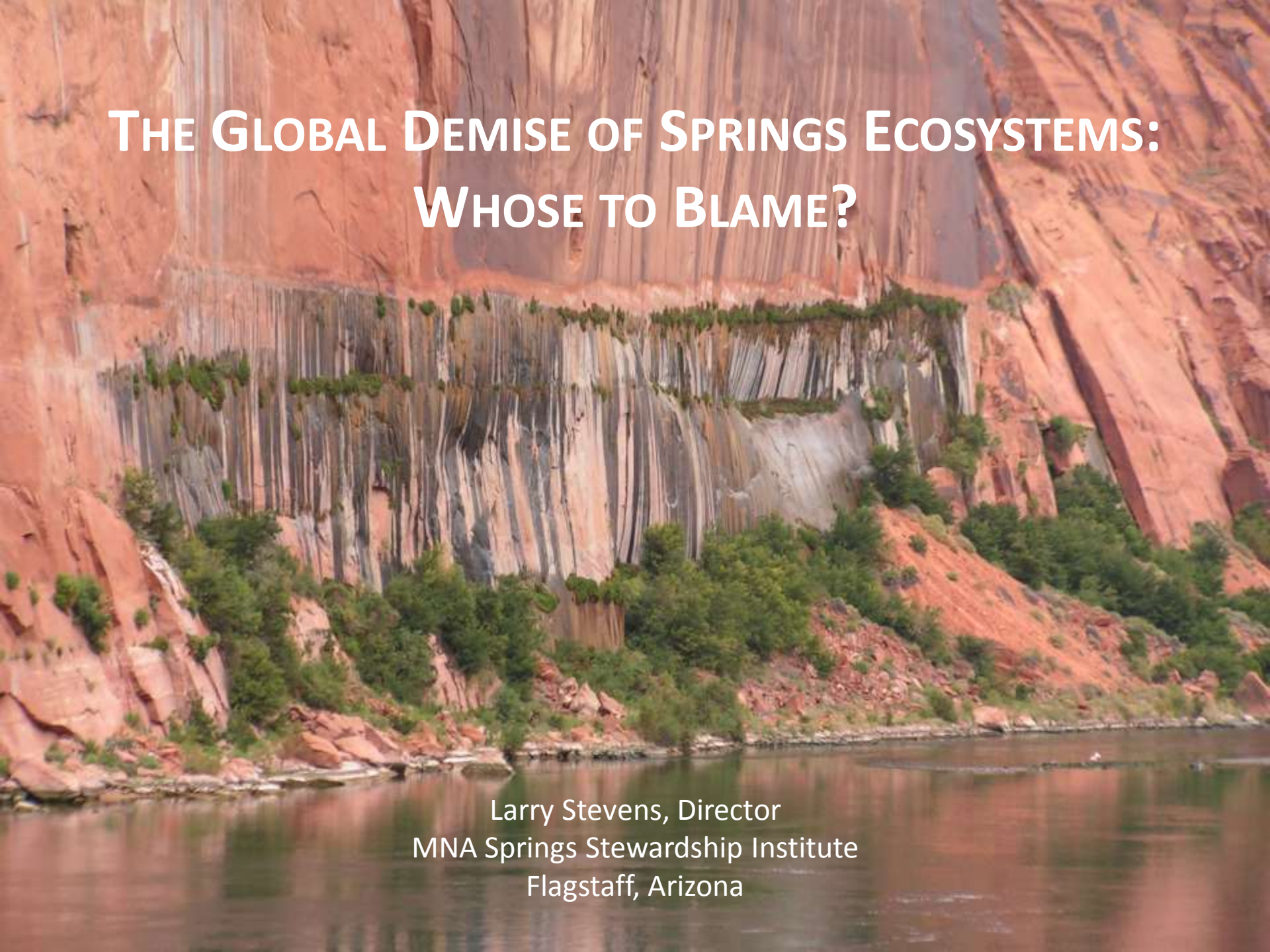


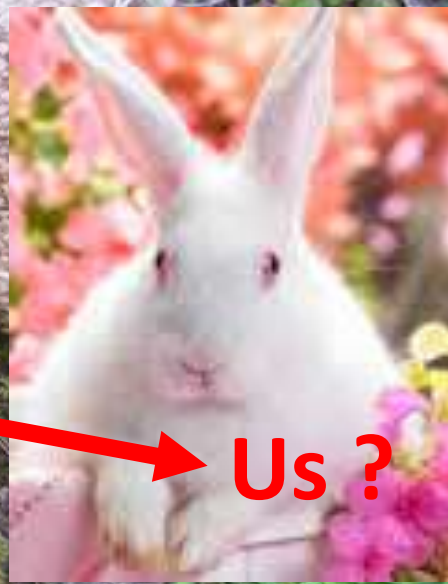
The Global Demise of Springs Ecosystems: Whose to Blame?

Larry Stevens, Director
MNA Springs Stewardship Institute
Flagstaff, Arizona

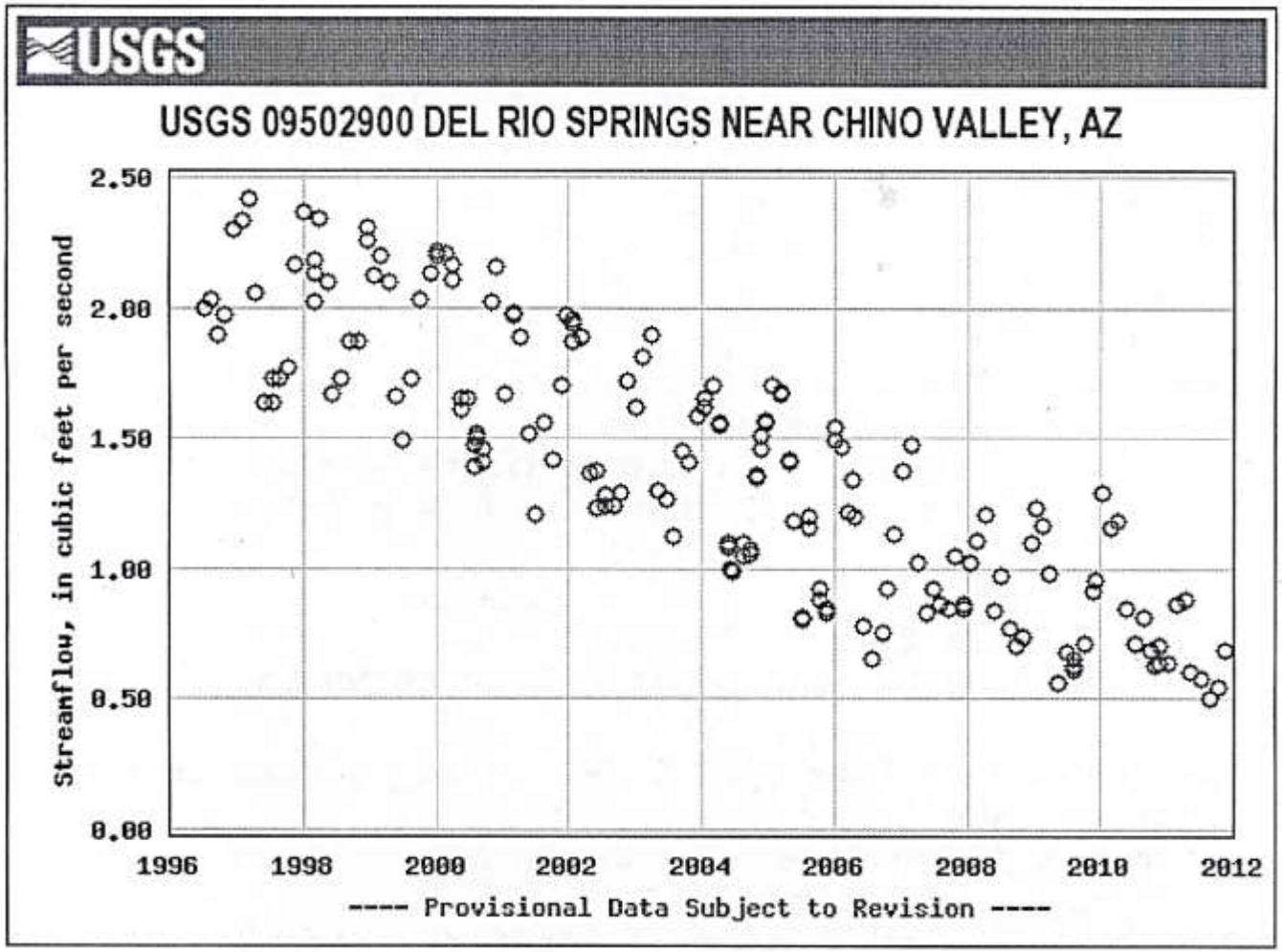
Springs: The most productive, diverse ecosystems on Earth

But springs are poorly understood and globally threatened

WHY? Are we just dumb bunnies?



Inventories of >1200 springs across western North America:
70->90 % are ecologically impaired, and many have been lost.
How many undescribed springs-dependent species
have been lost in the US alone?



PHOENIX ACTIVE GROUNDWATER MANAGEMENT AREA (2009)

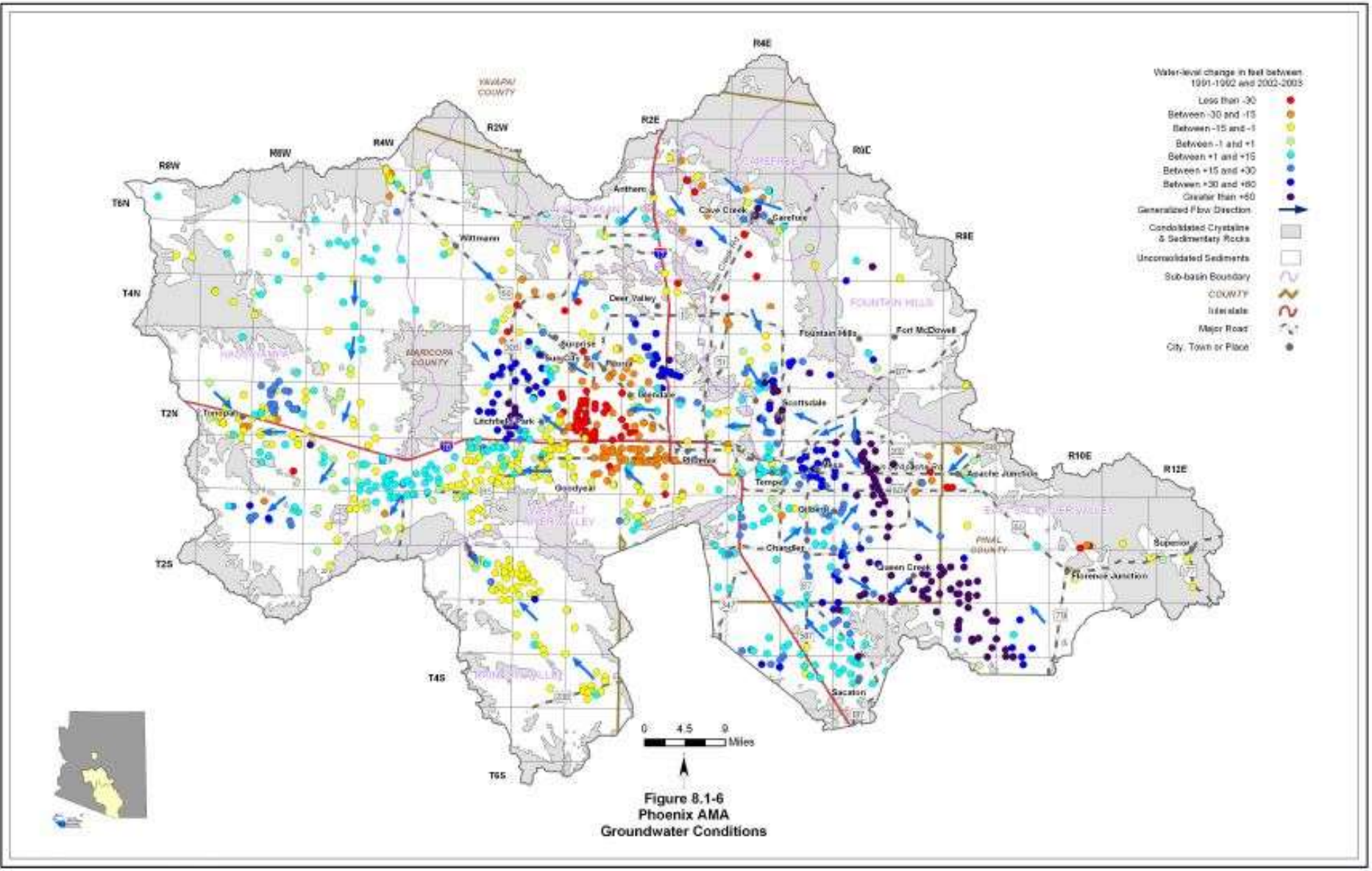


Figure 8.1-6
Phoenix AMA
Groundwater Conditions

FAILURE 1: Homography in English

spring by Pivotal

First up on Google 5 June 2018

THE SPRING BLOG

Spring Batch 4.1.0.M1 Released

RELEASES MAHMOUD BEN HASSINE MAY 31, 2018 0 COMMENTS

We are pleased to announce that Spring Batch 4.1.0.M1 is now available on Github and the Pivotal download repository. Many thanks to all of those who contributed to this release!

http://tucson.com/spring-break-when-students-go-wild-here-are-photos-to/collection_9b9c1ff6-08f7-11e7-af7b-ab54a9d0926f.html#25

SPRING AND SPRINGS

Failure 1:

English, the language of science, is not the best language for the study of springs

Springs:

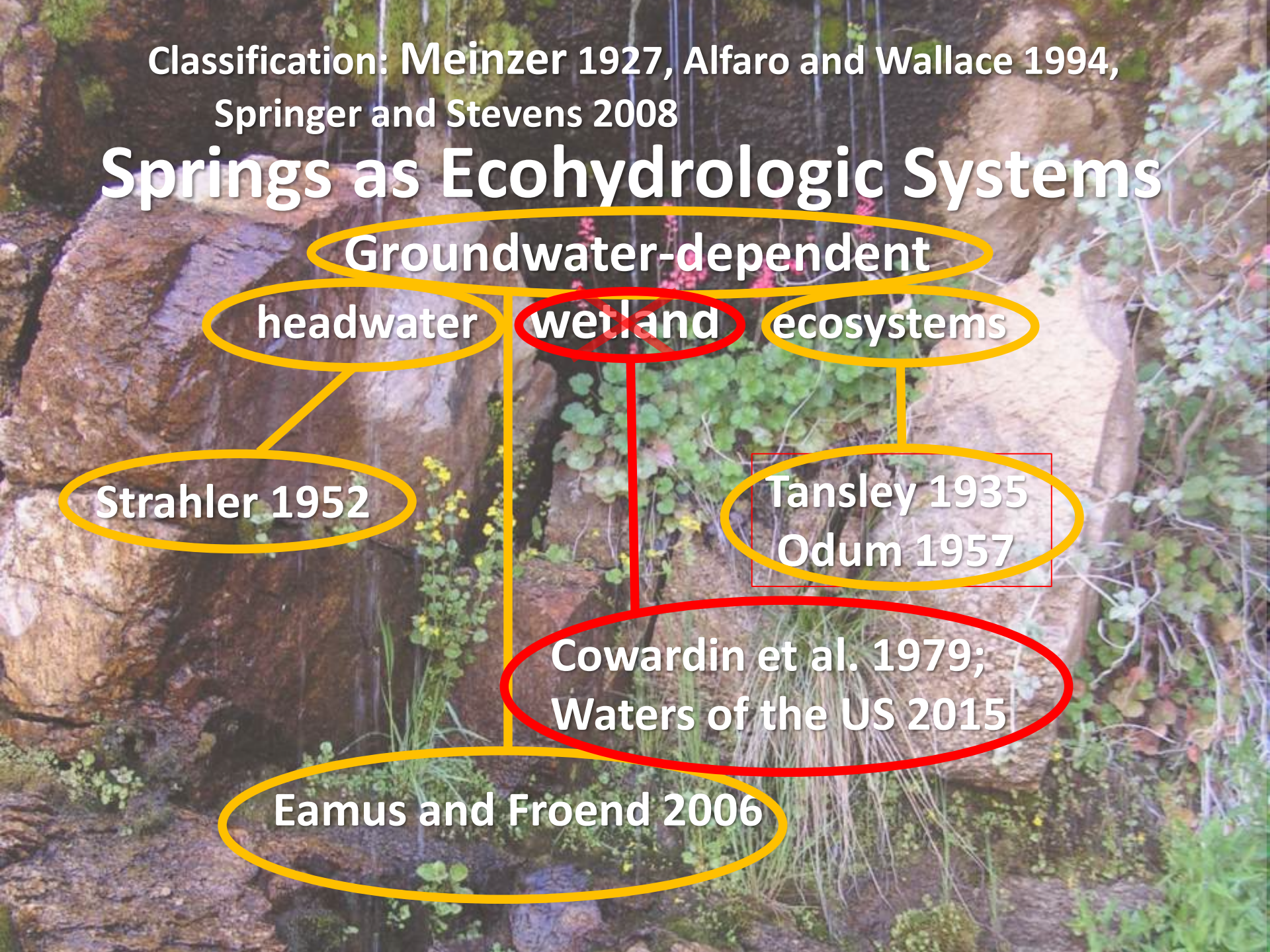
Season: Springtime

Auto Parts

Water Features

Sorgente (IT), *Manantial* (SP), *Source* (FR)


FAILURE 2: Governmental Policy
Springs as Ecohydrologic Systems
Surface-linked groundwater-dependent
headwater wetland ecosystems


Classification: Meinzer 1927, Alfaro and Wallace 1994, Springer and Stevens 2008
Springs as Ecohydrologic Systems
Groundwater-dependent
headwater
wetland
ecosystems
Strahler 1952
Tansley 1935
Odum 1957
Cowardin et al. 1979;
Waters of the US 2015
Eamus and Froend 2006

Failure 2: Management and Policy:

Federal policies in the developed world (esp. USA) have not adequately acknowledged linkage between groundwater and surface water. Springs "fall between the cracks" in legal protection (Nelson 2008).

This has precipitated:

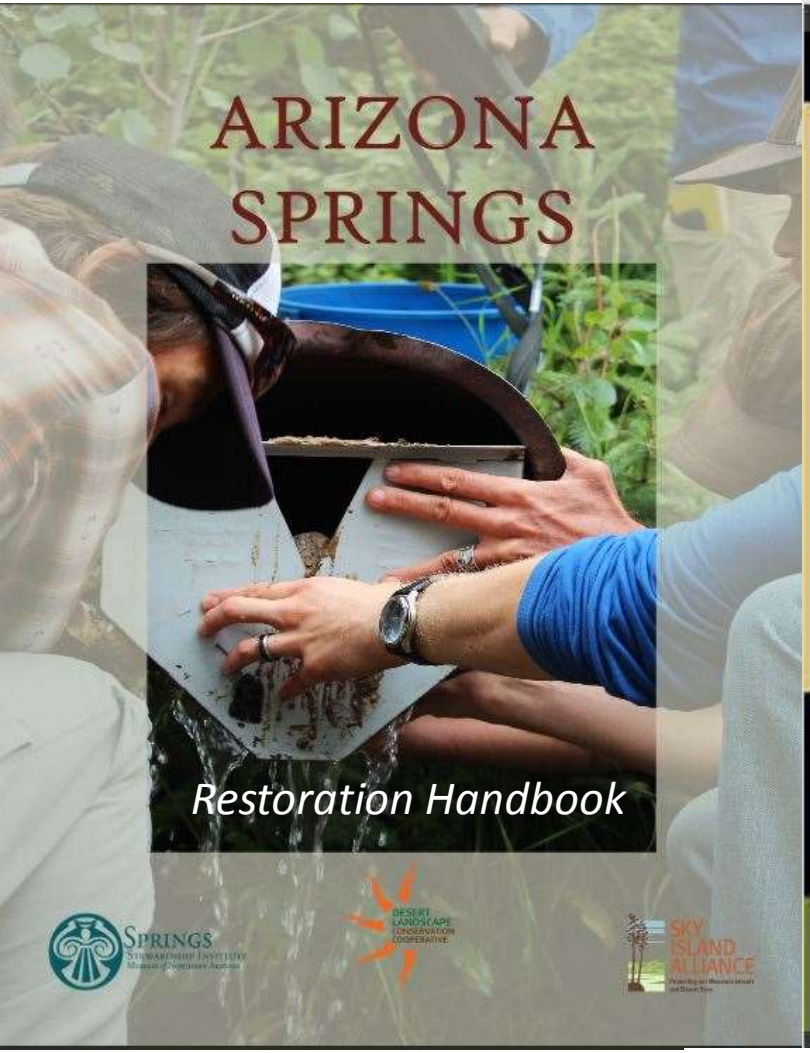
- Lack of policy and guidance about springs in general
- Lack of funding for springs ecohydrology
- Lack of research on springs

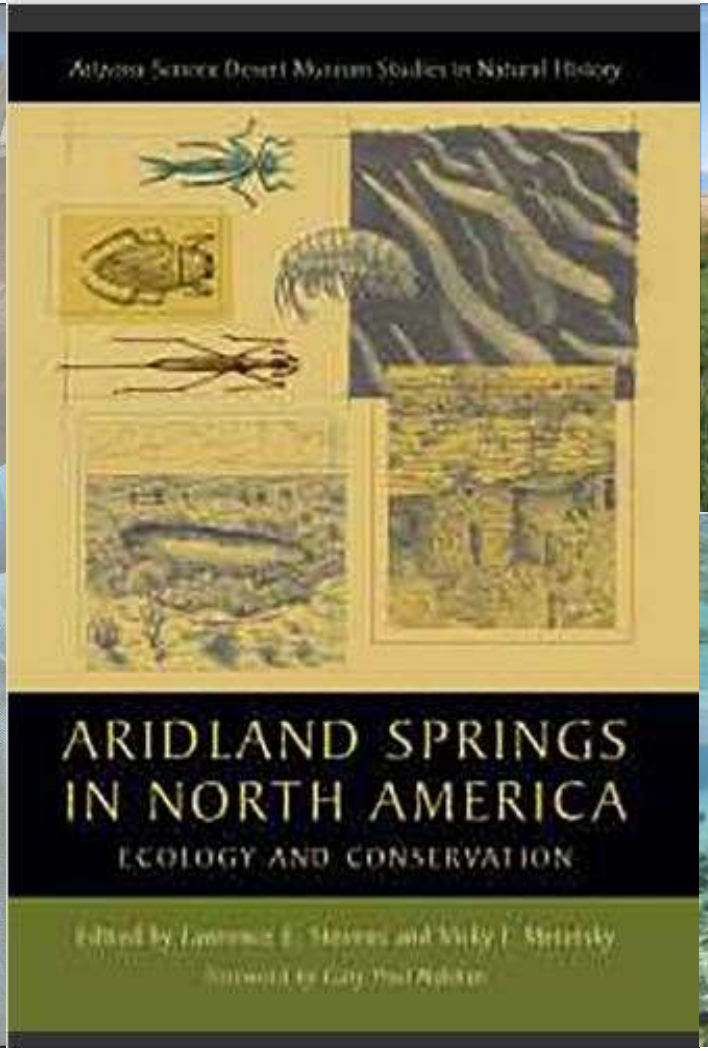
This failure has produced:

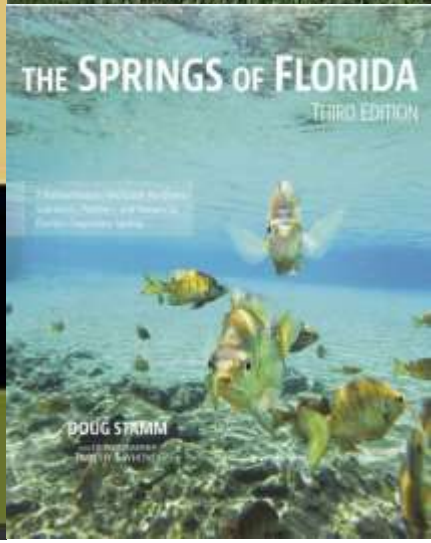
- A lexicon deeply confounded by bureaucratic jargon
- Failed groundwater and surface water stewardship
  (GW pumping, pollution, flow diversion, livestock mgt.)
- Failure to guide and support research and stewardship


Edited by
Malchus B. Baker, Jr.
Peter F. Ffolliott
Leonard F. DeBano
Daniel G. Neary
Riparian Areas of the Southwestern United States
Hydrology, Ecology, and Management
LEWIS PUBLISHERS
ECOLOGY, BIODIVERSITY AND CONSERVATION
Assessing the Conservation Value of Fresh Waters
An International Perspective
The State of The Nation's Ecosystems 2008
Measuring the Lands, Waters, and Living Resources of the United States
Second Edition
Wetlands
William J. Mitsch
James G. Gosselink
More than 20 major books on aquatic ecosystems in the past decade with virtually no mention of springs.
Climate Change Impacts on Freshwater Ecosystems
Edited by Martin Kernan, Richard W. Battarbee & Brian Moss
WILEY-BLACKWELL
DROUGHT and AQUATIC ECOSYSTEMS
Effects and Responses
P. Sam Lake
WILEY-BLACKWELL
BRIAN MOSS
ECOLOGY OF FRESHWATERS
A VIEW FOR THE TWENTY-FIRST CENTURY
FOURTH EDITION
WILEY-BLACKWELL
Hydroecology and Ecohydrology
Past, Present and Future
Editors Paul J. Wood, David M. Hannah and Jonathan P. Sadle
WILEY

Recent Additions to the Literature







Mueller, J.M., R.E. Lima, and A.E. Springer. 2017. Can environmental attributes influence protected area designation? A case study valuing preferences for springs in Grand Canyon National Park. *Land Use Policy* 63:196-205.


FAILURE 3: Springs Science
Economics
Archaeology
Anthropology
Soils
Sociology
History
Geomorphology
Geography
Taxonomy
Hydrology
Ecohydrology
Ecology
Geology
Geochemistry
Climatology
Evolution
Engineering
Modeling
Paleontology
Ecosystem Ecology
Information Management
Environmental Management
Restoration
Monitoring

Economics Archaeology Anthropology

Failure of Science

- Springs Ecosystems Are Dynamic, Complex, Individualistic Ecosystems, Requiring Dialogue among Disciplines that Rarely Communicate with Each Other
- Springs lexicon remains under-developed due to a lack of basic agreement among scientists on terminology

Management Management

Monitoring

FAILURE 4: Springs in Art

SPRINGS ARE RARELY DEPICTED OR USED METAPHORICALLY IN POPULAR MEDIA

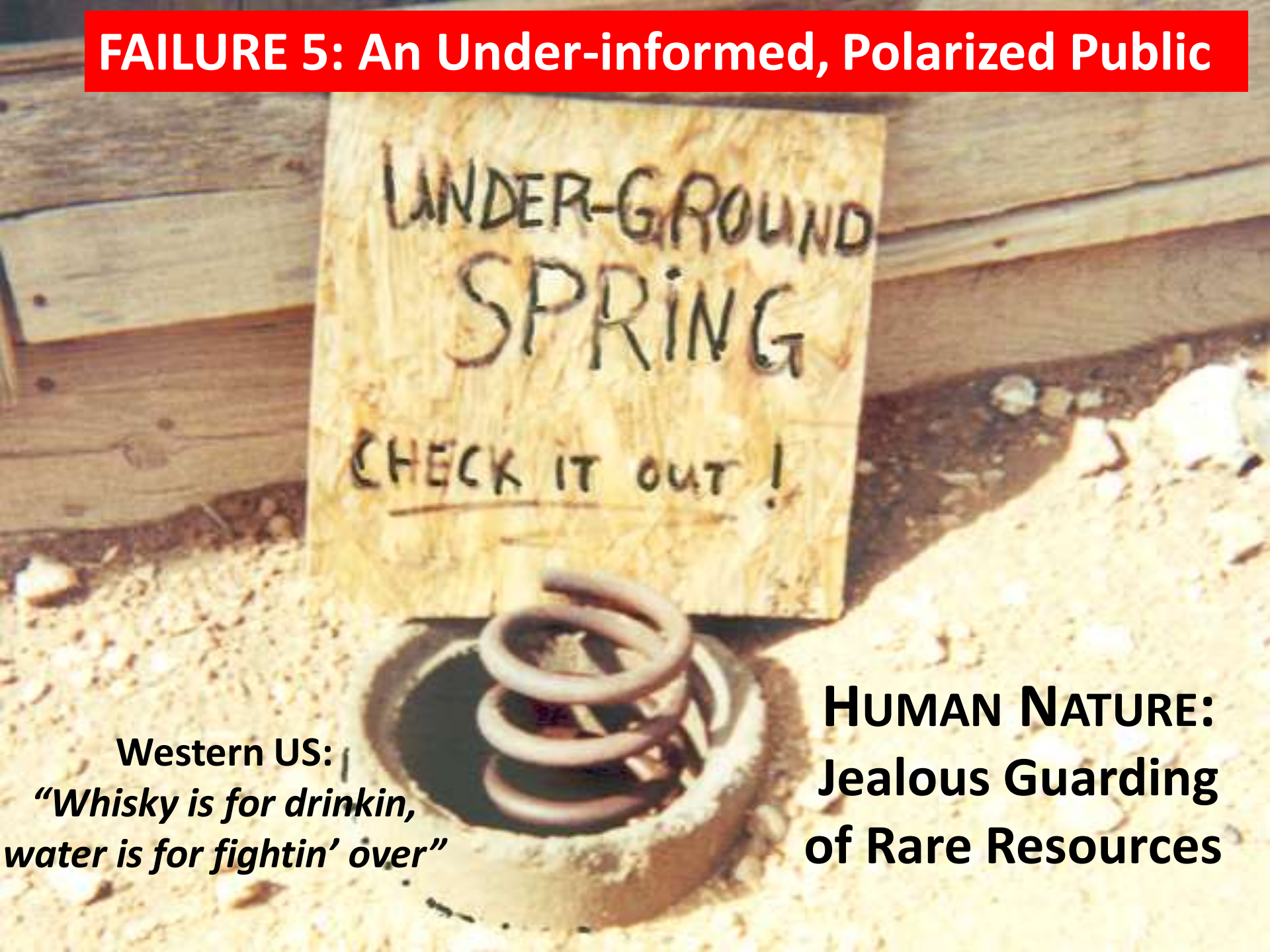
***Manon of the* Spring**
(French Drama)

Creature from the Black Lagoon
(American Cracker SciFi)

Warm Springs
(American Political History)

Springs in Art and Science:
An MNA Exhibit Featuring the Sculpture of Rosalyn Driscoll, November 2019

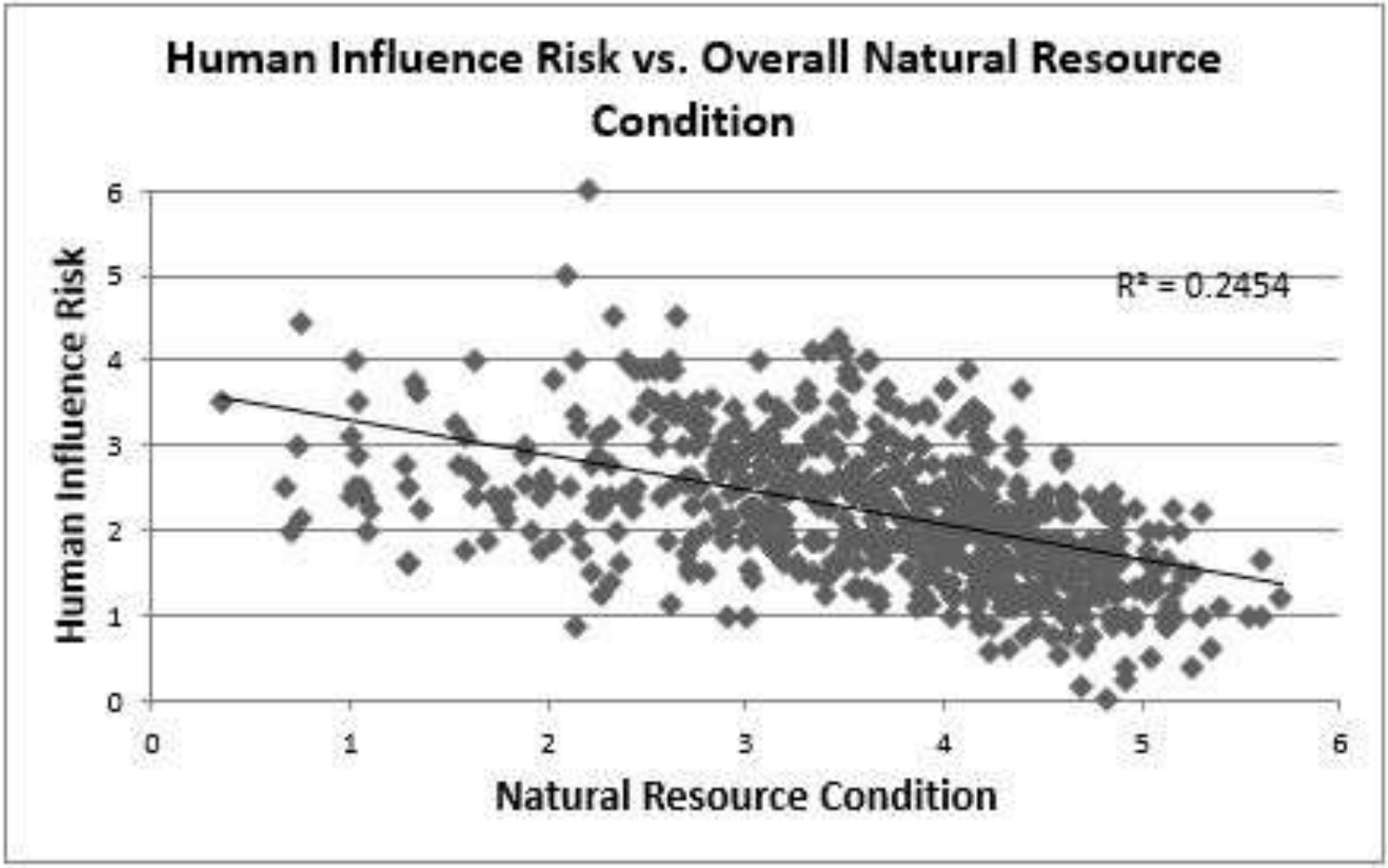
FAILURE 5: An Under-informed, Polarized Public



Western US:
"Whisky is for drinkin, water is for fightin' over"

HUMAN NATURE:
Jealous Guarding of Rare Resources


HUMAN INFLUENCES
Groundwater pumping
Agricultural irrigation
Potable water
Livestock watering
Disturbance/geomorphic alteration
Groundwater pollution
Habitat fragmentation
Flow diversion
Recreation impacts
Non-native species
CLIMATE CHANGE
Grassy Spring, Arizona Strip



Natural Resources (composite) condition scores in relation to Human Influence (category) risk for 641 springs in the southwestern USA.

Who's to Blame for the Demise of Springs?

Poor language, policy, mapping, understanding of biotic and cultural significance, art, polarization, greed, incomplete science, and underinformed management

We All Are!

Solutions:

Education

An international journal/forum to facilitate springs ecosystem research, policy discourse, outreach

Informed policy discussion and ecological reconciliation

Improved lexicon and classification

Better understanding of springs-dependent species

Improved, springs-type-based restoration options

Unmapped Spring, Head of F. Tagliamento nr F de Sopra, Italy

Working with Collaborators:
Prescott College and Grand Canyon Wildlands Council
Excavating Leopard Frog Springs Habitat
in Glen Canyon, March 2015