THE FORAGE AND RANGE RESEARCH LABORATORY

Forage and Range Research Laboratory

Plant Evaluation in the Beaver Dam Wash and Red Cliff Reserve of Utah

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Who are we?

Our Mission

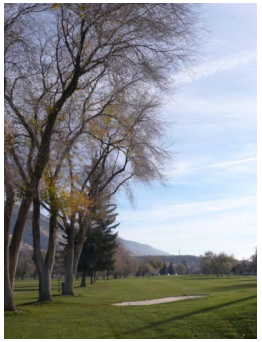
Provide improved plant materials and management alternatives for sustainable stewardship of rangelands and pastures in the western U.S.

Range Ecology Breeding

Pasture Breeding Culture

Plant Genetics (6)
Molecular Biologists (4)
Physiologist (1)
Ecologist (1)

Turf Breeding



Biomass Breeding

Rangeland Wildfires

- Cerro Grand Fire in NM in 2000 (48,000 acres, $800 million in damages)
- Rodeo-Chediski Fire in AZ in 2002 (150,000 acres, $300 million in damages)
- Milford Flat Fire in NV/UT in 2007 (366,000 acres, $37 million in damages)
- Southern Nevada Complex in NV and UT (739,037 acres, no $ assessment)

General Ecosystems of the Mojave Desert

Low elevation shrubland

Middle elevation shrubland

High elevation shrubland

Brooks & Minnich (2006)

Increasing Fire Resiliency →

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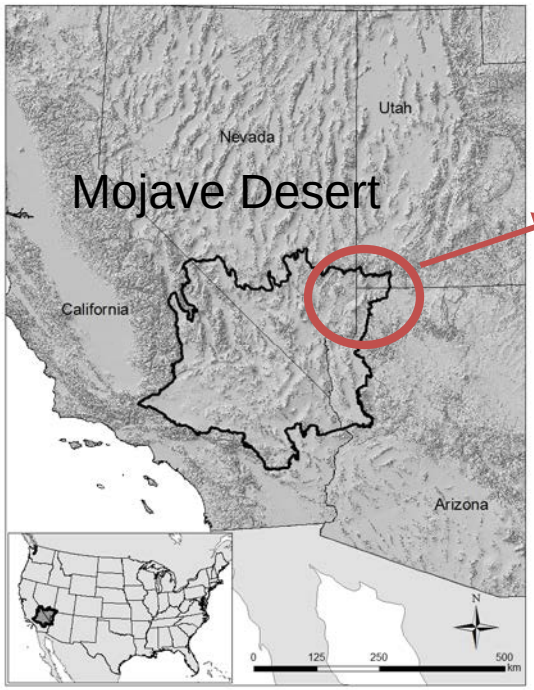
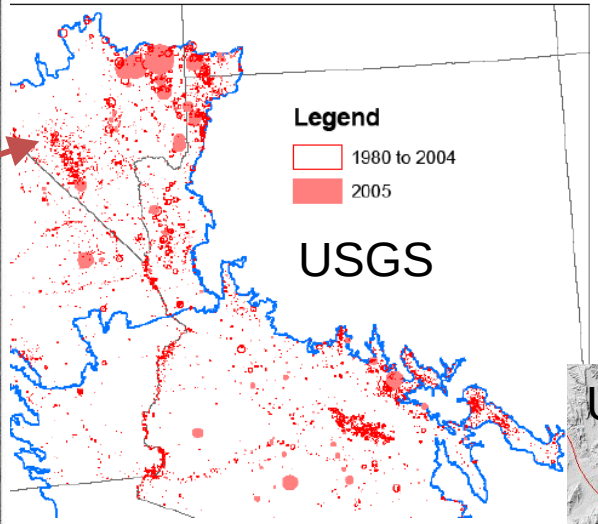
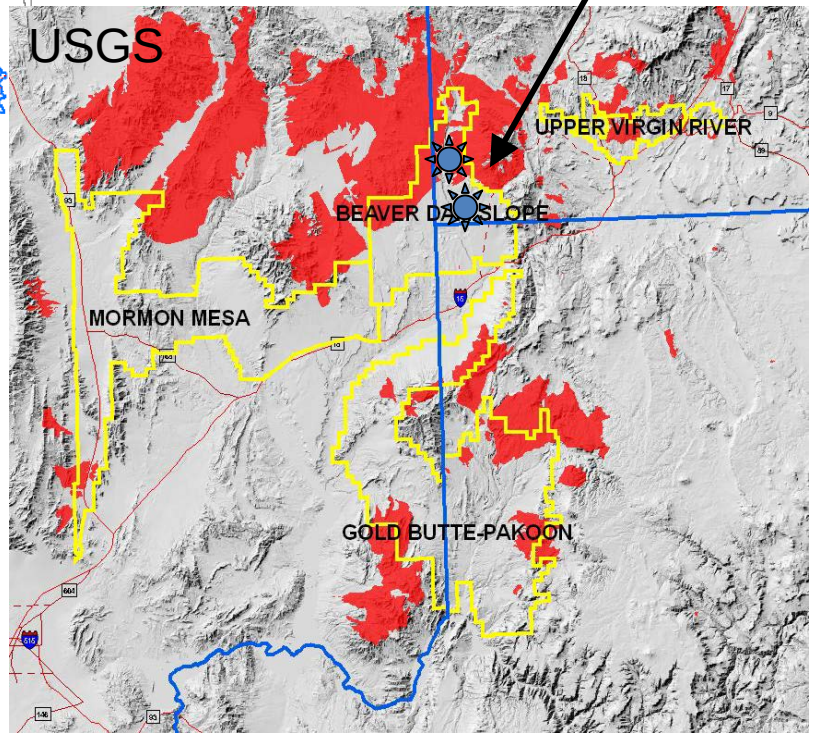
Rangeland Wildfires



Wildfire Activity



Experimental Sites
Beaver Dam Wash
Red Cliff Reserve



Brooks & Matchett (2006)

- ❖Most fires are in the low-middle elevations
- ❖(creostoe bush scrub & blackbrush)
- ❖Fire size is dictated primarily by non-native annual grasses
- ❖Fire size related to winter rainfall
- ❖Warming climate may shift fire regimes

Climate Change Predictions

Brooks & Matchett (2006)

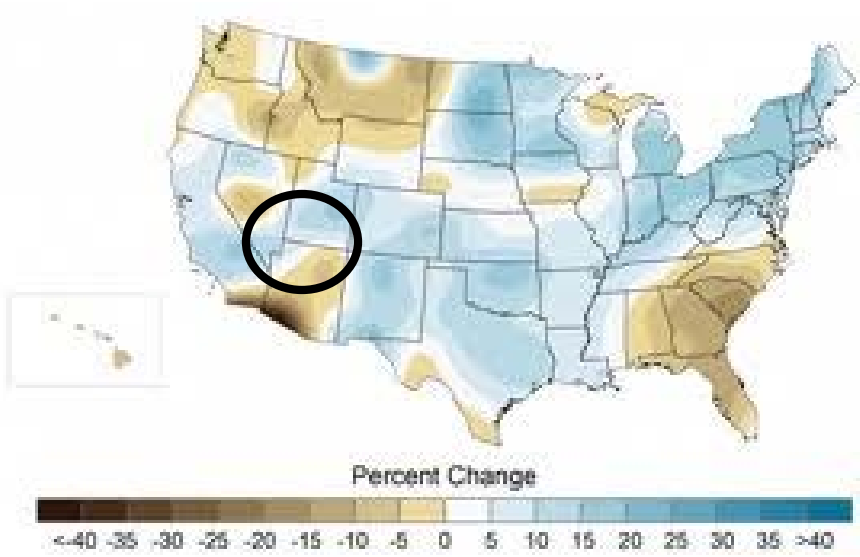
❖Potential future precipitation events is difficult to predict

❖Changes in summer:winter precipitation (< or >) have differing implications for invasive plants, fire regimes, and their interactions

❖Generally, increasing temperatures will mean decreasing effective precipitation available to plants and concomitant effects on fuelbeds

❖Expect the Mojave Desert to generally be hotter and drier, and wildfires to be much larger.

Percent Change in precipitation between 1958-2088

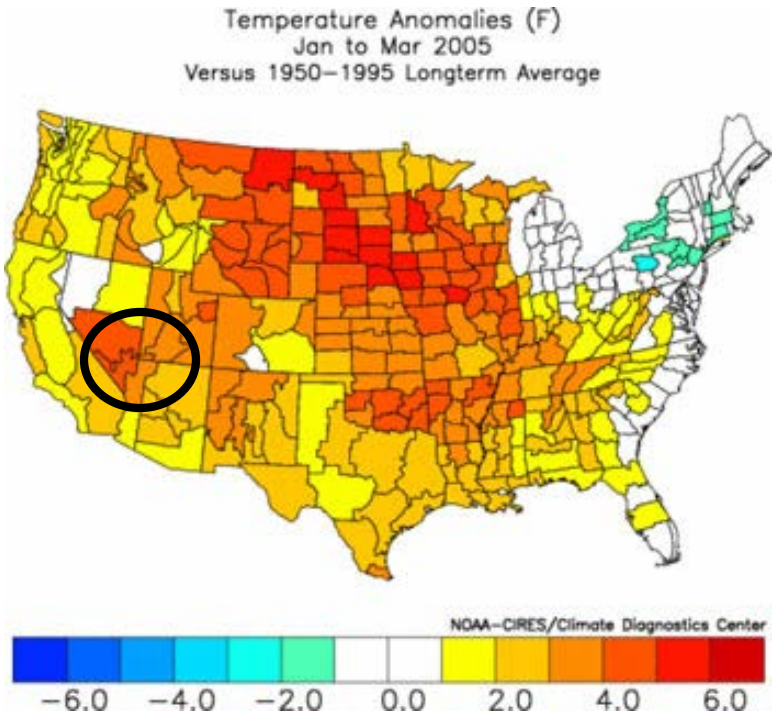


nca2009.globalchange.gov

Climate Change Predictions

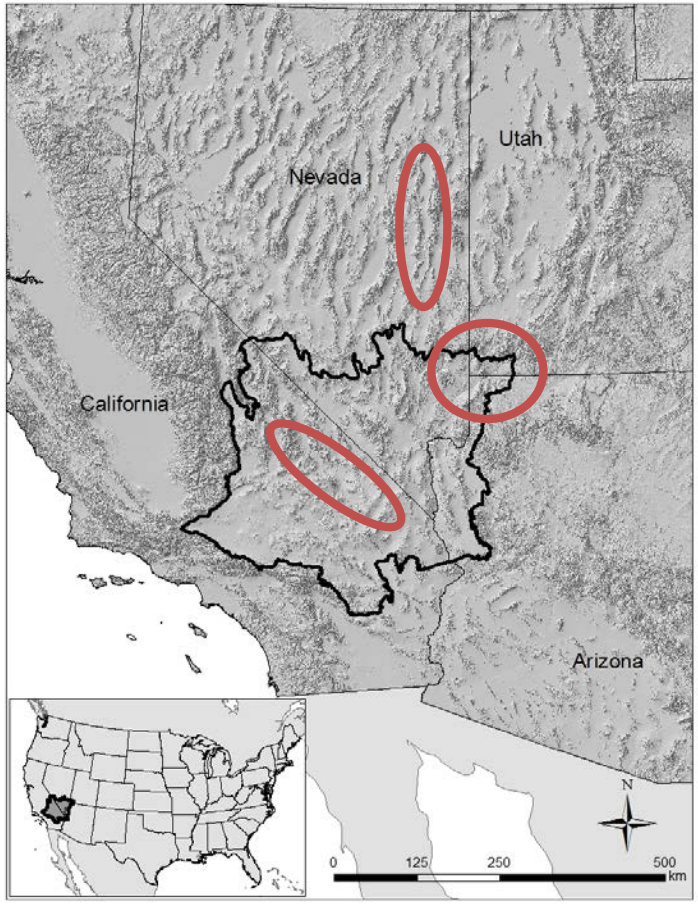
Brooks & Matchett (2006)

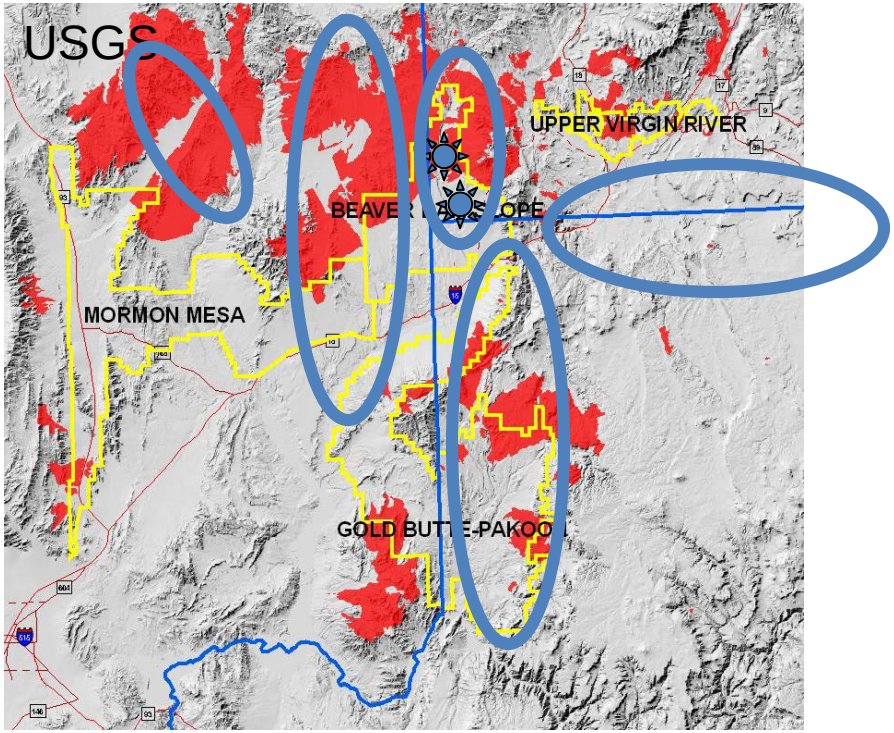
- Climate models predict increasing temperatures
- Temperature increases will change hot deserts
- Non-native annual grasses may move upslope
- Earlier warming in winter season will favor non-native invasive weeds
- Increased temperatures will increase the length and aridity of the summer fire season



USDA Project Objective

Collect, characterize and evaluate grass, legume, and forb germplasm for <u>genetic structure/variation</u> and <u>stand establishment</u>, and <u>persistence</u> characteristics for use on disturbed and dry rangelands in the Mojave Desert





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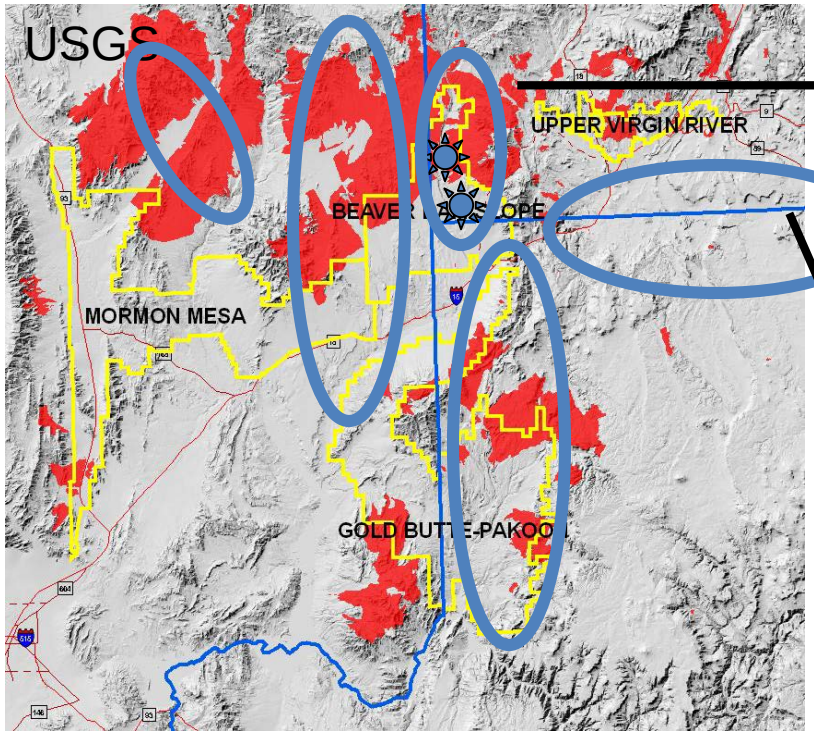
Collection Sites



Test Hypotheses

Hypothesis 1.1: Phenotypic- and DNA-based variation in wildland collections of sideoats grama (*Bouteloua curtipendula*)) and big galleta grass (*Pleuraphis rigida*) from the Mojave Desert is greater than that of available commercial cultivars.

Hypothesis 1.2: Shrubs, forbs, and warm-season grasses from the Mojave Desert have lower vegetative vigor and survival after simulated herbivory than forage kochia and cool-season grasses in a disturbed, Mojave Desert-blackbrush environment.

Hypothesis 1.3: The extent and rate of recovery of warm-season grasses and sub-shrubs is greater than cool-season grasses after a fire challenge.

Experimental Tests

General Information

How did we choose the species?

Talking to universities, BLM, and USFS

Abella (2010; Increasers, Versatile, Decreasers)

Total of 46 species will be evaluated to include:

Perennial Grasses

Sub-shrubs

Experimental Tests

Hypothesis 1.1: Phenotypic- and DNA-based variation in wildland collections of sideoats grama and big galleta grass.

- Sideoats grama and big galleta grass provide abundant forage
- Tall stature with dominant tussock
- Sideoats possesses genetically-based grazing tolerance in desert environments

Smith 1998 and Smith et al. 2000 (Sonora Desert)

Experimental Design

- Evaluate at two locations, RCBD, 7 replications of 10 plants
- Evaluate biomass, plant height, plant vigor, seed yield, forage quality

Experimental Tests

Hypothesis 1.2: Shrubs, forbs, and warm-season grasses from the Mojave Desert have lower vegetative vigor and survival after simulated herbivory than forage kochia and cool-season grasses.

- Forty-six species entries
- Two locations, RCBD, 3 replications of 10 plants
- Hand Clip 5 of 10 plants in the second year
- Harvest Biomass each year (2 years)
- Evaluate mortality and persistence

Experimental Tests

Hypothesis 1.3: The extent and rate of recovery of warm-season grasses and sub-shrubs is greater than cool-season grasses after a fire.

- Selected plants:

  Grasses: sideoats, big galleta, indian ricegrass

  Sub-shrubs: globemallow, winterfat, forage kochia

- Controlled burn of potted plants in a cage

  (Vermeire & Rinella, 2009)

- RCBD, 4 reps of 7 plants
- Plant height weekly to estimate rate of regrowth (greenhouse)
- Harvest biomass after 4 months growth (greenhouse)
- Evaluate mortality and persistence

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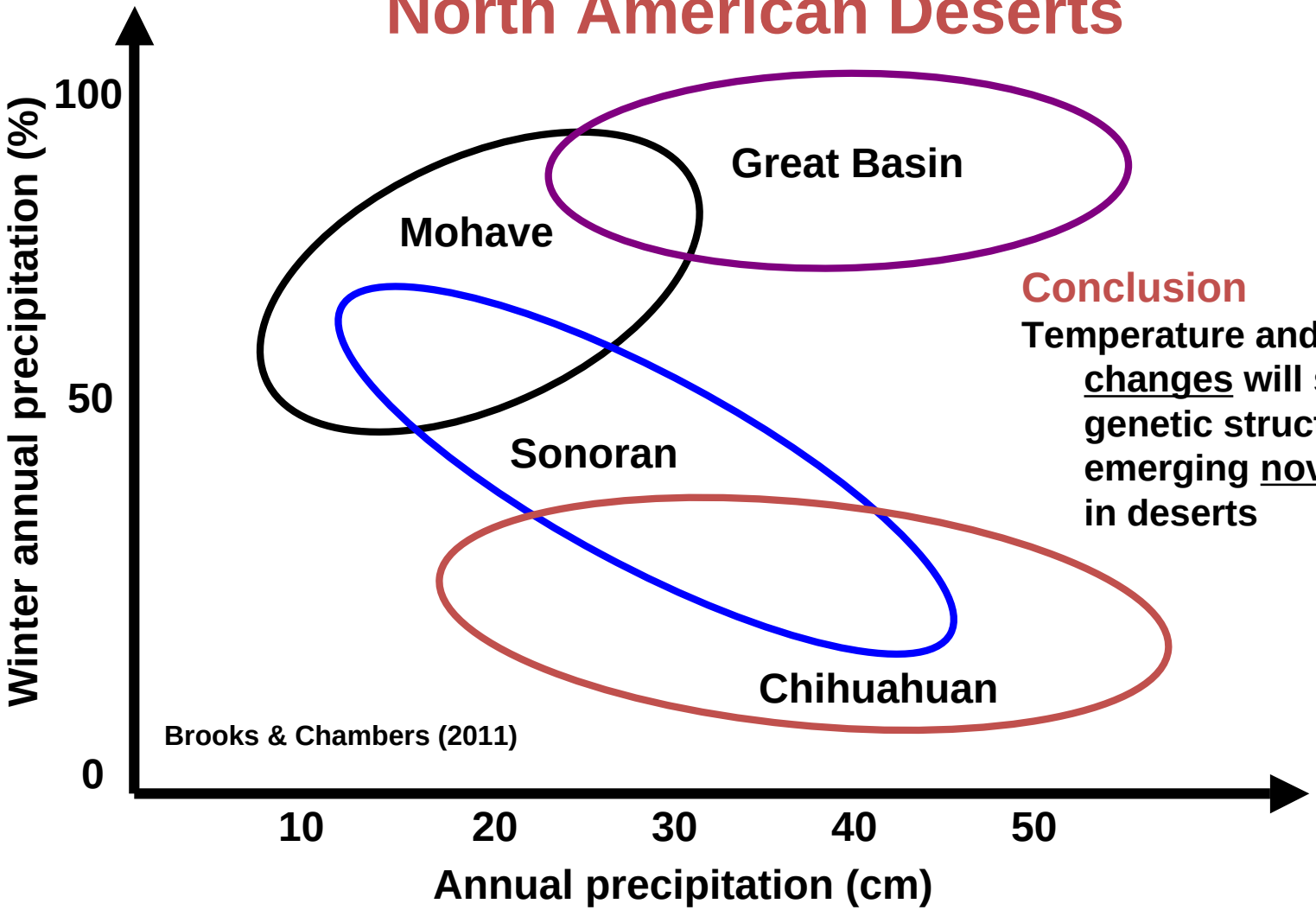
Site Preparation & Planting

Emergence of Novel Ecosystems

North American Deserts



Conclusion

Temperature and precipitation <u>changes</u> will shape the genetic structure of emerging <u>novel ecosystems</u> in deserts

Novel Ecosystems: Colorado Plateau

Colorado Plateau on the Brink of Change (Munson et al. 2011)

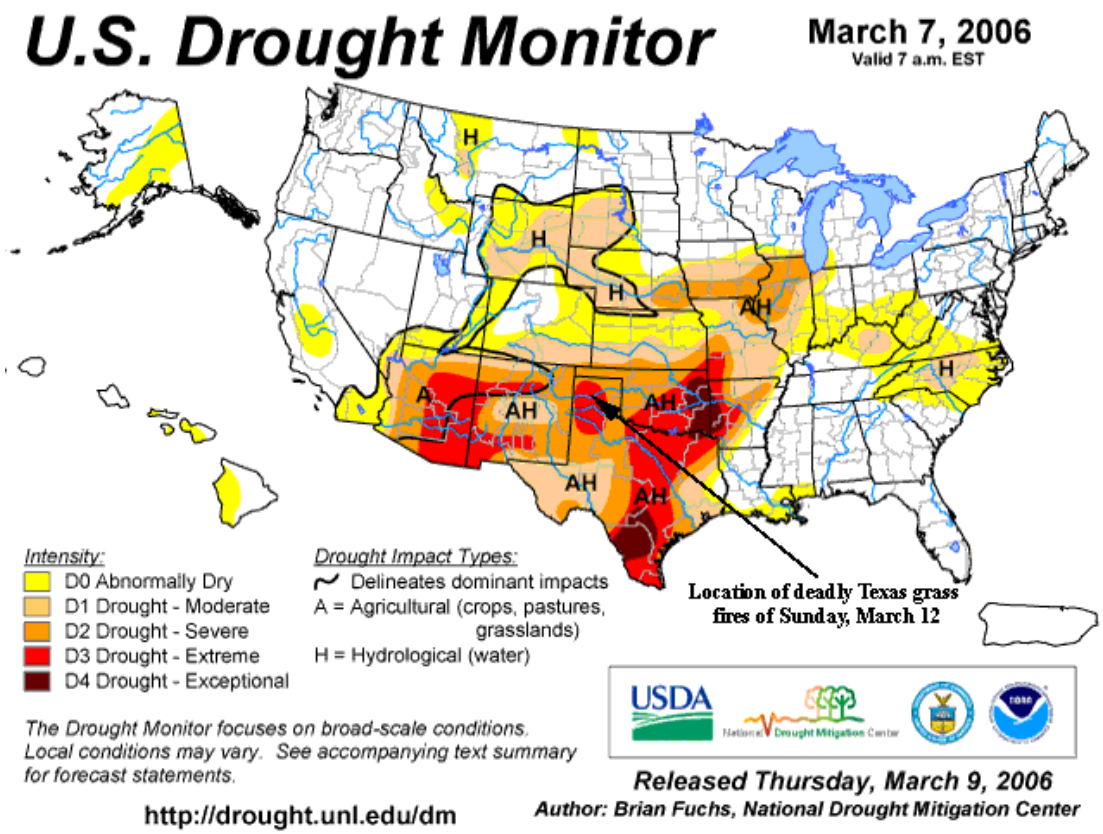
1) Plant species & functional types have changed in the last 20 yrs
2) Increase of 0.18^{o}C, 1989-1995
   Increase of 0.06^{o}C, 1995-2003
   Increase of 0.14^{o}C, 2003-2008
3) High variability in precipitation over the last 20 years
4) Canopy cover of perennial plants is sensitive to mean annual temperatures occurring in the previous year
   Canopy cover of annual plants respond to cool season precipitation
5) Decline in C_3 perennial grasses
   No change in C_4 perennial grasses
   Increase of shrubs with increasing temperature

Conclusion

Increased aridity will promote grass loss and shrub expansion

Parting Thoughts

- ❖Fuel loads of annual invasive weeds will, in combination with higher temperatures and less precipitation, will lead to increased landscape disturbances in North American deserts

- ❖Such changes will create novel ecosystems

- ❖Therefore, there is a need for improving plant species that optimize ecosystem services in novel environments