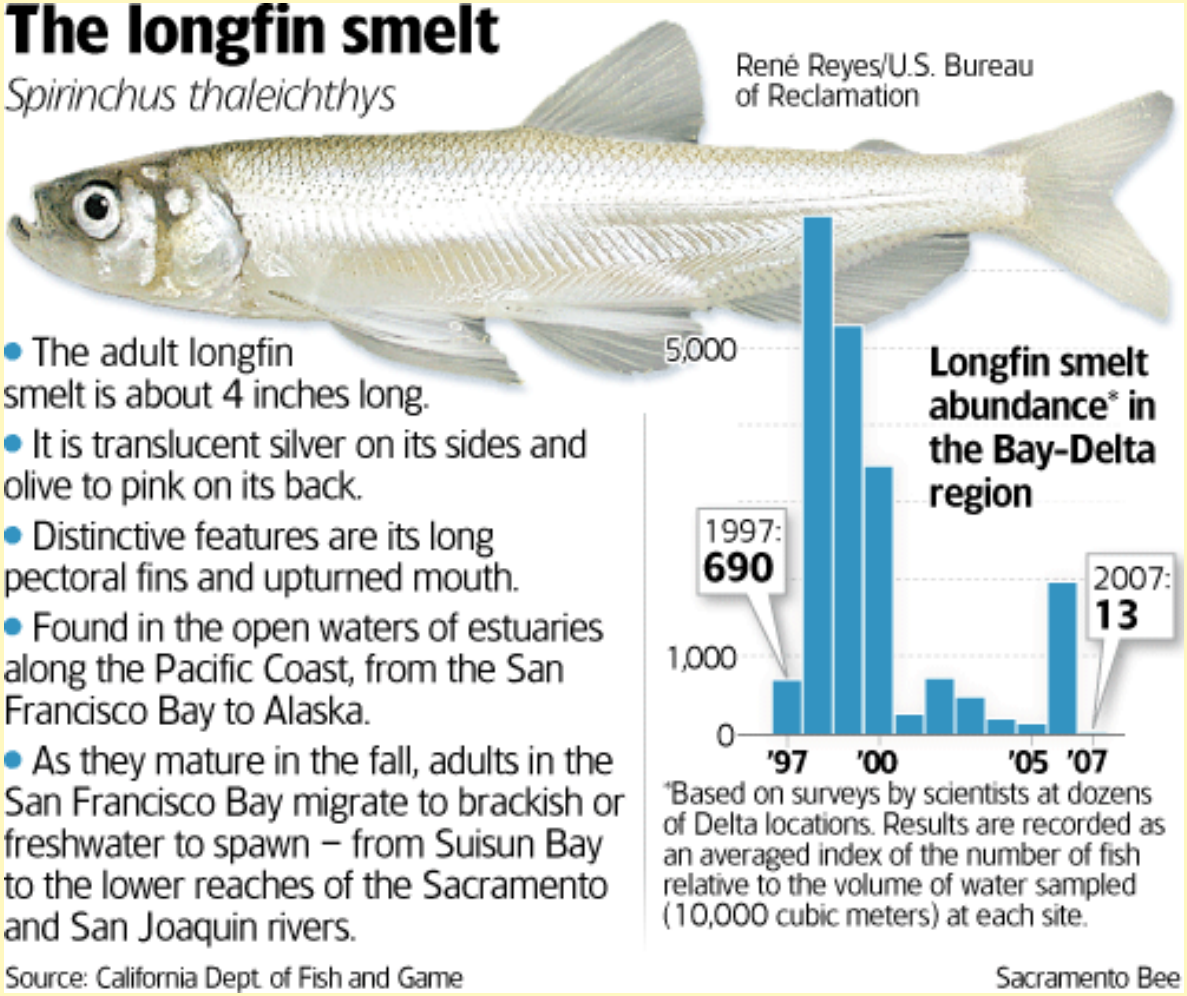
San Francisco Estuary

- Sacramento and San Joaquin rivers
- 1800 km of levees
- Water for 25 million Californians
- 12,000 km^2 of agricultural land: half the nation's produce, $15B / year

Viable Native Species



Path to delisting: new information on status

Path to delisting: alleviate primary threats

source: US Fish and Wildlife Service

Path to delisting: sustained management

Obviate Need to List

species listed: “management failed”

listing averted: a “win,” but stressors may persist

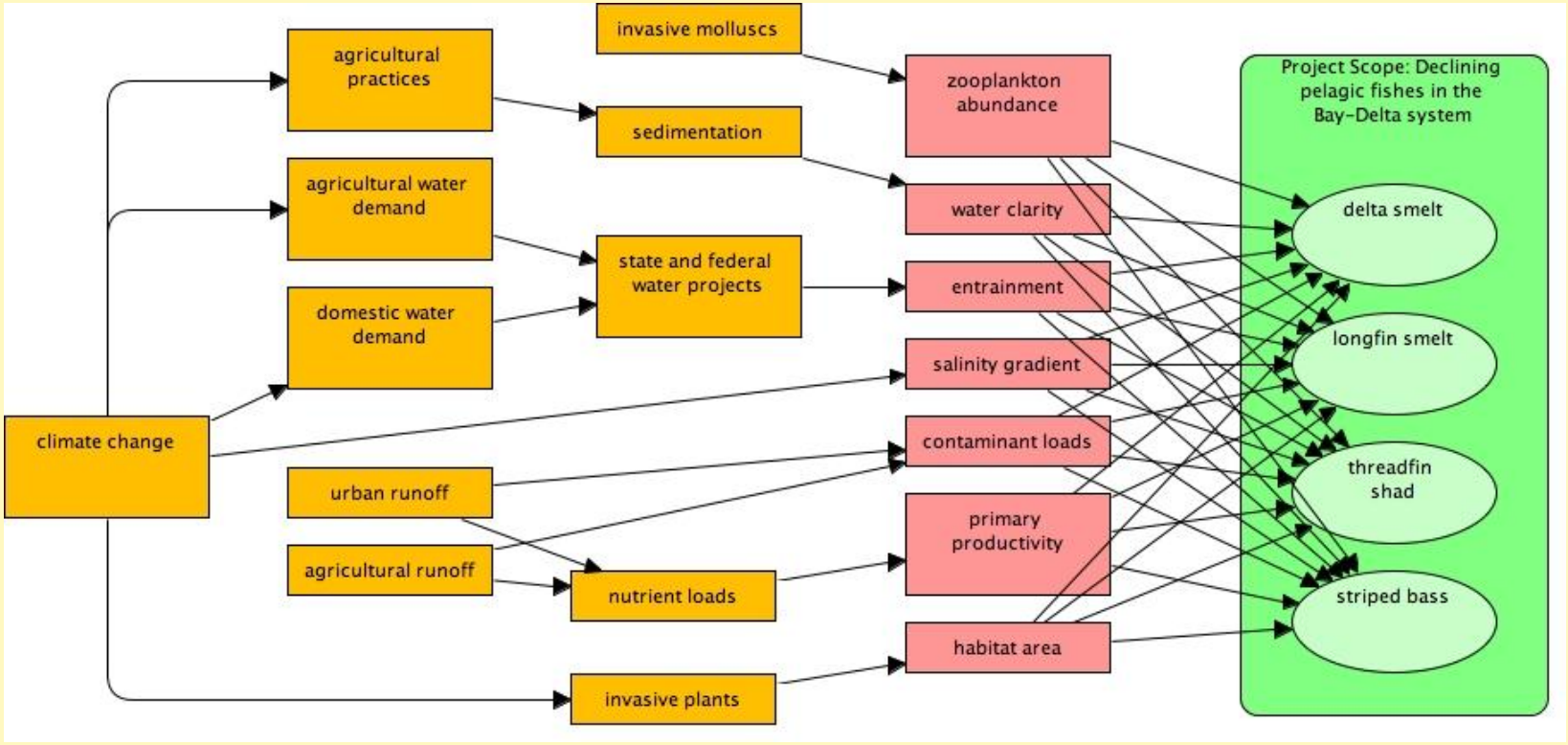
Application of Science

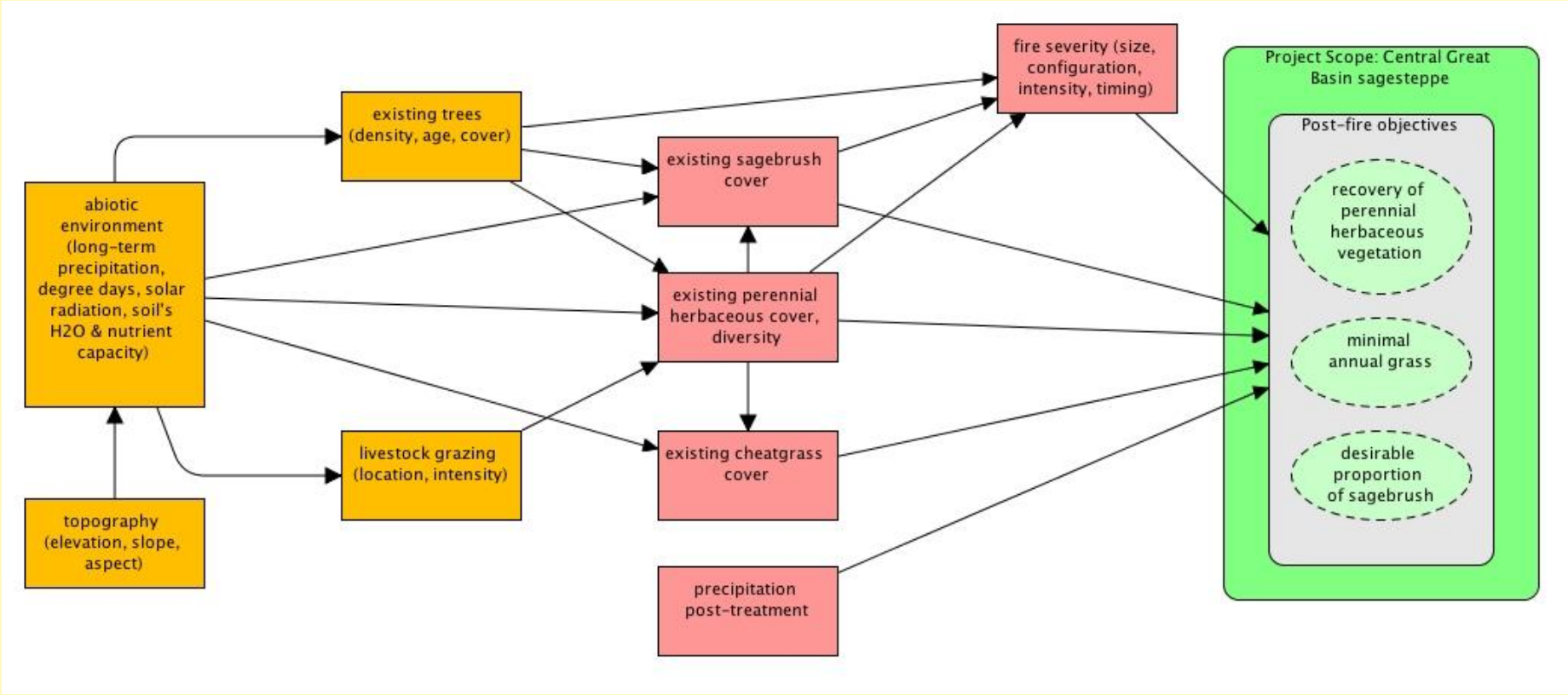
"No, a thousand times no; there does not exist a category of science to which one can give the name applied science. There are science and the applications of science, bound together as the fruit to the tree which bears it."

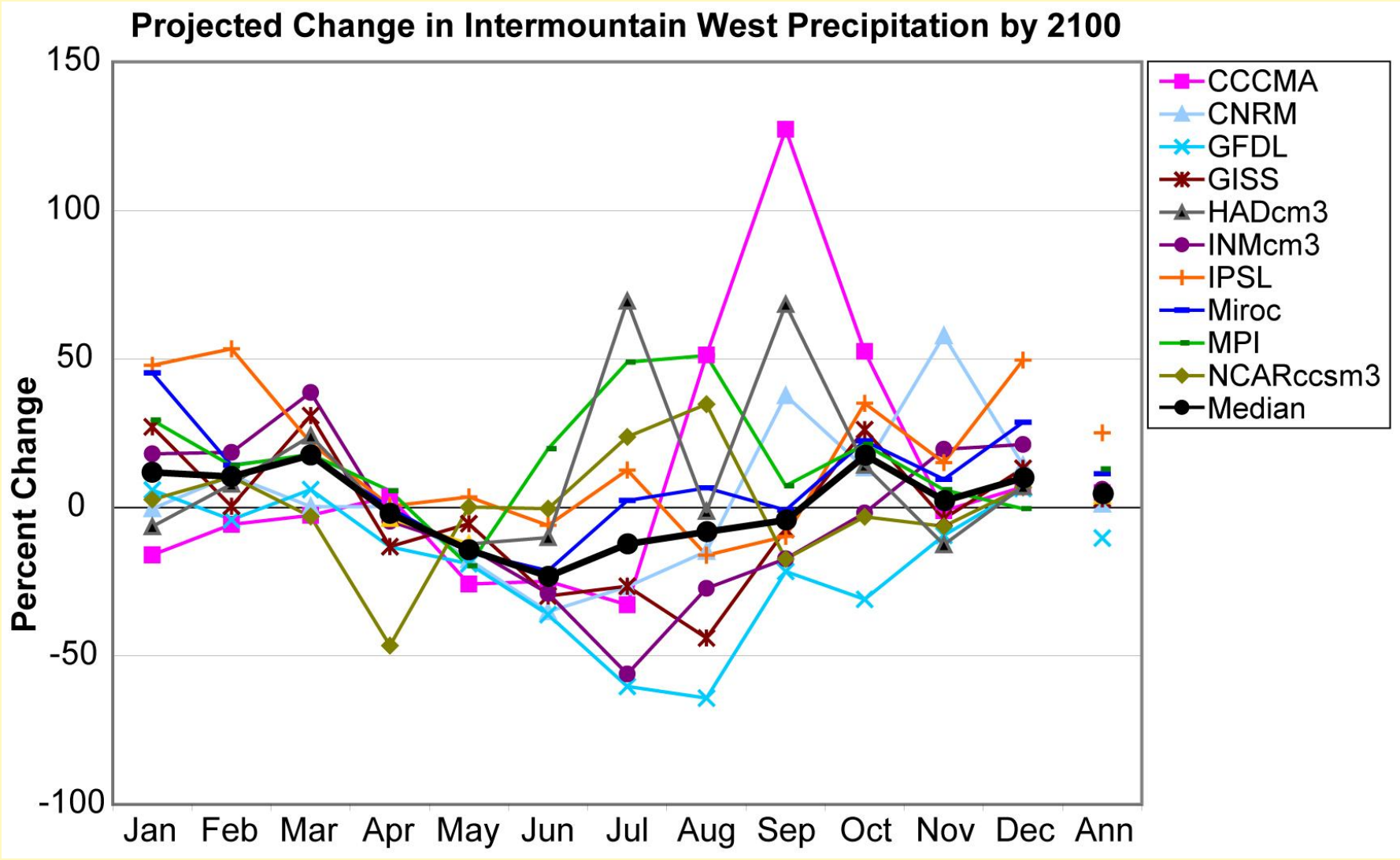
Louis Pasteur, 1871

Information Needs

- Conceptual model
- Targets, direct threats to status
- Drivers of direct threats, especially anthropogenic
- Logic or results chain
- Strategies: sets of feasible actions


climate change
agricultural practices
agricultural water demand
domestic water demand
urban runoff
agricultural runoff
invasive molluscs
sedimentation
state and federal water projects
nutrient loads
invasive plants
zooplankton abundance
water clarity
entrainment
salinity gradient
contaminant loads
primary productivity
habitat area
Project Scope: Declining pelagic fishes in the Bay-Delta system
delta smelt
longfin smelt
threadfin shad
striped bass

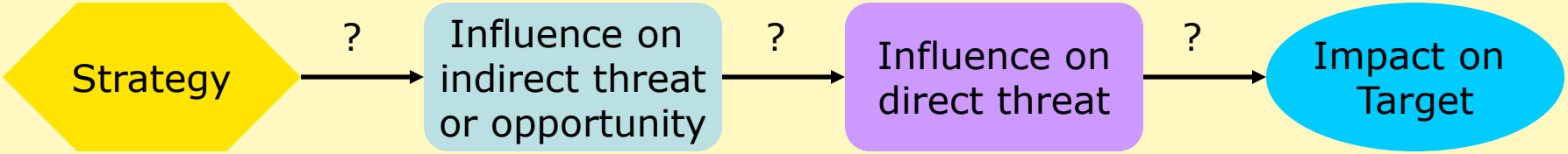

abiotic environment (long-term precipitation, degree days, solar radiation, soil's H2O & nutrient capacity)
topography (elevation, slope, aspect)
existing trees (density, age, cover)
livestock grazing (location, intensity)
existing sagebrush cover
existing perennial herbaceous cover, diversity
existing cheatgrass cover
precipitation post-treatment
fire severity (size, configuration, intensity, timing)
Project Scope: Central Great Basin sagesteppe
Post-fire objectives
recovery of perennial herbaceous vegetation
minimal annual grass
desirable proportion of sagebrush



courtesy Bethany Bradley

Results Chain

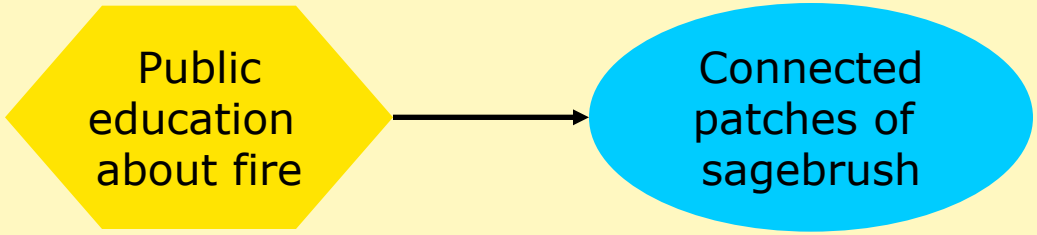
- Illustrates assumptions of how actions will lead to results
- How will strategies influence threats and opportunities affecting conservation targets?



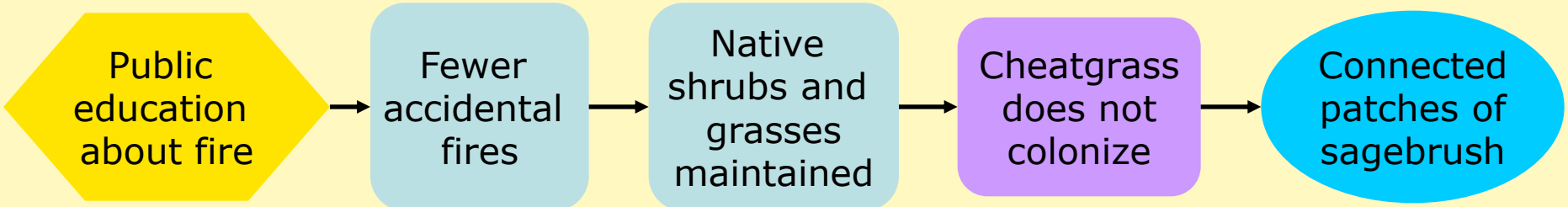
- Link strategy, expected outcomes, desired impact using "if . . . then" format

Refine Theory of Change

- Formally state assumptions about how strategies will achieve desired outcomes



- Make assumptions explicit to assess validity



Success

Erroneous theory

Unsuccessful implementation

Failure

Realistic assumptions, objectives

- Population dynamics
- Restoration potential
- Habitat quantity
- # of populations
- # of individuals

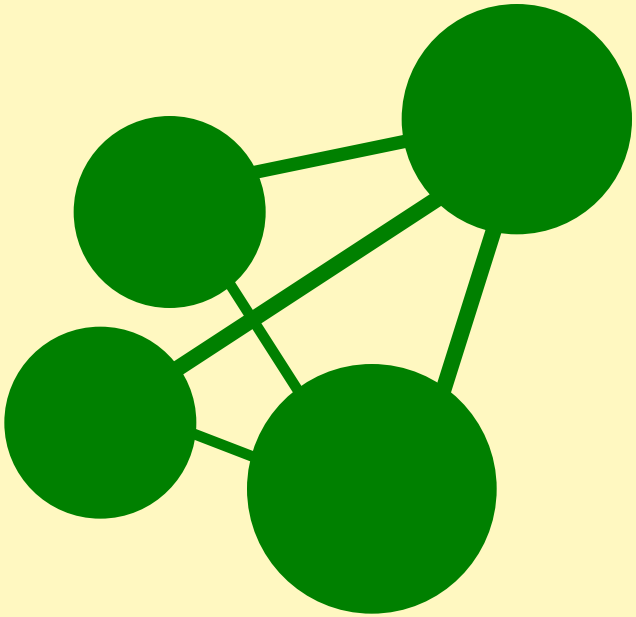
Speyeria nokomis apacheana

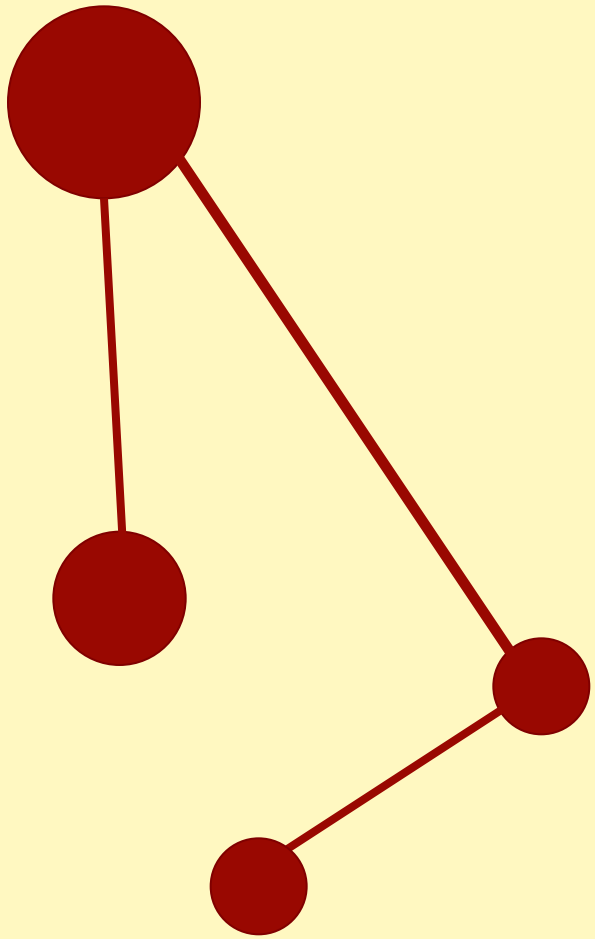
Arid, montane landscape

Isolated patches of habitat

Mark-recapture studies

Drivers of metapopulation dynamics

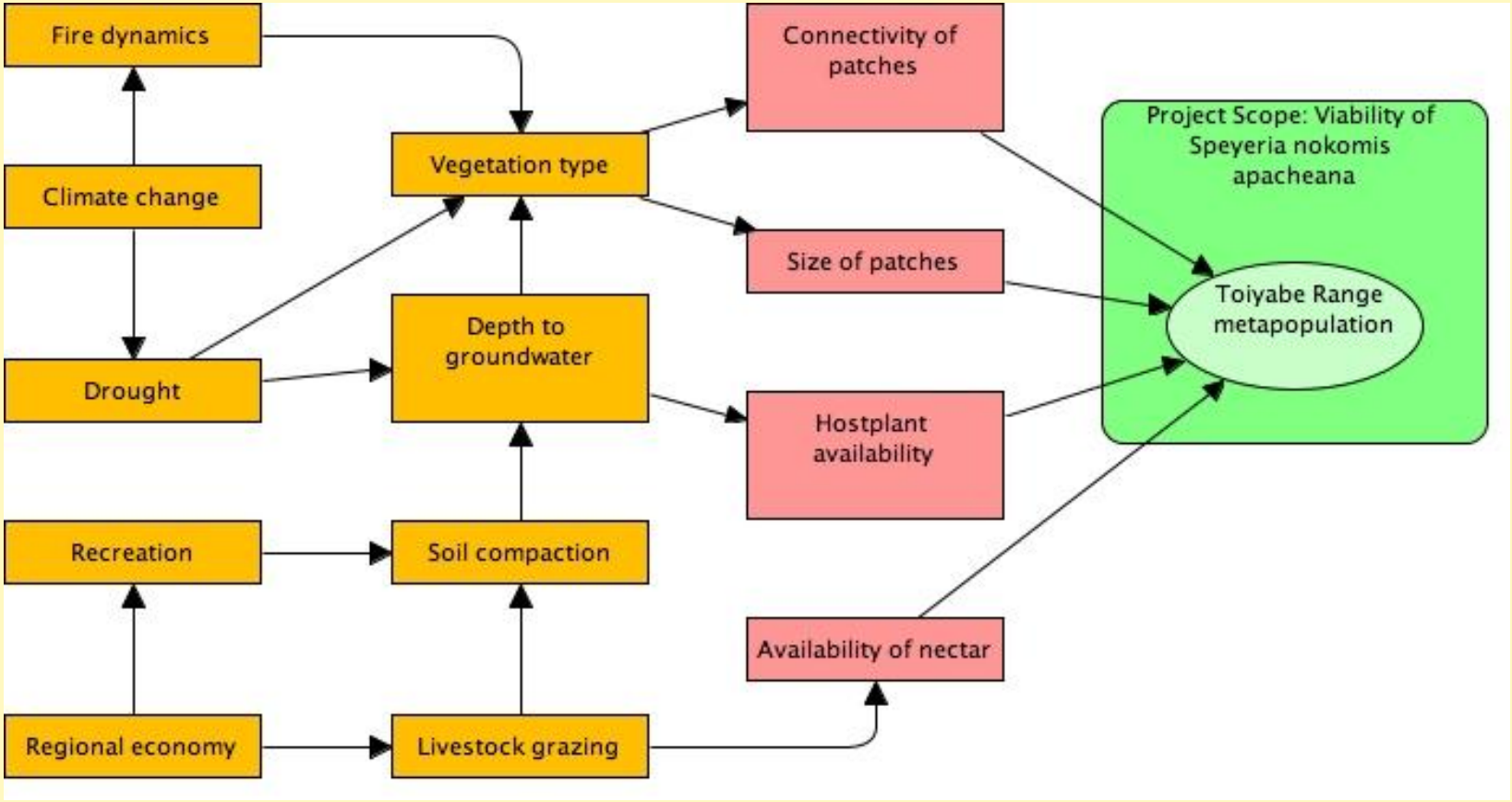




Area, isolation assumed to serve as surrogates for habitat quality

Inference from related species

source: California Academy of Sciences


Fire dynamics
Climate change
Drought
Recreation
Regional economy
Vegetation type
Depth to groundwater
Soil compaction
Livestock grazing
Connectivity of patches
Size of patches
Hostplant availability
Availability of nectar
Project Scope: Viability of Speyeria nokomis apacheana
Toiyabe Range metapopulation

Patch geometry, vegetation

Direct Drivers

Management Interventions

- Delay grazing in wet meadows
- Minimize impact of summer camping
- Restrict herbicide use in riparian areas

Greater Sage-grouse


Alberta
Saskatchewan
Washington
Montana
North Dakota
Oregon
Idaho
South Dakota
Wyoming
Nebraska
Utah
Colorado
California
Nevada

Non-native Invasive Species

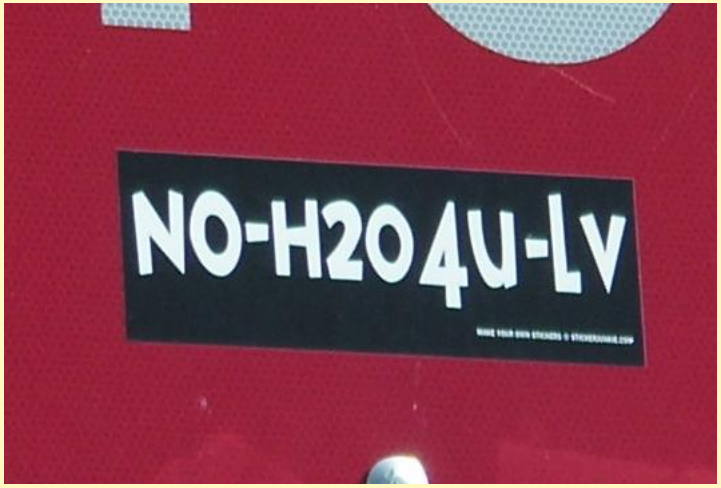
native shadscale and bunchgrasses

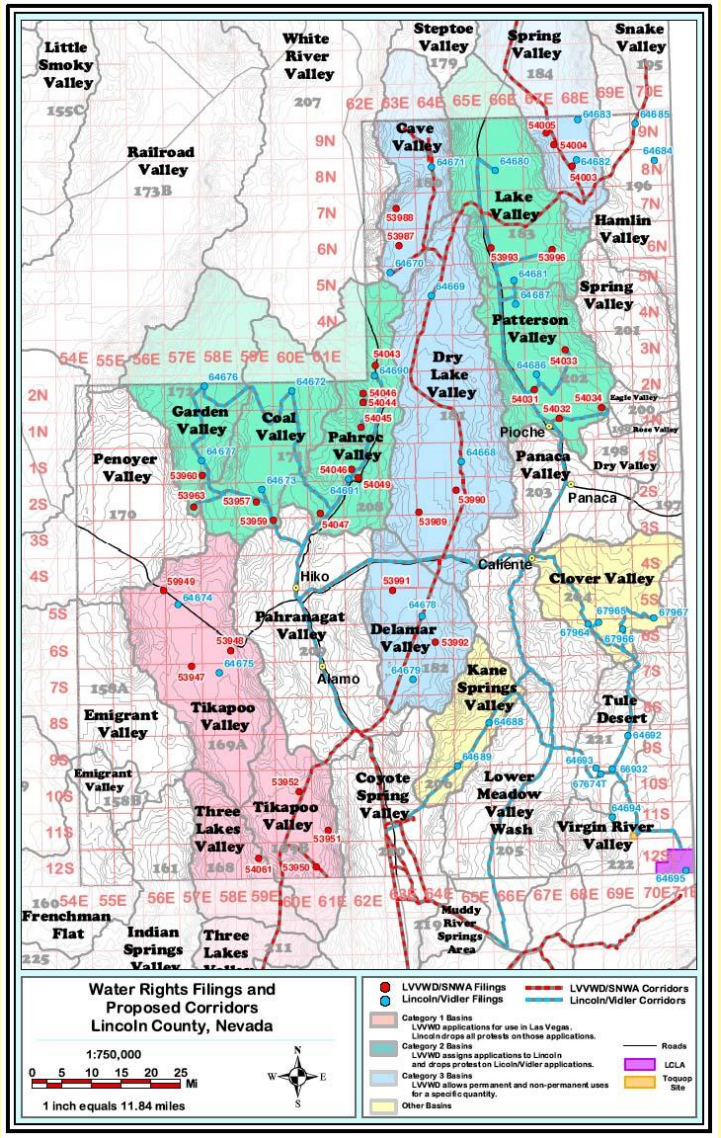
cheatgrass (*Bromus tectorum*)

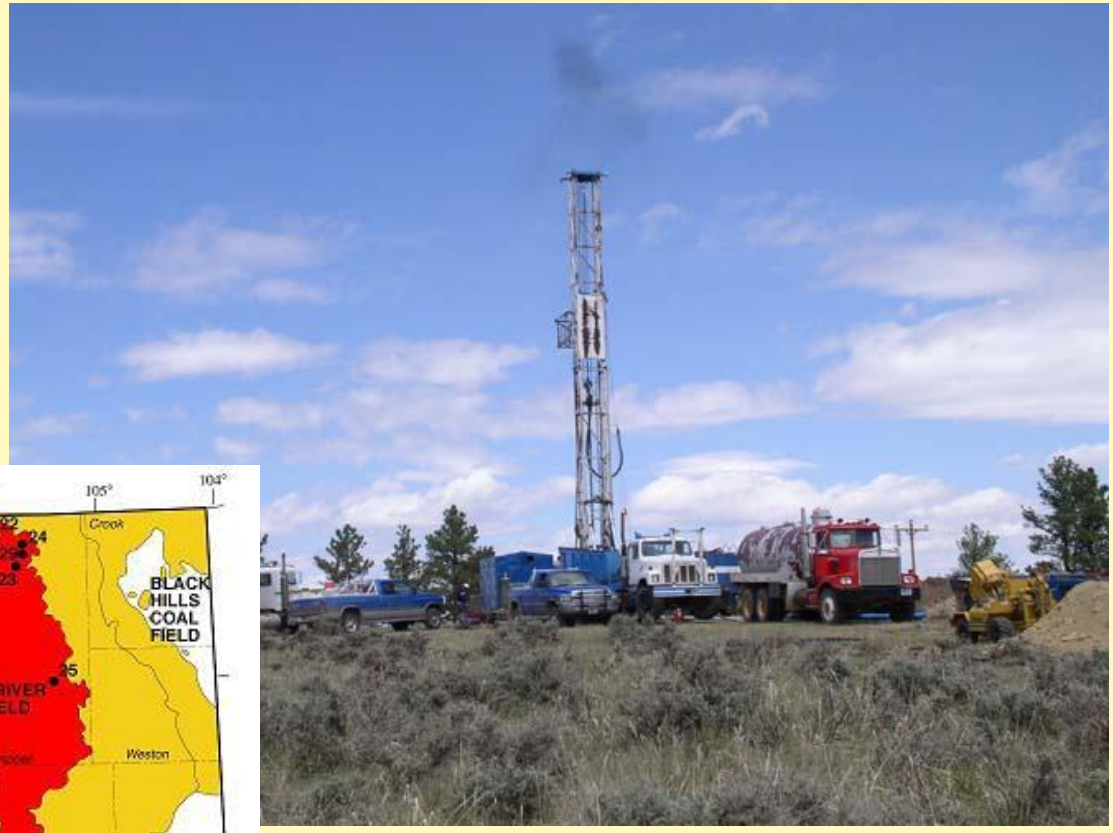
courtesy Bethany Bradley

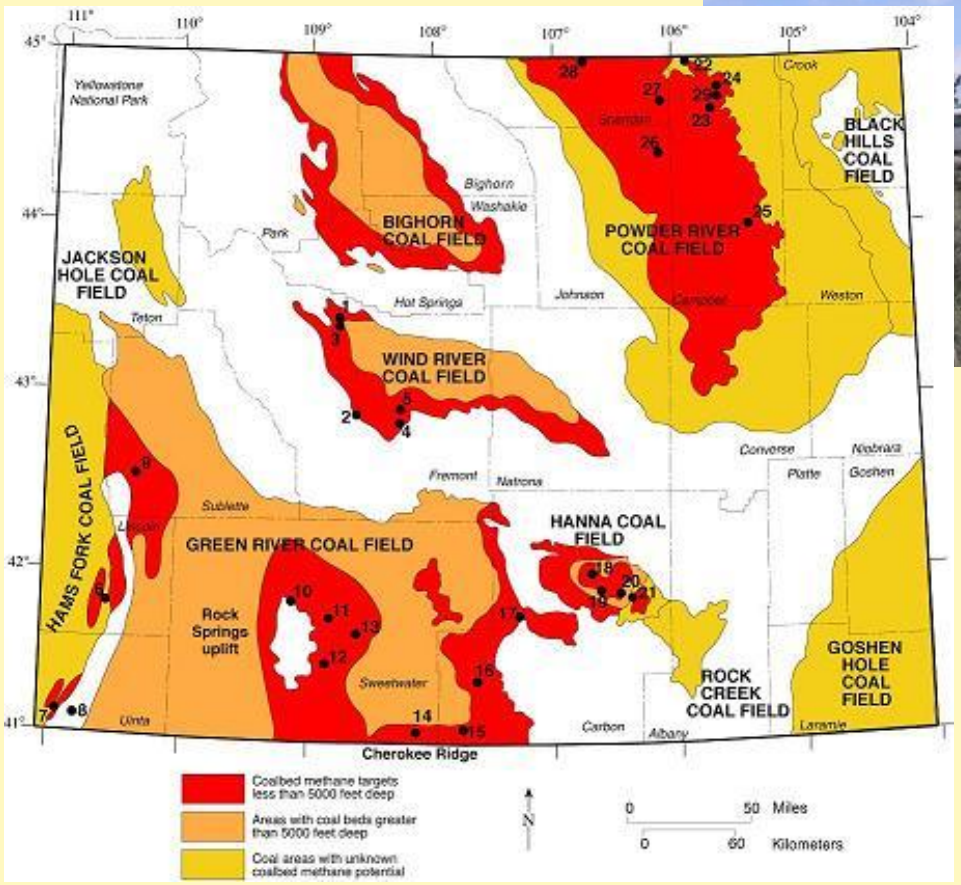
Exurbanization

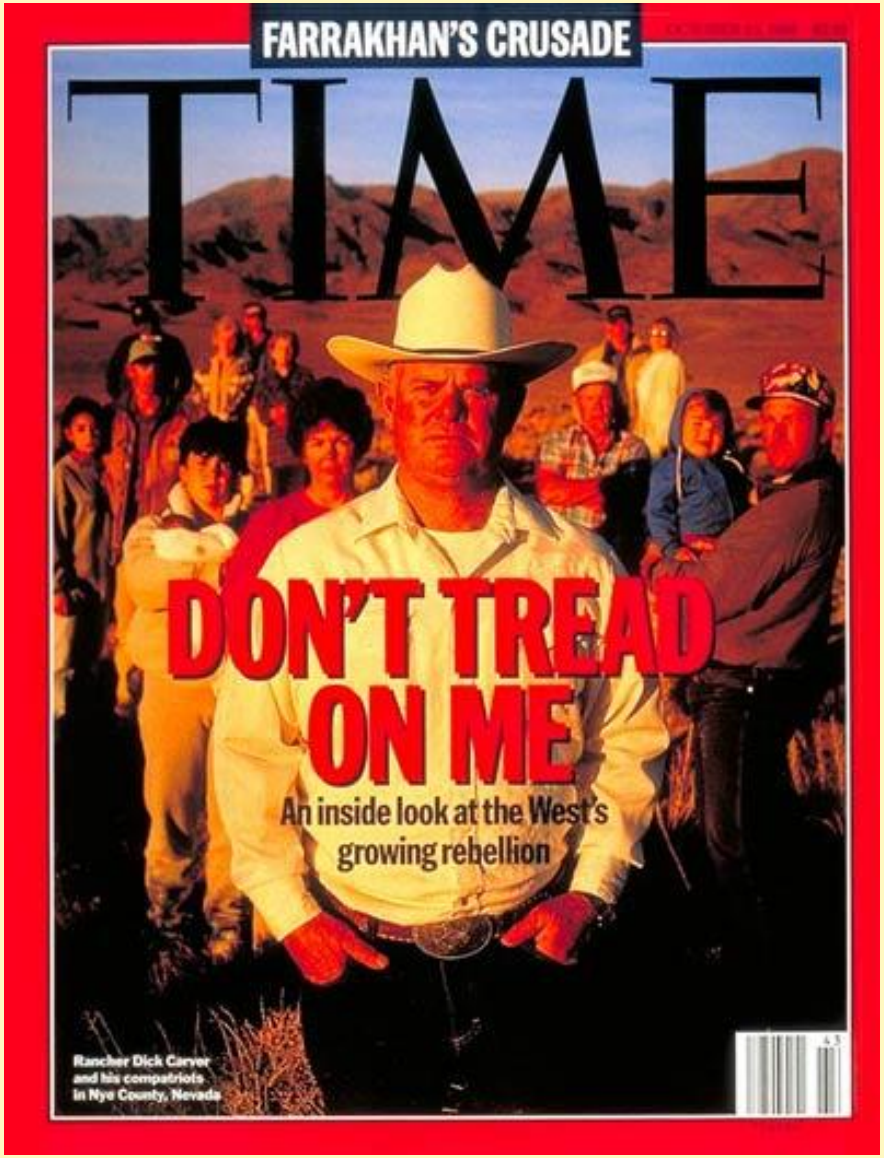
Lincoln County
Conservation, Recreation
and Development Act





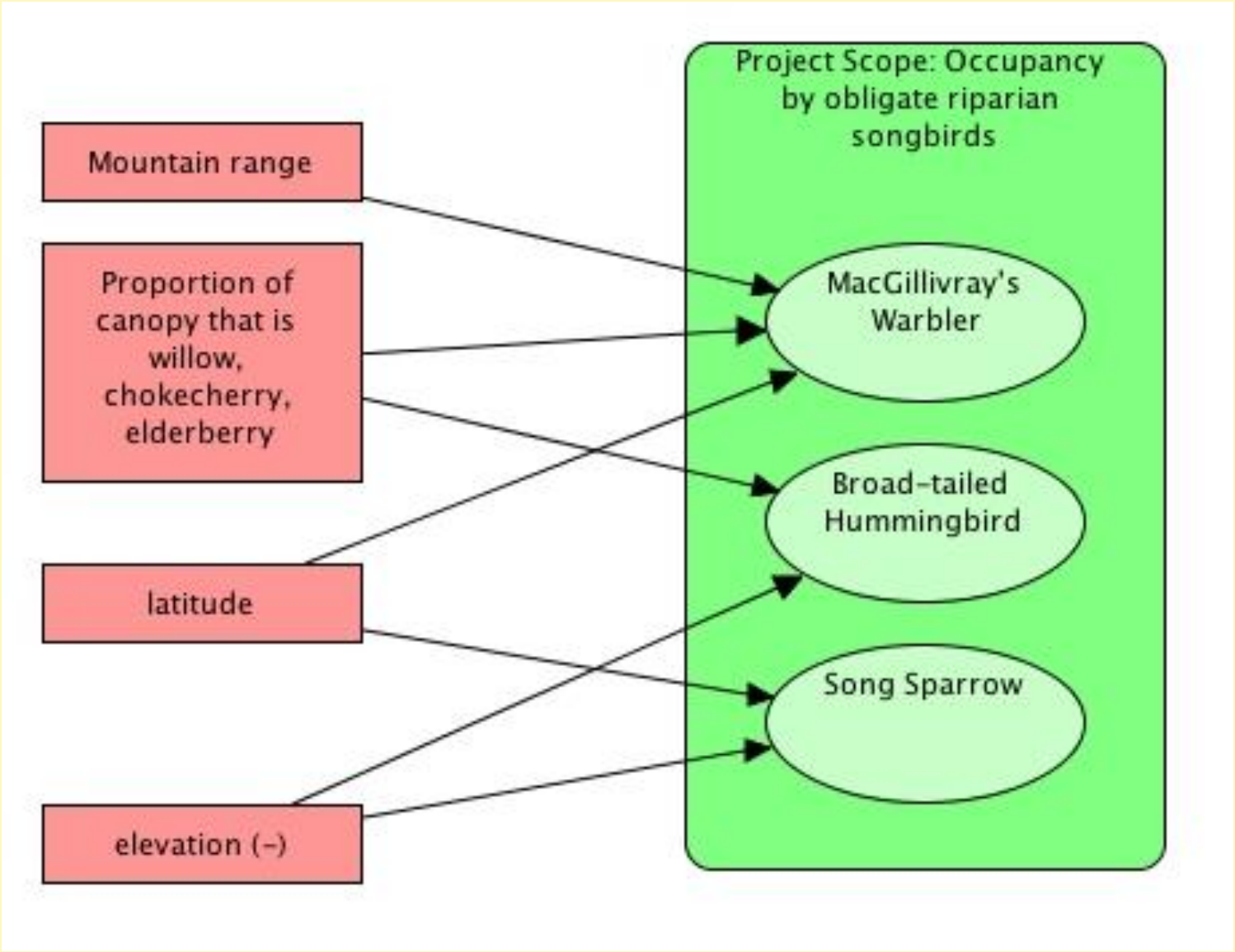



BIGHORN COAL FIELD
POWDER RIVER COAL FIELD
BLACK HILLS COAL FIELD
JACKSON HOLE COAL FIELD
WIND RIVER COAL FIELD
HAMS FORK COAL FIELD
GREEN RIVER COAL FIELD
HANNA COAL FIELD
ROCK CREEK COAL FIELD
GOSHEN HOLE COAL FIELD
Rock Springs uplift
Cherokee Ridge
Yellowstone National Park
Coalbed methane targets less than 5000 feet deep
Areas with coal beds greater than 5000 feet deep
Coal areas with unknown coalbed methane potential
0 50 Miles
0 80 Kilometers

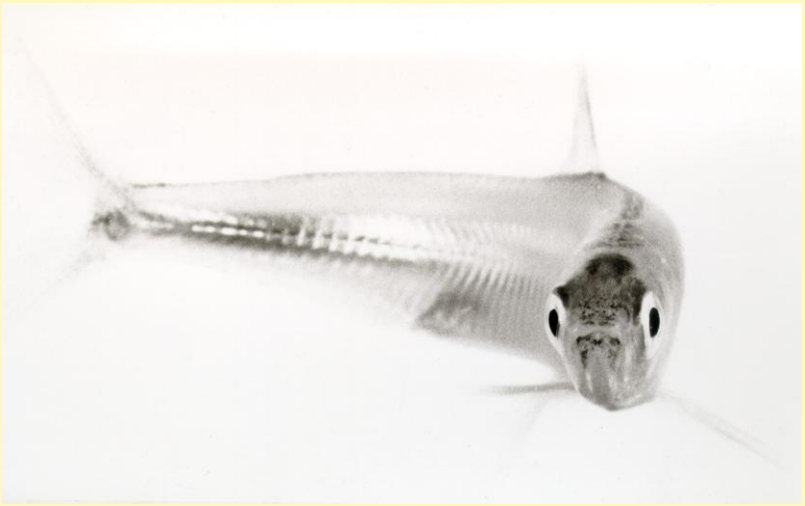


23 October 1995

One strategy doesn't fit all



Is Recovery Possible?



- Systems don’t decline overnight
- Chronic stressors
- Limited understanding
- Political will
- Tradeoffs

Collaborators and Sponsors

- Bethany Bradley
- Jeanne Chambers
- Nora Devoe
- Brett Dickson
- David Dobkin
- John Fay
- Steve Knick
- Matthias Leu
- Ralph Mac Nally
- Brad McRae
- Nathan Schumaker
- Steve Sesnie
- Jim Thomson
- Great Basin Ecosystem Management Project
- Nevada Biodiversity Initiative
- Joint Fire Science Program
- Wilburforce Foundation

"It of course goes without saying that economic feasibility limits the tether of what can or cannot be done for the land. It always has and it always will . . . [but the] bulk of all [management success] hinges on investments of time, forethought, skill, and faith rather than on investments of cash."

Aldo Leopold