Using Classification and Causal Chains to Consider Air Quality Impacts to Federal Lands

Tamara Blett and Michael Bell National Park Service ACES Conference- December 6, 2016

The trouble all started when....



Air Quality Regulatory Standards (legal pollution limits) for ecosystems are set based on an effect on "Public Welfare"

> ALL impacts to nature, nationwide





Critical loads are defined for specific indicators and endpoints

Stressor- Air Pollution

Potential Effect on Ecosystem Services: Exceedance of critical load of acid deposition

Critical Load

The threshold of deposition below which specified harmful ecological effects do not occur (Porter et al. 2005)



M.D. Bell | A framework to quantify the links between a stressor and final ecosystem services

Air Pollution Effects on Natural Ecosystems





Case Study- How to develop Causal Chains

- Air Quality and Ecosystem Services Workshop
- February 2015
- 27 Participants

 Land managers, scientists, economists

Air Quality and Ecosystem Services Workshop Report Santa Monica Mountains National Recreation Area, Thousand Oaks, CA – February 24-26, 2015

Natural Resource Report NP5/ NRSS/ARD/NRR-2016/1107



"When the plants you known's hund of go., the annuals you like will start failing, ion." "Elizabath Parngworth



Do average people care about:

Photosynthesis? Soil Formation? Pollination? Sedimentation? Carbon Storage?

Final Ecosystem Goods and Services

"components of nature, directly enjoyed, consumed, or used to yield human well-being" (Boyd & Banzhaf 2007)



Make linkages:

- (1) Impact of stressor to ecosystems
 (2) Loss of benefit (many simultaneously) to humans
 (3) Description of loss (of what by whom)
- (4) Level of certainty
- (5) Good stories

STEPS Framework







Our rules for chains

- Finish Line: All chains go until "Final ES" are reached
- <u>Science Support</u>: Each link must have supporting science (no speculative links)
- <u>**Bi-Directional</u>**: Can work backwards (from FEGS) or forward (from stressor) or both</u>

Format



Beneficiaries

Aquatic Acidification of lakes and



streams

Anglers Artists Aquaculture **Educators and students Food subsisters** Land Managers **People who care (Existence) People who care (Option/Bequest)** Researchers **Resource Dependent Businesses Spiritual and Ceremonial Participants** and Participants of Celebration



Aquatic Eutrophication of lakes and streams

Increase in stream water N



Increase in algal & bacteria abundance



Fish kill from DO toxicity/anoxia

Probability of presence of target fish species

Anglers Artists Aquaculture Boaters Educators Experience an Food Subsiste



Experience and Viewers Food Subsisters Land Managers People Who Care (option) **People Who Care (Existence/Bequest) Researchers Residential Property Owners Resource-Dependent Business Spiritual and Ceremonial Participants** and Participants of Celebration **Swimmers Food Extractors**

Terrestrial Acidification of northern forests

Decrease in Balsam Fir Growth / Increased crown dieback



Artists

Educators and Students Experiencers and Viewers Hunters Land Managers People who care (Existence) People who care (Option/Bequest) Researchers Spiritual and Ceremonial Participants and Participants of Celebration



Tim Rains | NPS

Terrestrial Eutrophication of CSS



Artists Educators and Students Experiencers and Viewers Homeowners People who care (Existence) People who care (Option/Bequest) Researchers Spiritual and Ceremonial Participants and Participants of Celebration



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Terrestrial Eutrophication



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
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Once upon a time:

How a rain of fertilizer caused a reign of fire

- Nitrogen deposition is like fertilizer raining down out of the sky.
- Just as lawn fertilizer causes lush growth, atmospheric deposition of excess nitrogen can cause invasive grasses to increase in natural areas.
- In Joshua Tree National Park, in California, nitrogen deposition has caused non-native grasses to increase so much that they can now carry fire.
- Park managers are now preparing for increased fire in the park; large fires have not occurred there since the park was established in 1936.



The workshop linked N induced invasive grass growth to 67 different beneficiaries in an ecosystem services context



Once upon a time: Whooooooo cares about lichen?

- Some types of lichen are very sensitive to air pollution and disappear from forests in the Pacific NW when pollutants increase by small amounts.
- These species serve as critical food and nesting materials for mammals and birds. For example the northern flying squirrel relies on lichens as a wintertime food source.
- The endangered spotted owl, in turn feeds on the squirrels almost exclusively
- Declines in lichen, squirrels and owls occur as pollution increases... air pollution may be impacting the whole food chain!



The workshop linked N -related extirpation of lichen to 34 different beneficiaries in an ecosystem services context



Tips & Hints for Developing Chains with a Group

- Invite both economists and 'ologists
- Need clear objectives and background on topic area and classification system
- Pick a small topic area (stressor or mgt action)
- Use Final ES (e.g. FEGS) as endpoints
- Participants need familiarity with the science and should track citations for chain links
- Small groups (5-8) w/ strong facilitation work best
- Develop follow up actions (publications)
- Consider the "stories" that develop



Please join our "EPF" session #32 Wednesday at 1:30 for more details on developing chains!!