

# An Overview of Climatic Influences on Invasive Plants in Arizona (and other factors)

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Biotic  
Factors?

Climate  
(CO<sub>2</sub>, Temp., Precip.)?

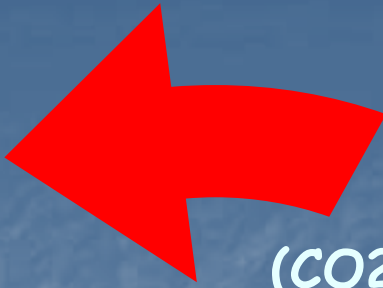
Will "plant x"  
invade or expand  
in "habitat y"

Abiotic  
Factors?

Management  
Practices?

Stochastic,  
Episodic  
Events

(rain/fire/drought)?



# Past and Future CO<sub>2</sub> Levels

**Past** -- CO<sub>2</sub> levels increased from 280 ppm (pre-industrial) to 370 ppm (1997), and are rising faster than at any other time during the past 20,000 years (Weltzin et al. 2003).

**Future** -- CO<sub>2</sub> levels may > double by 2100 (Weltzin et al. 2003).

# Increased CO<sub>2</sub> may:

- Favor C3 plants > C4 plants, especially during El Nino years
- Slow succession in desert ecosystems due to increased WUE by low successional species (red brome, cheatgrass)
- Reverse desertification on dryland systems due to the "fertilization effect"
- Favor woody plants > herbaceous plants
- Increase crop productivity

# Past and Future Temperature Levels

**Past** -- The Earth's temperature rose about  $0.5^{\circ}\text{C}$  during the 20<sup>th</sup> century (Schneider 1994). Last year (2005), was tied with 2002 for the 2<sup>nd</sup> warmest year since reliable records have been kept in the late 1800's.

**Future** -- Intergovernmental Panel on Climate Change (IPCC 2001) predicted the earth's average surface temperature will increase  $1.4\text{-}5.8^{\circ}\text{C}$  ( $2.5\text{-}10.4^{\circ}\text{F}$ ) by 2100.

**Future** -- Recent study by Purdue University (2005) predicts southwest U.S. will become hotter. Overpeck (2003) predicted AZ will be  $5\text{-}12^{\circ}\text{F}$  warmer during all seasons during the 21<sup>st</sup> century.

# Increased temperatures may:

- Influence fire regimes
- Favor C4 plants > C3 plants
- Favor woody plants > herbaceous plants
- Decrease WUE and speed the desertification process
- Decrease dryland crop productivity

# Past and Future Precipitation Levels

**Past** -- Historically (over the last 1000 years), droughts lasting a decade or more were not uncommon in AZ (Hughes et al., 2003).

**Future** -- One study suggested that the next 2-3 decades will be drier than normal in the southern deserts of North America (Dettinger et al., 2001). However, a recent study by Purdue University (2005) predicted little overall change in year-round rainfall across much of the Southwest.

**Future** -- The timing and amount of precipitation received will continue to be extremely important in AZ.

# Timing and amount of precipitation may:

- Shismus spp. > red brome?
- Episodes of well-timed rainfall events stimulate “pulse-reserve” arid ecosystems
- Change fire regimes
  - Warm-season exotics (Lehmann's, buffle, fountain grass)
  - Cool-seasons (bromes [red, cheatgrass]; wild oats; Sahara mustard)



# Cave Creek Complex Fire, 2005



"There are ominous signs that the Earth's weather patterns have begun to change dramatically - with serious political implications for just about every nation on Earth. The evidence in support of these predictions has now begun to accumulate so massively that meteorologists are hard-pressed to keep up with it. To scientists, these seemingly disparate incidents represent the advance signs of fundamental changes in the world's weather. 'A major climatic change would force economic and social adjustments on a worldwide scale,' warns a recent report by the National Academy of Sciences. Climatologists are pessimistic that political leaders will take any positive action to compensate for the climatic change. The longer the planners delay, the more difficult will they find it to cope with climatic change once the results become grim reality."

“(Climatologists) concede that some of the more spectacular solutions proposed, such as melting the Arctic ice cap by covering it with black soot or diverting arctic rivers, might create problems far greater than those they solve. If the climatic change is as profound as some of the pessimists fear, the resulting famines could be catastrophic. But the scientists see few signs that government leaders anywhere are even prepared to take the simple measures of stockpiling food or of introducing the variables of climatic uncertainty into economic projections of future food supplies.”

Excerpt from a Newsweek article entitled, [“The Cooling World”](#) April 28, 1975. The article quoted a NAS report written by scientists from NOAA and several other well-respected institutions.

"As far as the laws of mathematics refer to reality, they are not certain; as far as they are certain, they do not refer to reality."

-- Albert Einstein

“Under the state-and transition model, range management would not see itself as establishing a permanent equilibrium. Rather, it would see itself as engaged in a continuing game, the object of which is to seize opportunities and to evade hazards, so far as possible. The emphasis (of range management practices and decisions) would be on timing and flexibility rather than on establishing a fixed policy.” Westoby et al., 1989 (JRM).