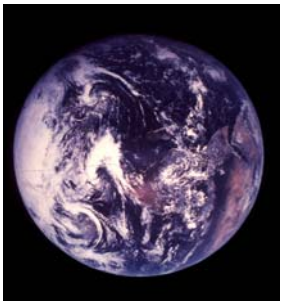
Drivers of ecosystem structure and function: threats to biological diversity



Getting from here to there (i.e., how to eat an elephant)

?

Coarse-scale communities

Drivers

Historical:

Fire
Livestock grazing
Logging
Urbanization
Agricultural expansion

Contemporary:

Livestock grazing
Fire (prescribed)
Urbanization
Biological invasions
Climate change

Historical disturbances – fire frequency

Coniferous forest – *Low-intensity surface fires every 10-50 yr (MFI); high-intensity stand-replacing fires every 200+ yr*

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Savanna – ***Low-intensity surface fires every 5-15 yr (MFI)***

Historical disturbances – fire frequency

Coniferous forest – ***Low-intensity surface fires every 10-50 yr (MFI); high-intensity stand-replacing fires every 200+ yr***

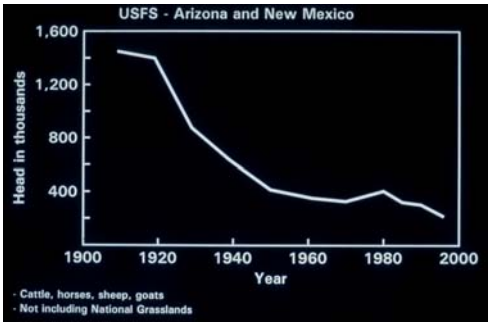
Oak woodland – ***Unknown***

Savanna – ***Low-intensity surface fires every 5-15 yr (MFI)***

Desert – ***Low-intensity surface fires rarely or never (Selaginella)***

Historical disturbances – livestock grazing

All community types – ***Impact peaked ca. 1895; droughts***



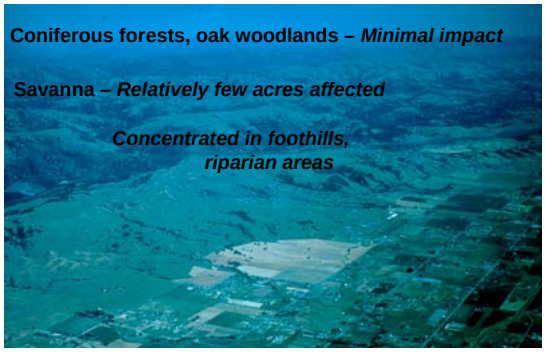
Historical disturbances – timber removal

All community types except deserts – ***Impact peaked ca. 1870***

Concentrated around mining towns

Historical disturbances – urbanization, agricultural expansion

Historical disturbances – urbanization, agricultural expansion



Historical disturbances – urbanization, agricultural expansion

Coniferous forests, oak woodlands – ***Minimal impact***

Savanna – ***Relatively few acres affected***

Concentrated in foothills, riparian areas

Deserts – ***Relatively few acres affected***

Concentrated near ore deposits, rivers

Contemporary disturbances

Coniferous forests, oak woodlands

Livestock grazing

Contemporary disturbances

Coniferous forests, oak woodlands

Livestock grazing
Infrequent high-intensity, stand-replacing fires (exception: Gila National Forest)

Contemporary disturbances

Coniferous forests, oak woodlands

Livestock grazing
Infrequent high-intensity, stand-replacing fires
(exception: Gila National Forest)

Savanna

Livestock grazing
Prescribed fire
Urbanization

Contemporary disturbances

Coniferous forests, oak woodlands

Livestock grazing
Infrequent high-intensity, stand-replacing fires
(exception: Gila National Forest)

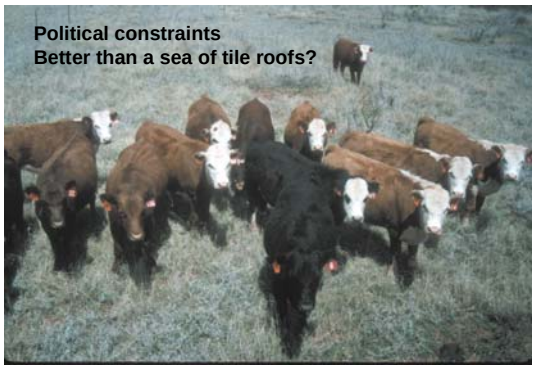
Savanna

Livestock grazing
Prescribed fire
Urbanization

Deserts

Livestock grazing
Urbanization
Increasingly frequent fires

Livestock grazing



Wildfires in deserts: note interaction with biological invasions

High-intensity, stand-replacing fires

Biodiversity, soils, aesthetics

Prescribed fire

Relatively new
Seasonality

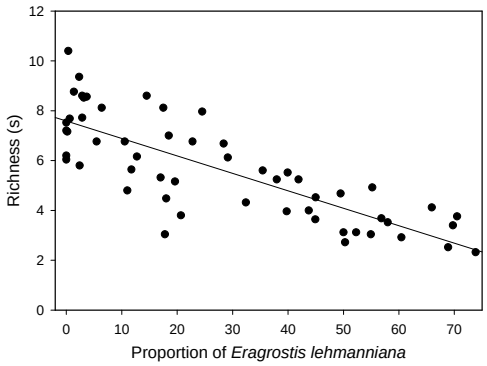
Fire effects = f(season)?

Typical Rx fire – *spring*

Typical pre-settlement (and contemporary) wildfire – *early summer*

Urbanization

Biological invasions – impact structure/function?



Biological invasions

Impacts on structure and function?

Interact with fire regime

Biological invasions

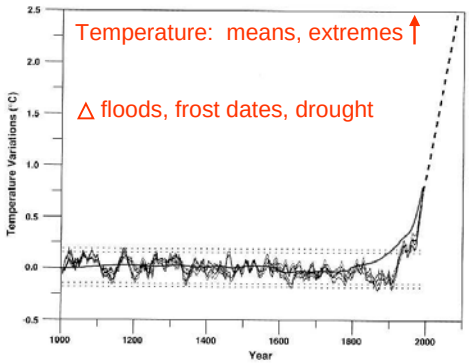
Impacts on structure and function?

Interact with fire regime

Precautionary principle:

Biological invasions cause extinction

Regional climate change



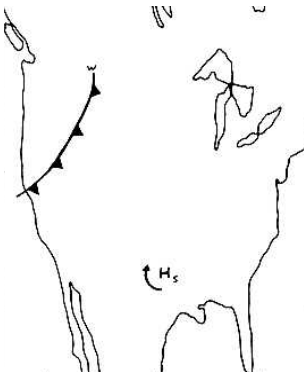
Crowley (2000) Science 289:270-277

Regional climate change

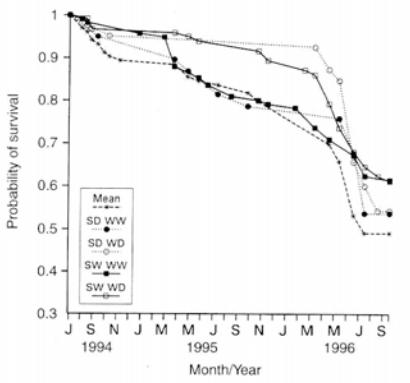
Precipitation:
bimodal distribution

Pacific Decadal Oscillation (PDO)

Atlantic Multidecadal Oscillation (AMO)



Regional climate change



Recommendations: contemporary drivers

Restore **fire** regimes, especially frequency, season
(*personal solution: engage in the political process*)

Recommendations: contemporary drivers

Restore **fire** regimes (frequency, season)

Reduce or eliminate **livestock grazing**
(*personal solution: vegetarianism*)

Recommendations: contemporary drivers

Restore **fire** regimes (frequency, season)

Reduce or eliminate **livestock grazing**

Reduce **urban/exurban development**
(*personal solution: stop at zero*)

Recommendations: contemporary drivers

Restore **fire** regimes (frequency, season)

Reduce or eliminate **livestock grazing**

Reduce **urban/exurban development**

Vigilantly monitor and control **nonnative species**
(personal solution: travel with care)

Recommendations: contemporary drivers

Restore **fire** regimes (frequency, season)

Reduce or eliminate **livestock grazing**

Reduce **urban/exurban development**

Vigilantly monitor and control **nonnative species**

Anticipate and plan for **climatic change**
(*personal solution: minimize consumption*)