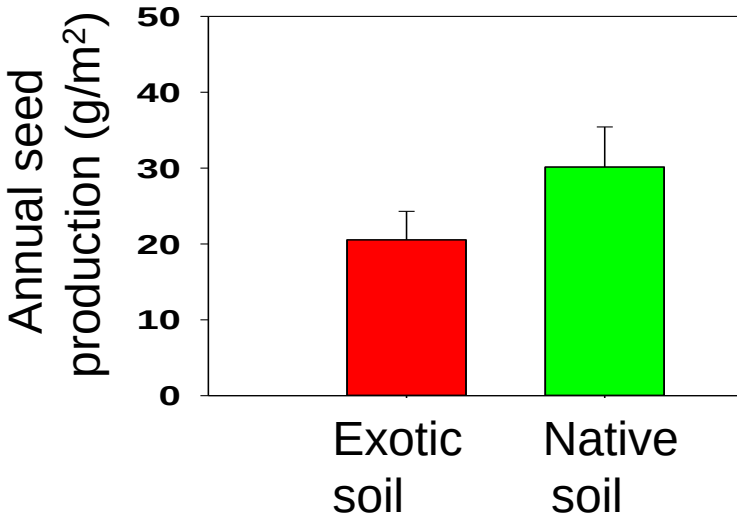
→Increases rooting depth of annual grasses

→Annuals stay greener into the dry season (2 weeks)

→Increase seed production

→Increase rate of recovery post-drought





Ecosystem services provided by native grass restoration varied across sites

Across regions:

Ecosystem service	**Central Valley**	**North coast**
Soil carbon	Increased deep soil C	Increased deep soil C

Ecosystem services provided by native grass restoration varied across sites

Across regions:

Ecosystem service	**Central Valley**	**North coast**
Soil carbon	Increased deep soil C	Increased deep soil C
Nitrogen supply	Increased	Decreased
Erosion control	Decreased	No change
Alleviation of soil compaction	Decreased	No change

Local variation: Despite some consistent regional trends, at local scales, effects of restoration varied

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Next steps- short-term

- In next 2 weeks- finalize data input protocols
- Increase case studies in database
  - Recruit collaborations
  - Seek funding for targeted questions (e.g. invasive species control, soil C sequestration)
- Data analysis and synthesis (rolling basis based on case studies available)
- Outreach and training to encourage stakeholder use of the database, and contributions of management trials to database
- Version 2.0 of database
  - Improve database functionality
  - Funding to facilitate participation
  - Funding to fill in holes in data
- Version 2 of Measuring Ecosystem Services Handbook

Monitoring Handbook:

Encourage standardized methods for data collection to enhance strength of future analyses

Tools and approaches for measuring ecosystem services in California's grasslands and oak woodlands.

Version 1. November 2017.

http://ucanr.edu/sites/RestorationEcology/Handbook-_Measuring_Ecosystem_Services/

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G. PRODUCTS

- ***Decision support tool***: site-specific management recommendations for multiple services
- ***Maps*** detailing sites more/less likely to provide each ecosystem service
- ***Maps*** detailing zones with different best management practices
- Factsheets on each ecosystem service: importance, management options, distribution maps
- Talks and field days (organized by UC and our stakeholder partners)

Interested in collaborating or in using the database?

- Contact info:
  - Valerie Eviner veviner@ucdavis.edu
  - 530-752-8538
- Database web platform: http://ucanr.edu/sites/RestorationEcology/

Terms of database use (abridged)

- Access to data- personal account, agreement to follow data use policies
- If data contributor's/author's data makes up at least 8% of dataset, must be invited as co-author
- If data contributor's/author's data makes up 40% of more of the dataset, must get their permission to use data (be sure they are not working on the same compilation)
- Region-specific data- must check with local farm advisors to be sure they are not analyzing that data in the same way
- When data from database comprises more than 60% of a dataset, must contact database PI to ensure similar efforts aren't in progress
- Use of data for a specific requested activity does not imply approval for other analyses
- Database must be acknowledged in products that result from it