

# Assisted Natural Regeneration for Semi-arid and Arid Lands

David A. Bainbridge  
Restoration Ecologist  
San Diego, California



# The challenge: degraded dry lands

They look tough - but are very fragile



Chihuahua, Mexico



# Understand the History

Why? How? When? Now?

- To guide regeneration we need to understand the causal chain
- What economic and cultural factors led to damage?
  - Family, community, nation,
  - Global politics and economics
- How can these be mitigated with policy or education?
- ADDED CHALLENGES - climate change—heat, drought, severe storms



Historical Overgrazing, California

# Resource Limitations

- The arid and semi-arid lands rarely have access to funding for intensive restoration work
- Treatment options are limited
- What can people do with local resources, labor and commitment?



Peru



# The key—Focus

- Traditionally much restoration has looked at historic structure - species, plants, etc.
- And planted nursery grown plants at great cost
- For assisted natural regeneration consider ecosystem function, particularly water flow on, over and through the site
- *Also — changes in soil properties*



Infiltrrometer training SER class  
Red Rock Canyon State Park



# Every drop counts



Hand pitting with straw wattle  
Hungry Valley, California



Zai pits Western Sahel



Imprinting Mojave Desert



# Kimseed Camel Pitter

- Effective
- Relatively low cost - pull with 4x4
- Add native seeds



# Flow capture

- Water flows in low points, small gullies and stream beds can be captured with simple check dams and brush weirs
- Larger flood flows may be spread over fields using brush weirs, with field edges protected by pole planted Populus and Salix trees



Rio Bavispe, Sonora Mexico



# Rainwater catchment

## Membrane and tank

- More costly
- Able to capture rainfall even less than 1 mm
- Provided critical irrigation water at this remote desert site



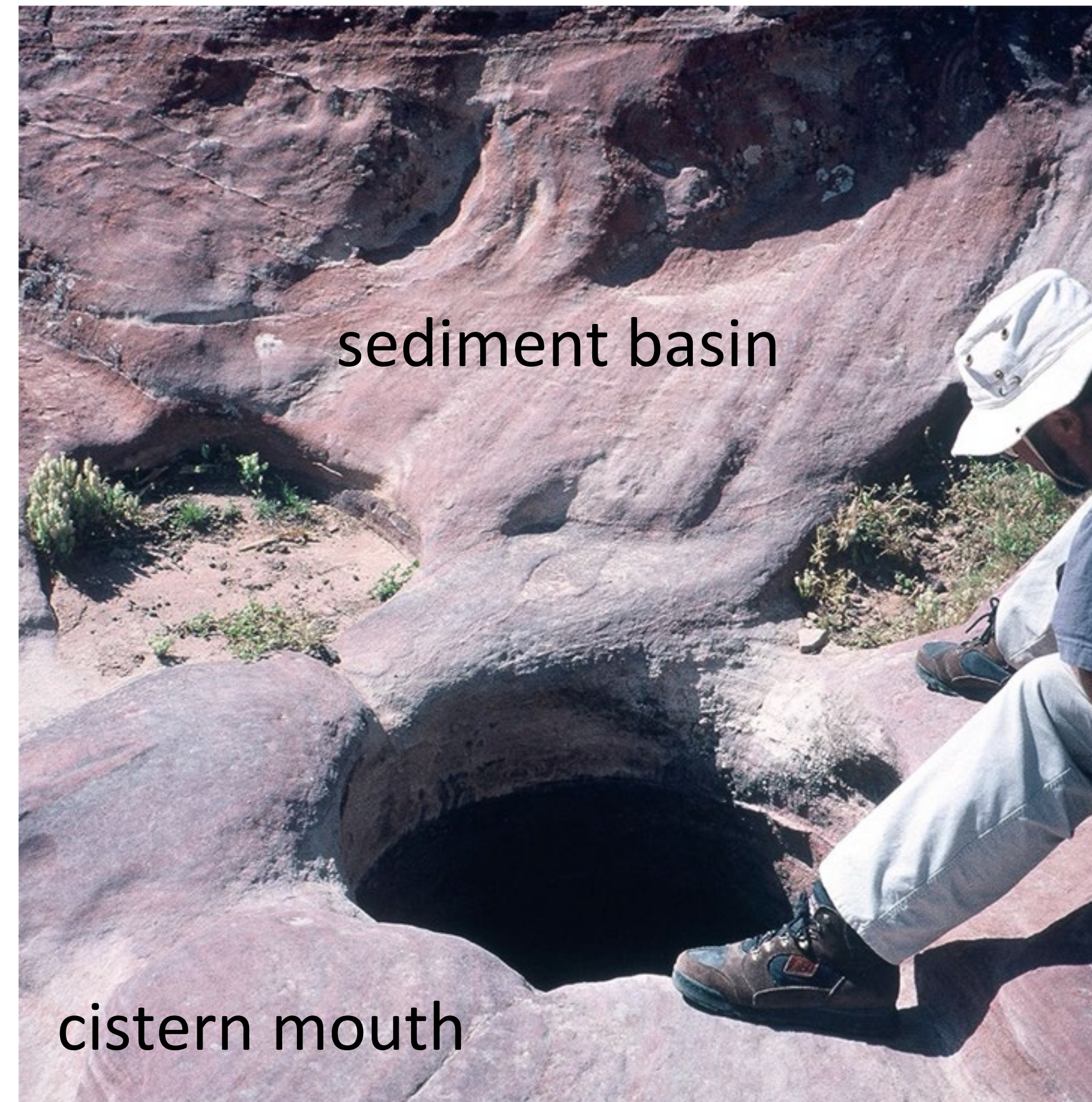
California Anza Borrego Desert State Park



# Rain Water Harvesting

## Nabatea

- No one has been better at capturing water
- This cistern is carved in sandstone
- Small channels collect rain
- Little basins catch sediment before going into cistern
- Worth study and a visit - Petra, Jordan

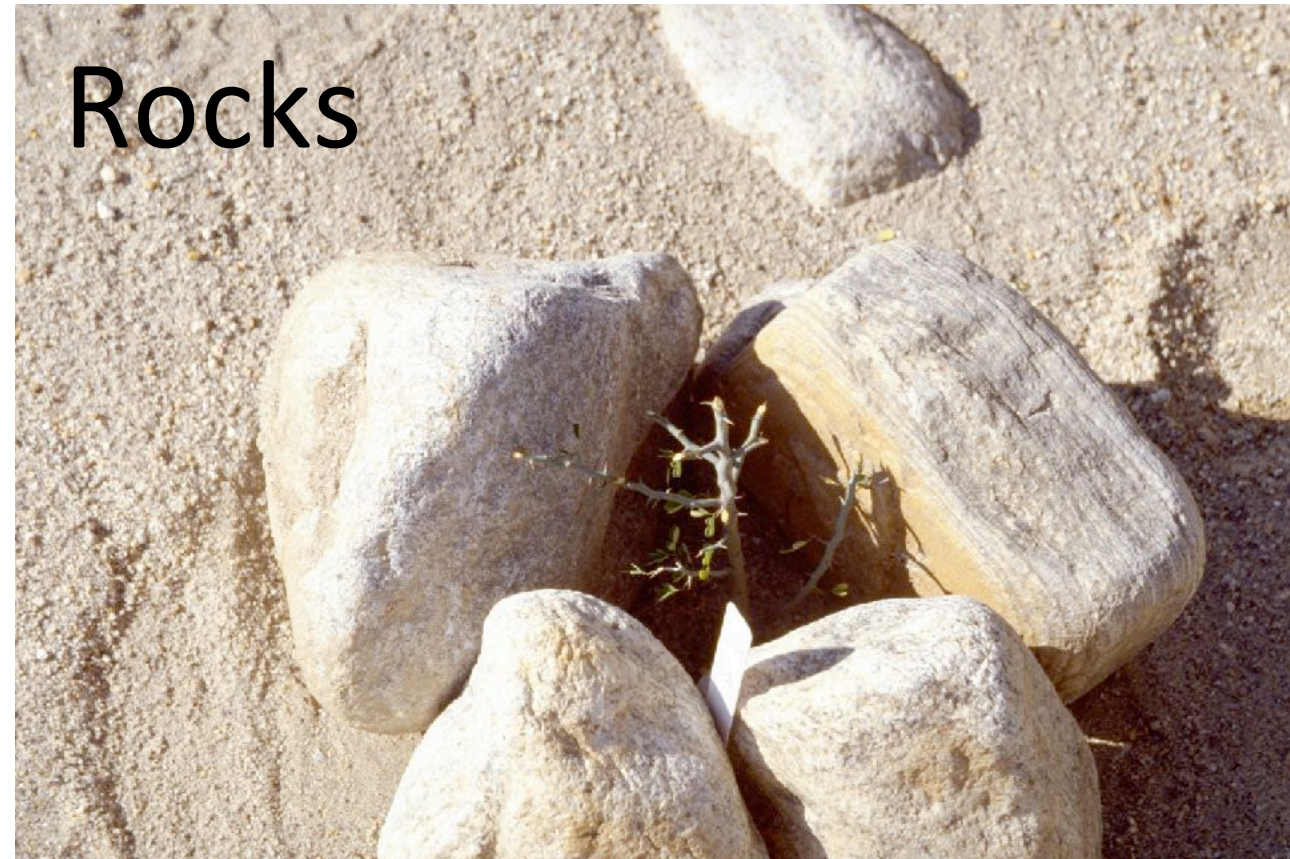




# Protect seedlings

- Native seedlings may be found after ecologically significant rain falls or flooding occurs
- Protecting these natural seedlings is a low cost best bet
- This can be done with thorny branches, rocks, wire cages or tree shelters
- Rocks also protect plants from sand blast and extreme temps

Rocks



Cages



Branches for tree protection, Portugal



# Seed collection

Make use of locally adapted plants

- Collect, stored, and respread just before or as rains fall
- Seeds and perhaps some plants can be used to create resource islands
- These can create a local seed source
- Protection using thorny branches
- Possible - supplemental irrigation

rabbit  
fence



Resource island



# Seeds

Collect and store properly

- Choose mature, fully ripe seeds
- Collect, clean
- Store under the best possible conditions (this is not a paper bag under your desk)
- Understand seed dormancy, treat seeds as needed

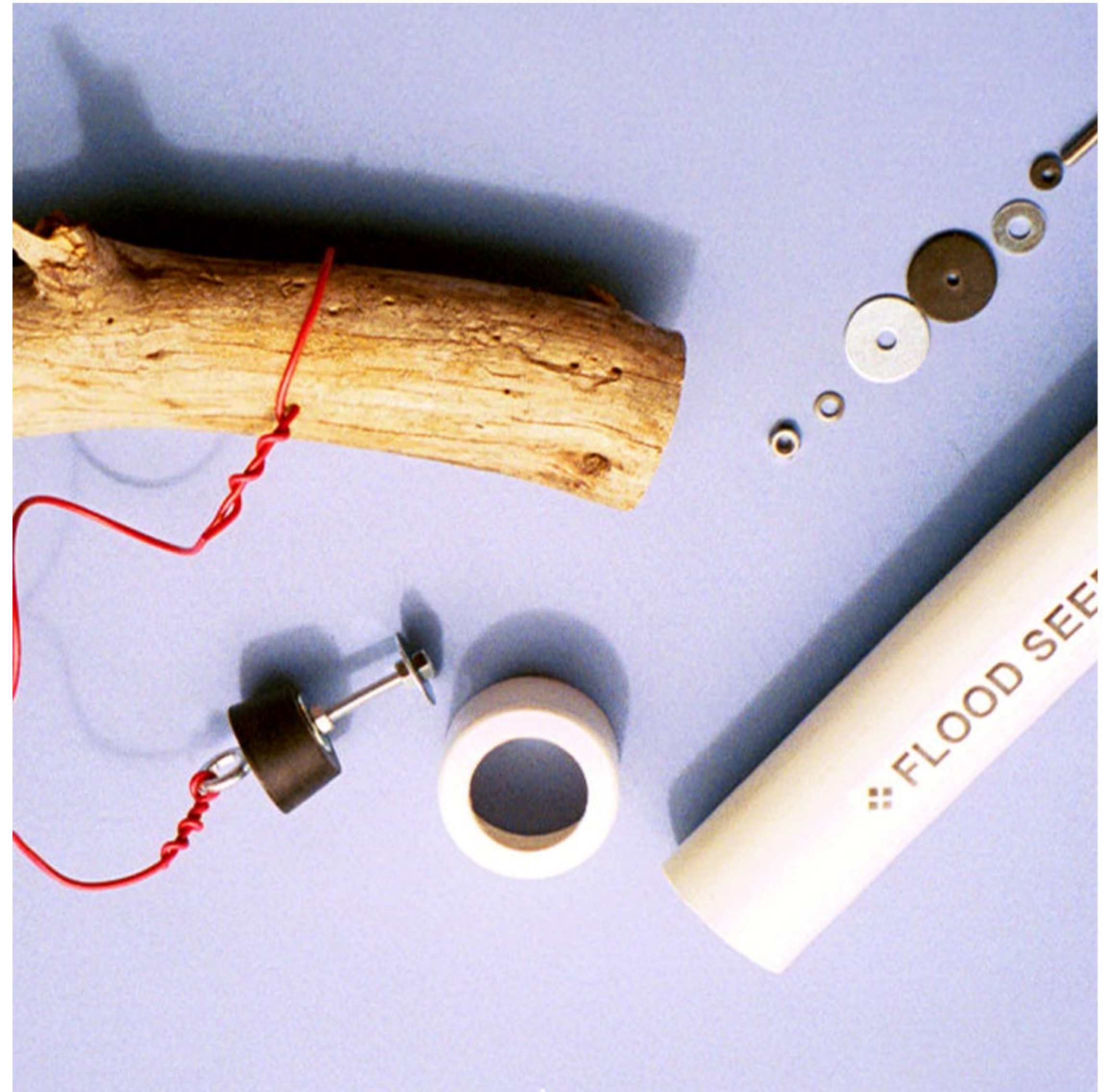


Castle Mountain Mine Project



# Flood seeding

- A flood seeder can be made that will release seeds during a flood event
- The branch is caught in the flood and pulls the cork out of a seed filled pipe positioned over the flood channel
- This releases seeds at the most advantageous time





# Irrigation

Rain?

- Arid areas may get a significant rainfall only every two or three years
- Supplemental irrigation of just a few gallons a year can keep seedlings alive until it rains again
- Super-efficient irrigation can be used - deep pipe, wicks, ollas



Deep pipe



# Seed into basins

Rain water plus seeds

- Carefully spread and lightly cover seed
- If possible - put out several species before most likely rainfall
- If possible add mulch
- If possible add some organic matter to basin soil
- Be prepared to protect seedling

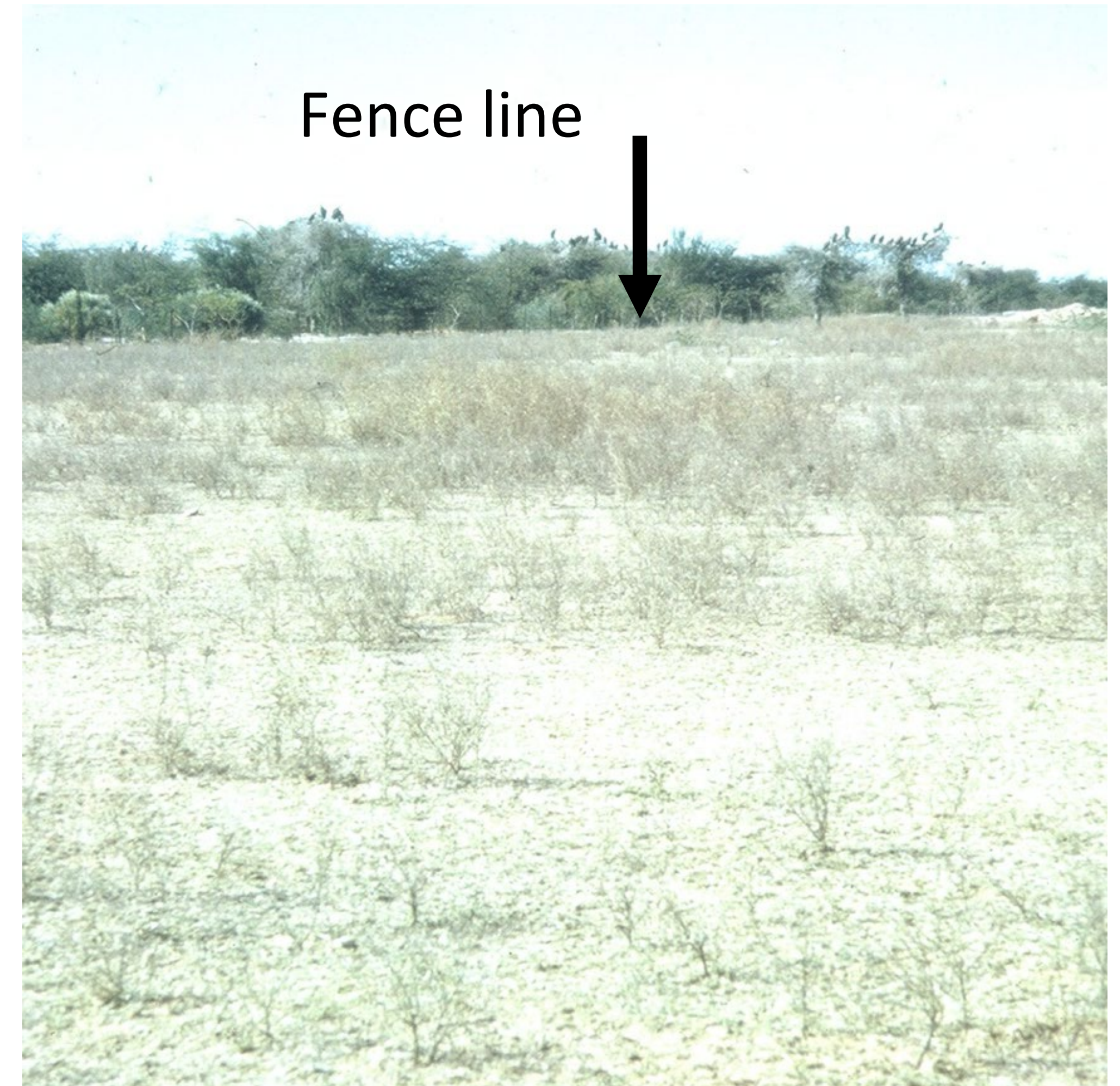


Anza Borrego Desert State Park



# Grazing exclusion

- The trees in the distance grew by themselves once a fence was erected
- The planned research center was never built but the fence was maintained
- Overgrazing outside the fence
- Firewood removal eliminated trees, roots, and shrubs
- Inside lush grasses, shrubs and trees



India



# Grazing management

Challenging but possible

- Grazing management is difficult but can be critical
- Rotational grazing
- Mixed species grazing
- Protection of riparian areas
- Protection of selected plots to explore impacts from grazing
- Stall feeding instead of field grazing



Osmanabadi Goats, Karnataka

Ten goats in each cohort

	<u>Stall feeding</u>	<u>Grazing</u>
Net profit	\$464	\$368



# Putting people to work

- Arid and semi-arid lands have limited financial resources
- Limited natural resources
- But they do have capable and hardworking people who want the best for their families and children
- With appropriate support for assisted regeneration they can improve their income and quality of life



Water harvesting competition



# Assisted regeneration

It can be effective

- Capture water
- Protect seedlings
- Collect and place seeds
- Plant seeds in basins with amendments
- Manage grazing
- Improve home gardens



Pit,  
seed,  
mulch  
1995



1998

Hungry Valley, California



# Resources

- David A. Bainbridge. 2007. A Guide for Desert and Dryland Restoration; 2015. Gardening with Less Water; 2012. Restoration of arid and semi-arid lands. Chapter 10, pp. 103-114. In: van Andel, J. and Aronson, J. (eds), Restoration Ecology: The New Frontier, 2nd edition, Blackwell Publishing Ltd, Oxford UK; 2020. Carbon sequestration with Mesquite (*Prosopis* spp.) in an agroforestry setting. Temperate Agroforester 26(4):1-3. Bulletins [http://works.bepress.com/david\\_a\\_bainbridge](http://works.bepress.com/david_a_bainbridge)
- Chomba S., F. Sinclair, P. Savadogo, M. Bourne and M. Lohbeck. 2020. Opportunities and constraints for using farmer managed natural regeneration for land restoration in Sub-Saharan Africa. Frontiers in Forests and Global Change. 3:1-15. Article 571679
- Bayala, J., J. Sanou, H. R. Bazié, R. Coe, A. Kalinganire and F. L. Sinclair. 2019. Regenerated trees in farmers' fields increase soil carbon across the Sahel. Agroforestry Systems. 94: 401–415.
- Tschakert, P. 2007. Environmental services and poverty reduction: Options for smallholders in the Sahel. Agricultural Systems. 94(1): 75-86.



# GARDENING WITH LESS WATER



Bainbridge

A Guide for Desert and Dryland Restoration



SOCIETY FOR ECOLOGICAL RESTORATION INTERNATIONAL



## A Guide for Desert and Dryland Restoration

*New Hope for Arid Lands*

David A. Bainbridge