

# A framework to quantify the strength of ecological links between critical loads of atmospheric deposition and final ecosystem services

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# Problem

- Acid deposition is impacting sensitive ecosystem components.
- **Today,** phytoplankton, lichen, jack pine

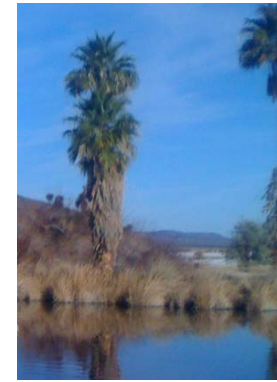


# Objectives

- Link changes in deposition to an ecosystem component that people care about.
- Identify the groups who are impacted by these changes.
- Develop narratives to communicate the science to a broader audience



# “Ecosystem Services” ... Also known as “Nature’s Benefits”



- Food Production
- Water
- Wood and Fiber
- Fuel

- Nutrient Cycling
- Soil Formation
- Primary Production
- Habitat Provision

- Spiritual
- Aesthetic
- Educational
- Recreational

- Climate Regulation
- Flood Regulation
- Water Purification



Source: Millenium Ecosystem Assessment, 2005.



# Final Ecosystem Services

the components of nature, directly enjoyed, consumed, or used to yield human well-being

(Boyd and Banzhaf, 2007)



# Final Ecosystem Goods and Services – Classification System

- Identifies distinct environmental class
- Identifies human beneficiaries and use of the class
- Ecosystem Valuation
  - Monetary
  - Non-monetary



# What was known:

CL → Biological Indicators

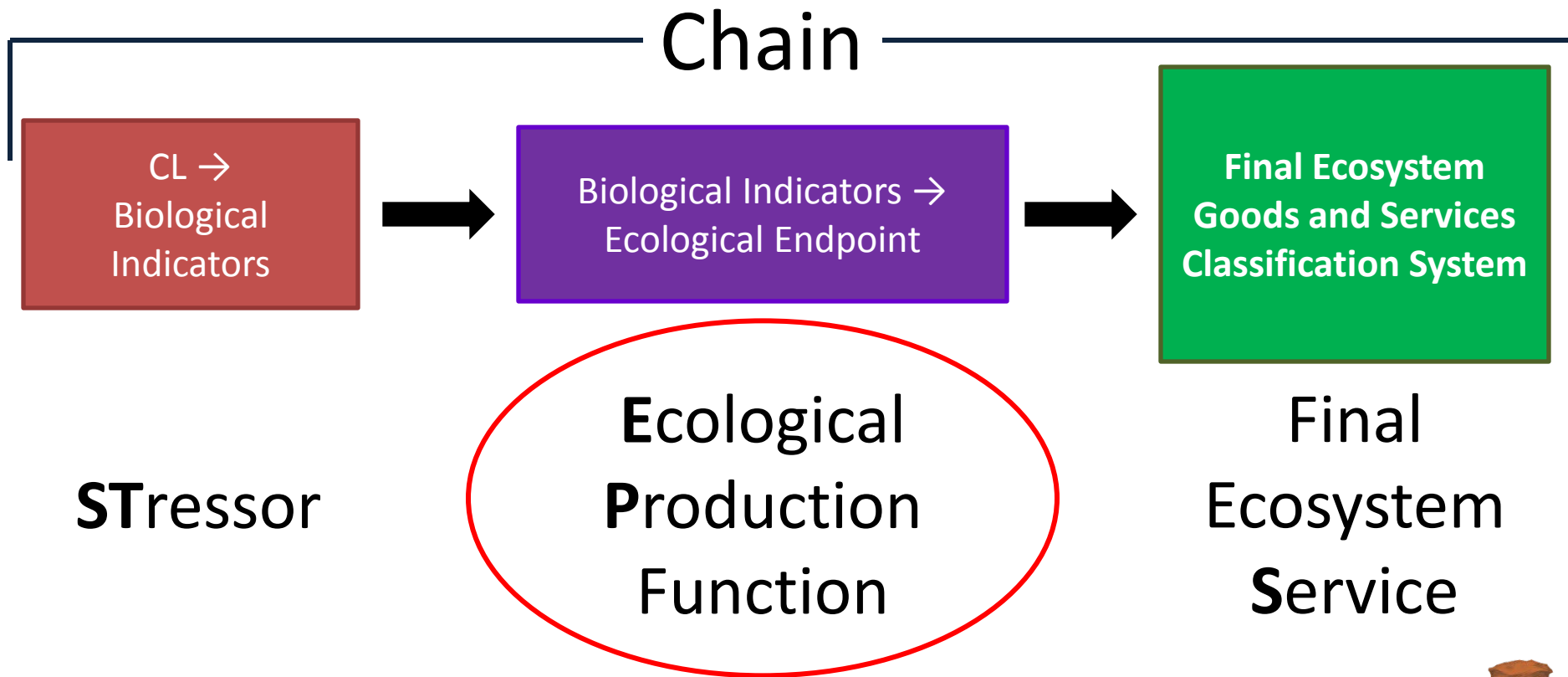
Ecosystem Services → Final  
Ecosystem Goods and  
Services Classification  
System

Biological Indicators →  $\Delta$  Ecosystems





# STEPS Framework

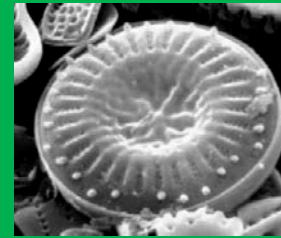
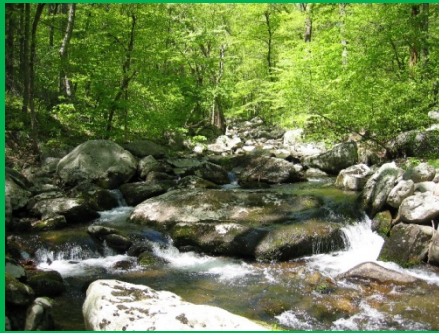


# 4 modes of response to deposition

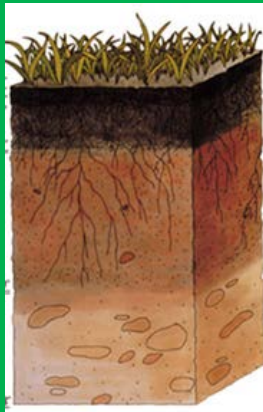
Acidification (eastern US)

Eutrophication (western US)

Aquatic



Terrestrial



# Coastal Sage Scrub Example

## Beneficiaries

Artists

Educators and Students

Experiencers and Viewers

People who care (Existence)

People who care (Option Bequest)

Researchers

Resource dependent businesses

Spiritual and Ceremonial Participants

Increase

Increase  
fire fuel  
load

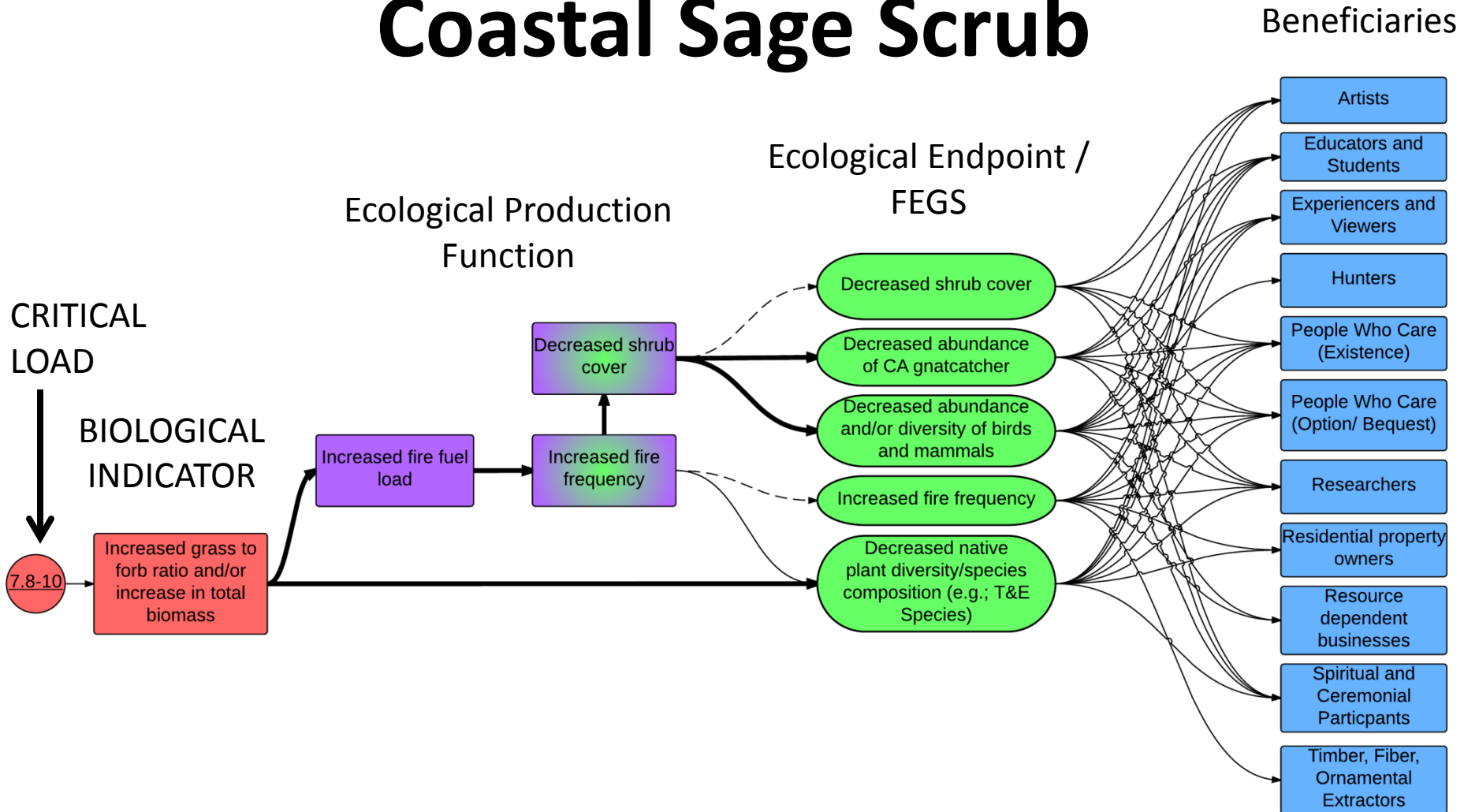


ratio

loss of  
California  
catcher



# Coastal Sage Scrub



# Links to Ecosystem Services

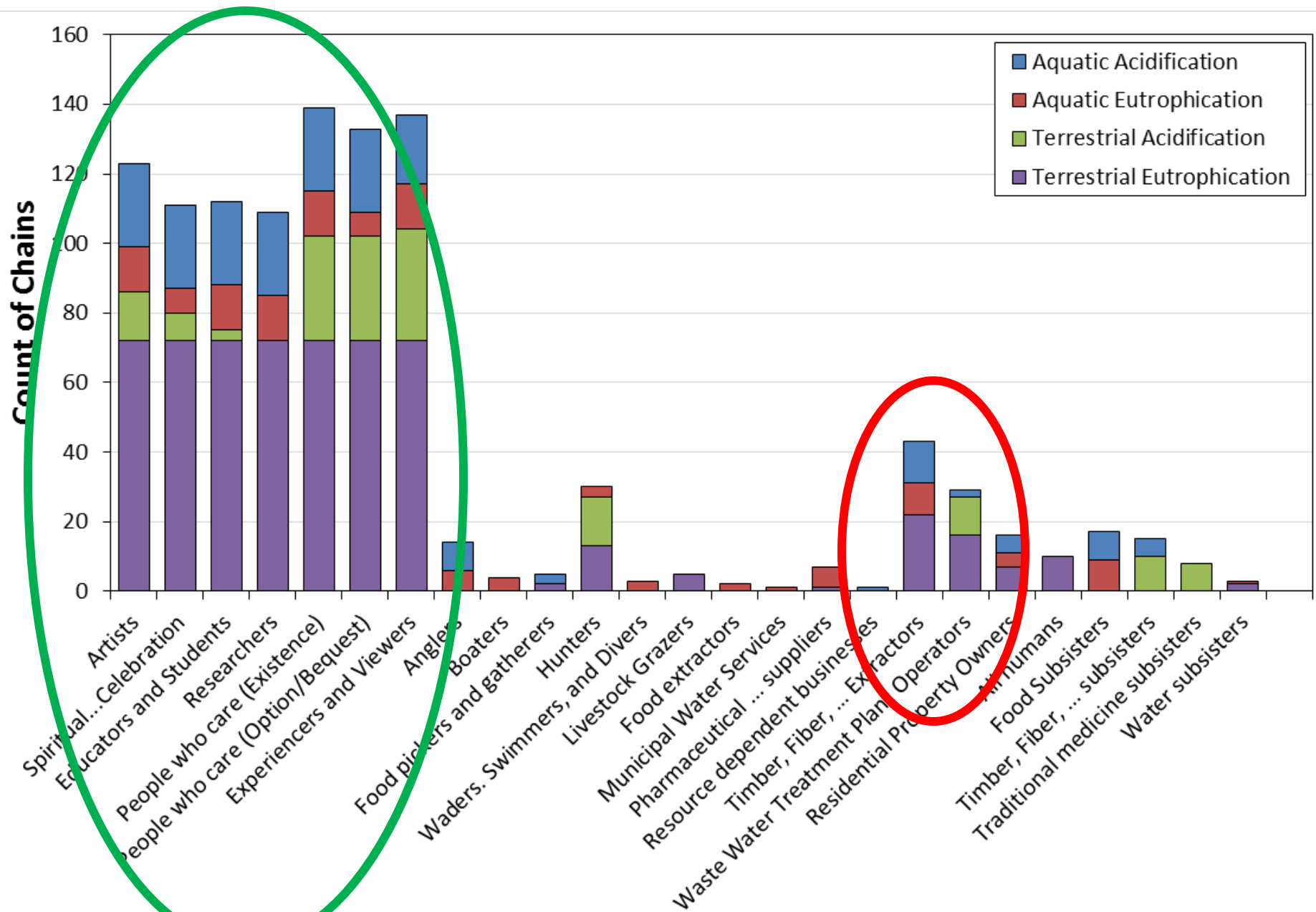
	Change in biological indicators	Ecological endpoints	Beneficiary groups	Ecological Production Functions	Chains
Aquatic acidification	9	10	15	25	208
Aquatic eutrophication	6	13	18	13	127
Terrestrial acidification	8	11	10	68	160
Terrestrial eutrophication	21	43	16	77	582

44

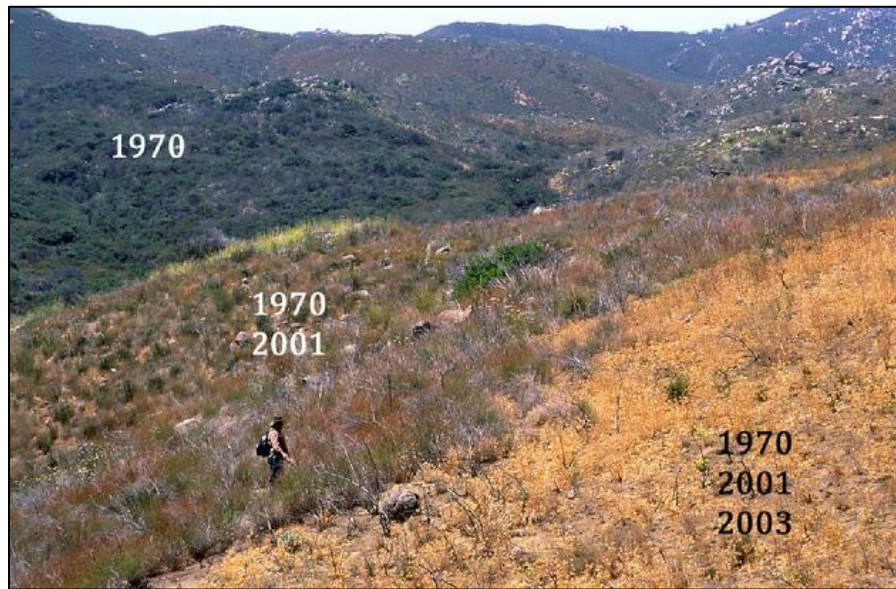
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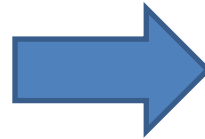




# How a rain of fertilizer caused a reign of fire



[www.californiachaparral.org](http://www.californiachaparral.org)





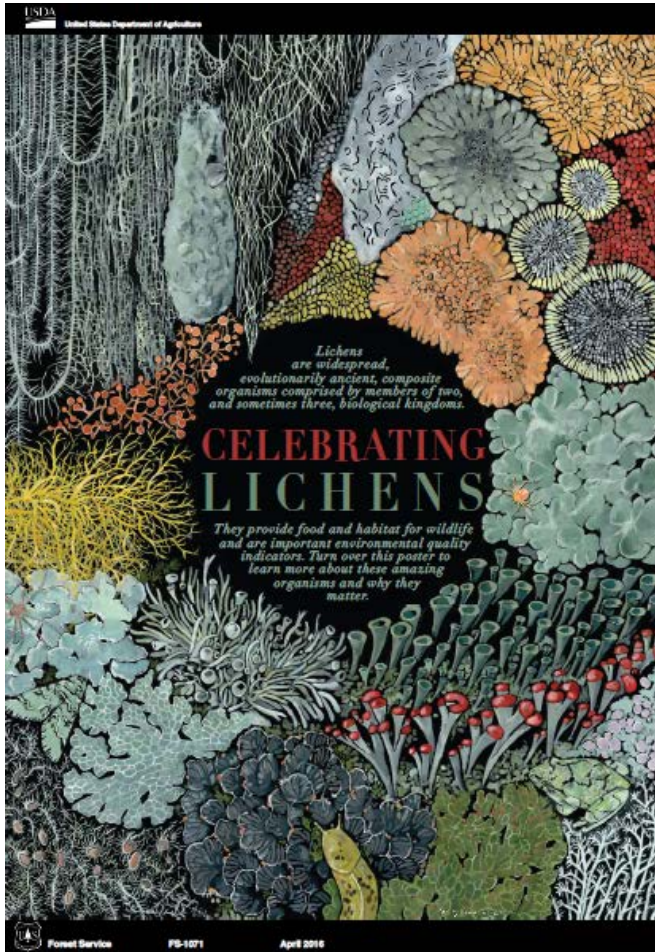


# Acidification cancels Christmas



# Next Steps

- Impacts of other stressors
- Identify synergistic effects
- Input new critical loads
- Develop outreach materials



# Questions

Send me your stories!

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