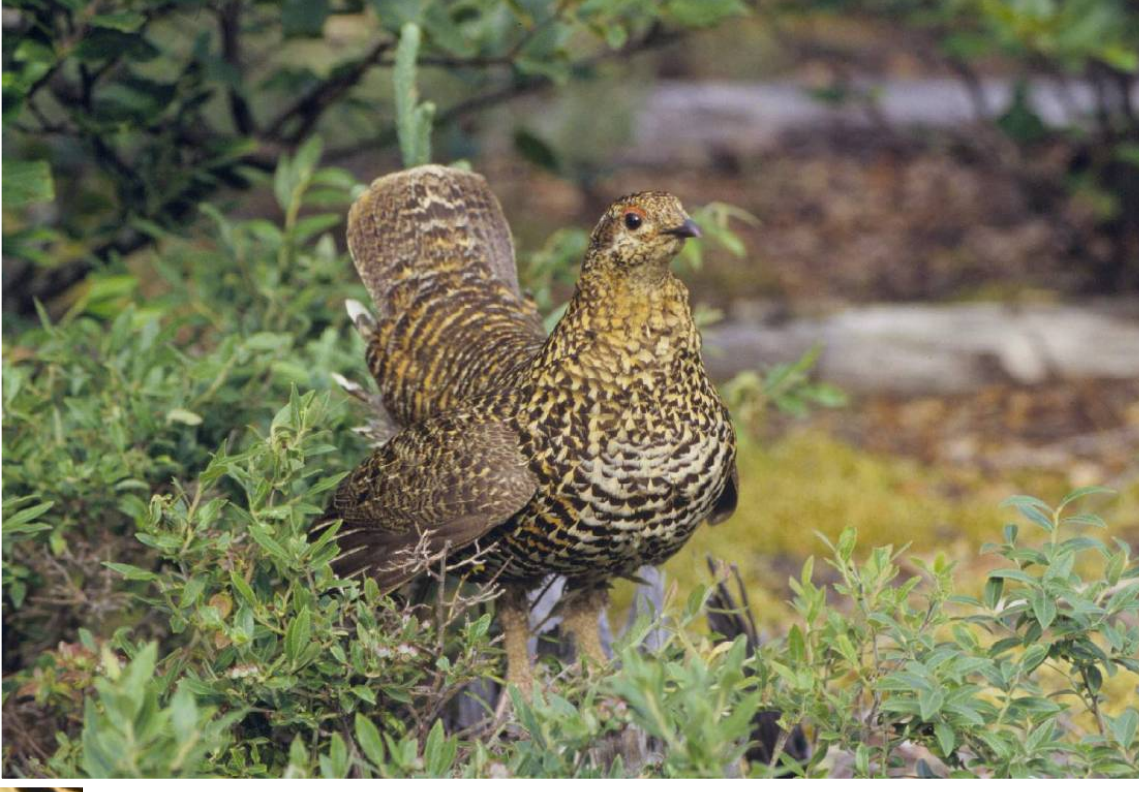


The Superior Basin

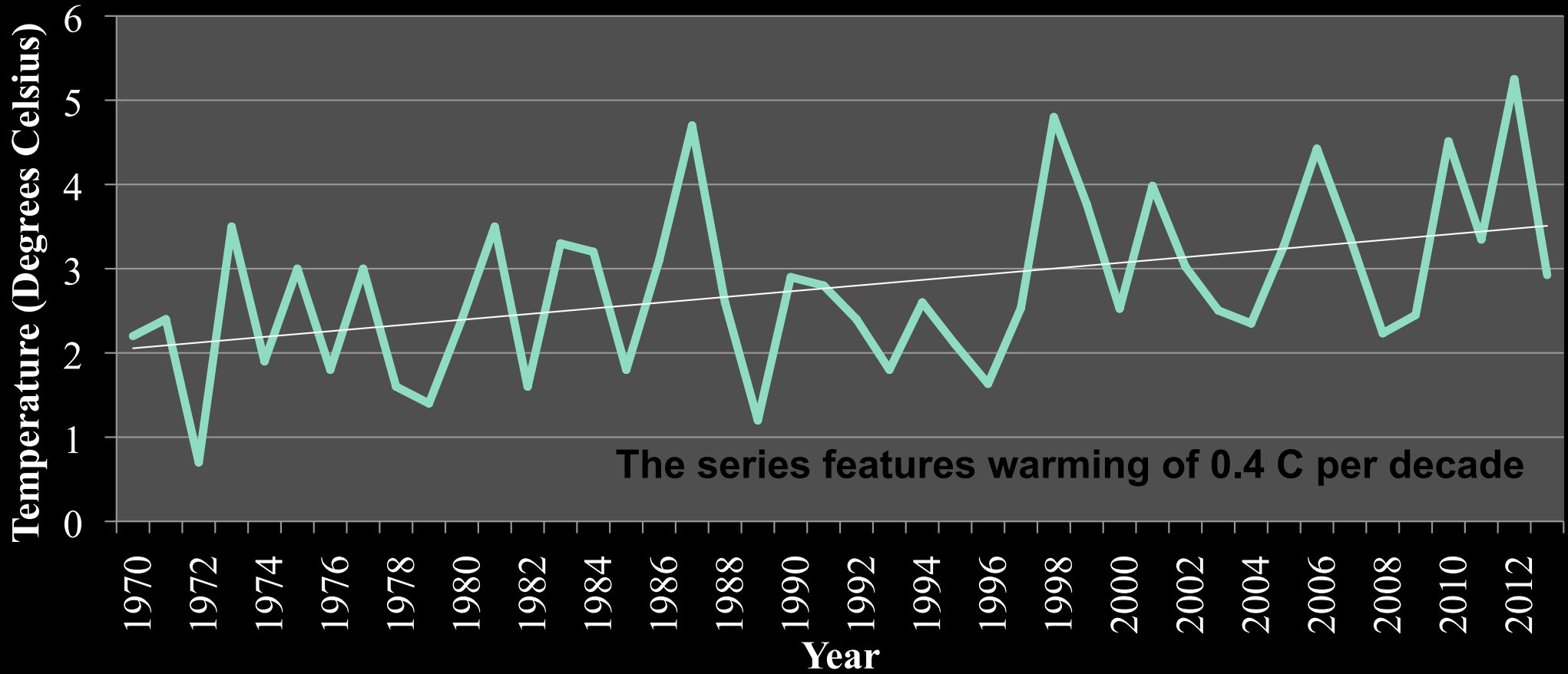
Changing Climate, Fauna, Flora

Graham Saunders
2015

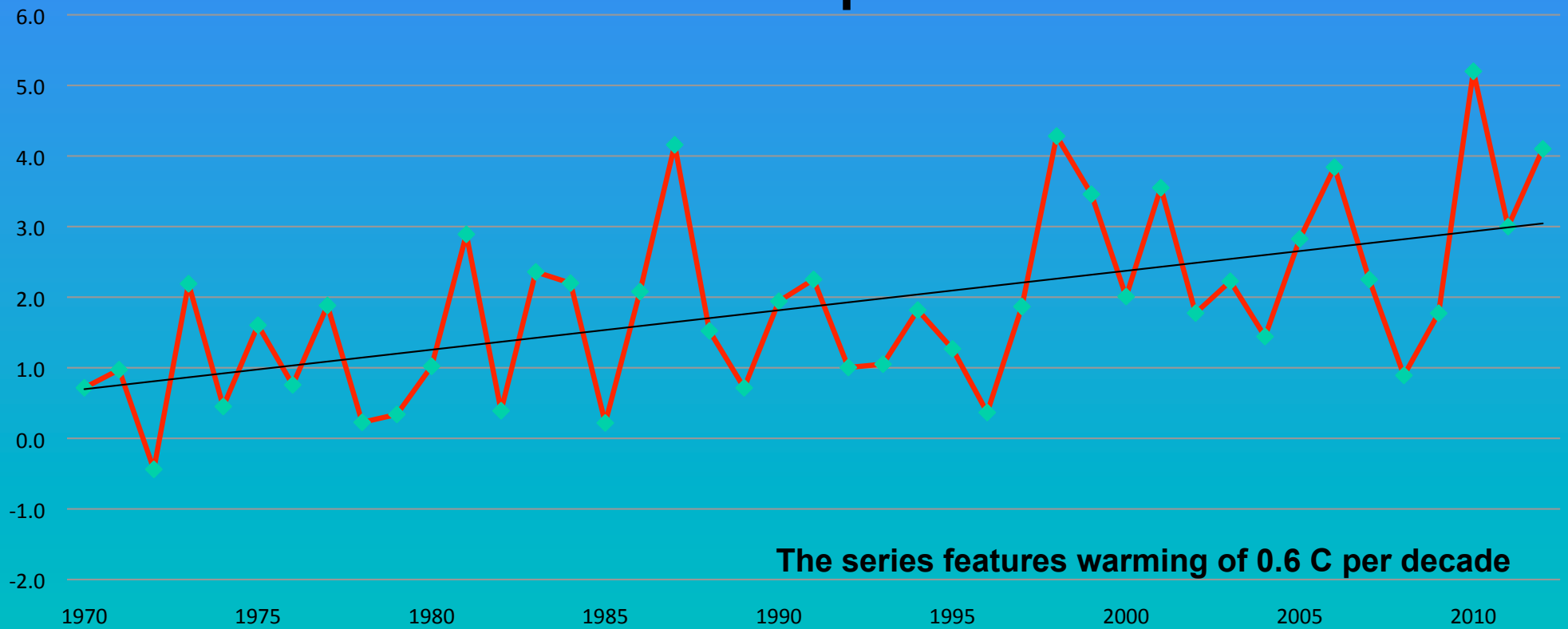




Thunder Bay Annual Temperatures: 1970 to 2013

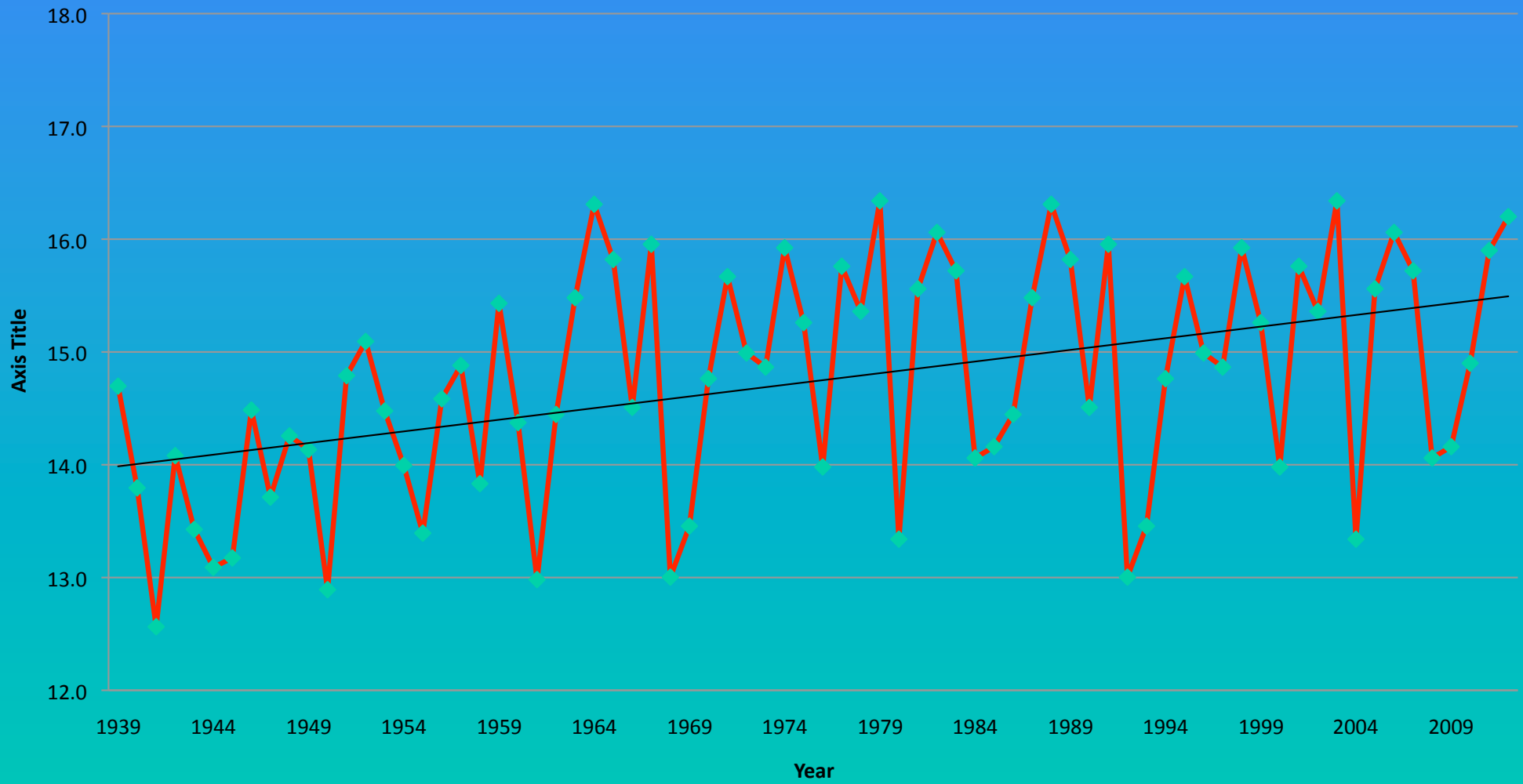


Sioux lookout annual temperatures: 1970 -2012



Source: Environment Canada (<http://www.climate.weatheroffice.ec.gc.ca>)

Sioux Lookout Growing Season: 1939- 2012



One key to adaptation is understanding the mechanisms

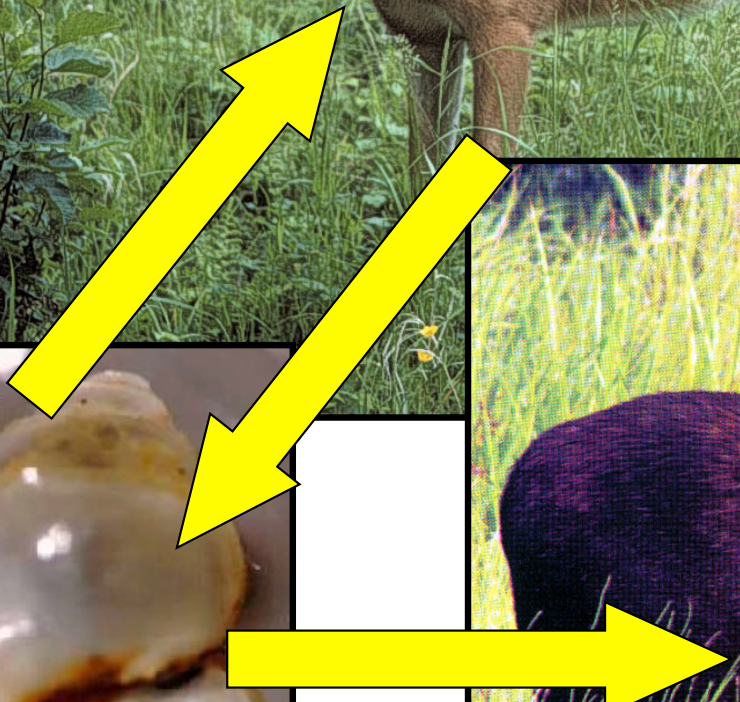
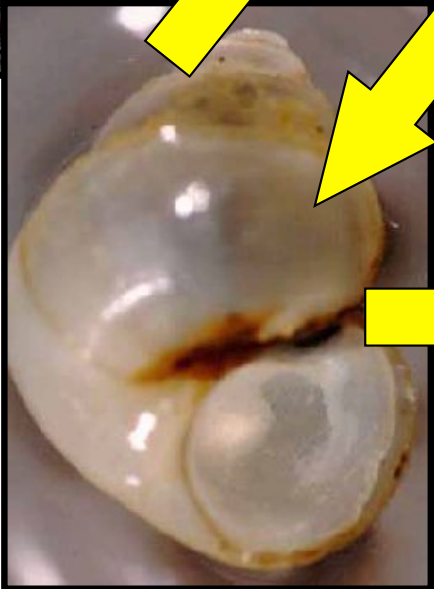
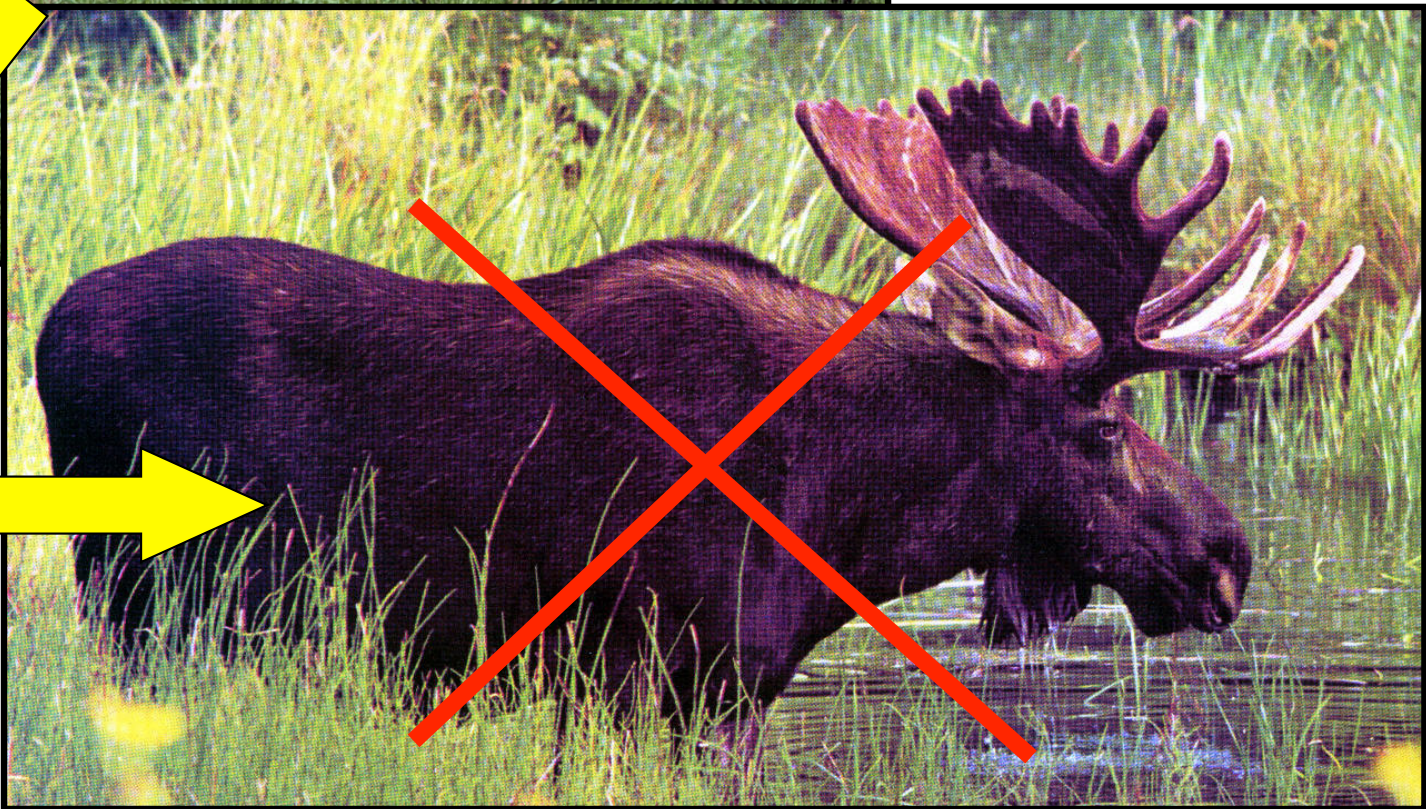
Every Area is Unique

- Ecological Context
- Social Context

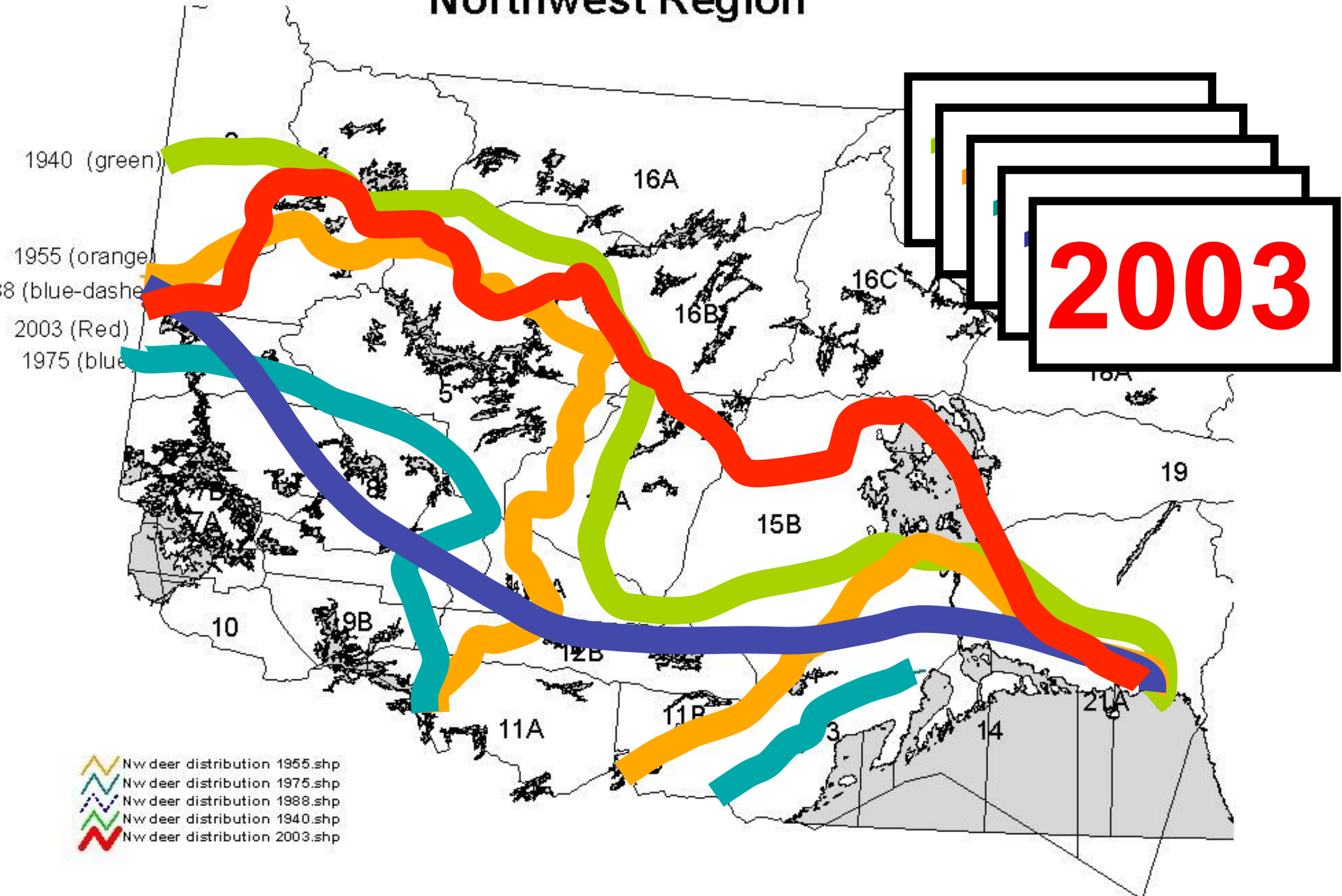
Three examples (wildlife, forests, fish)

- Winter severity and wildlife species shifts
- Plant moisture stress and tree growth
- Lake trout habitat

White-tailed deer and *P. tenuis*



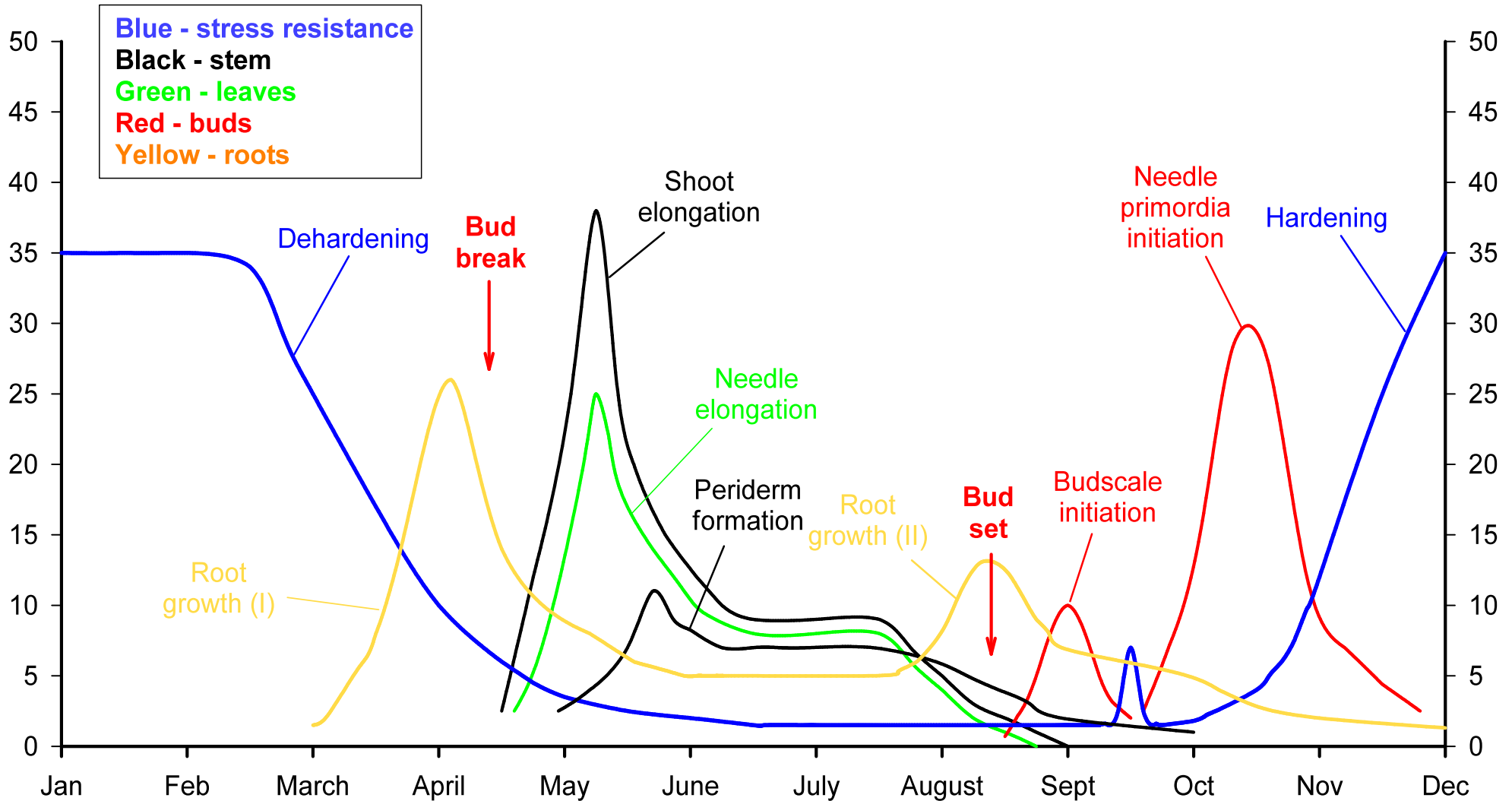
Approximate Distribution of White-tailed deer Northwest Region



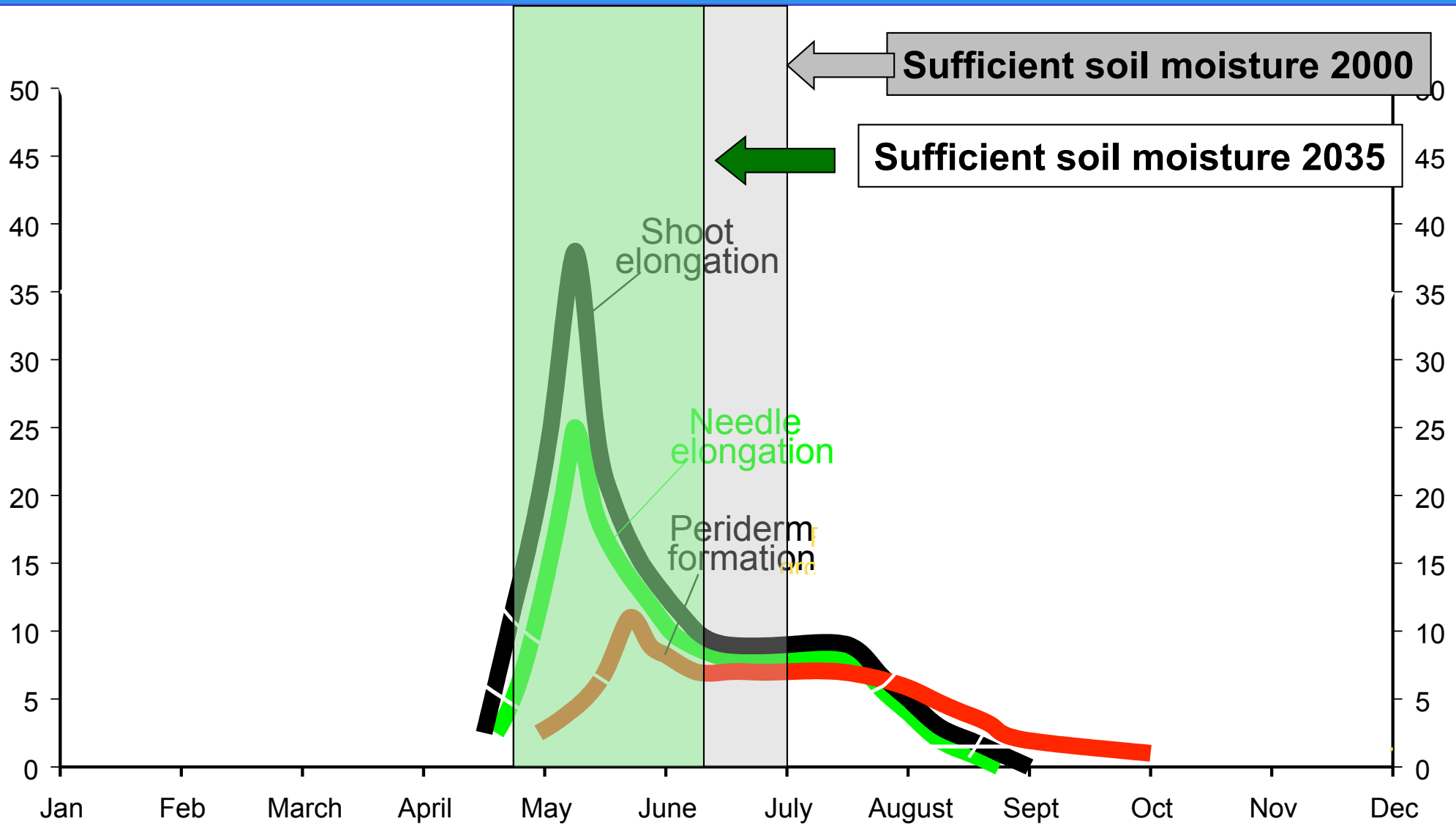
Tree Growth

- Greater tree growth **if moisture is not limiting**
- More stressful growing environment
 - higher temperatures and increased evapo-transpiration
 - longer droughts and sustained soil moisture deficits
- Stressed trees more susceptible to diseases and insects

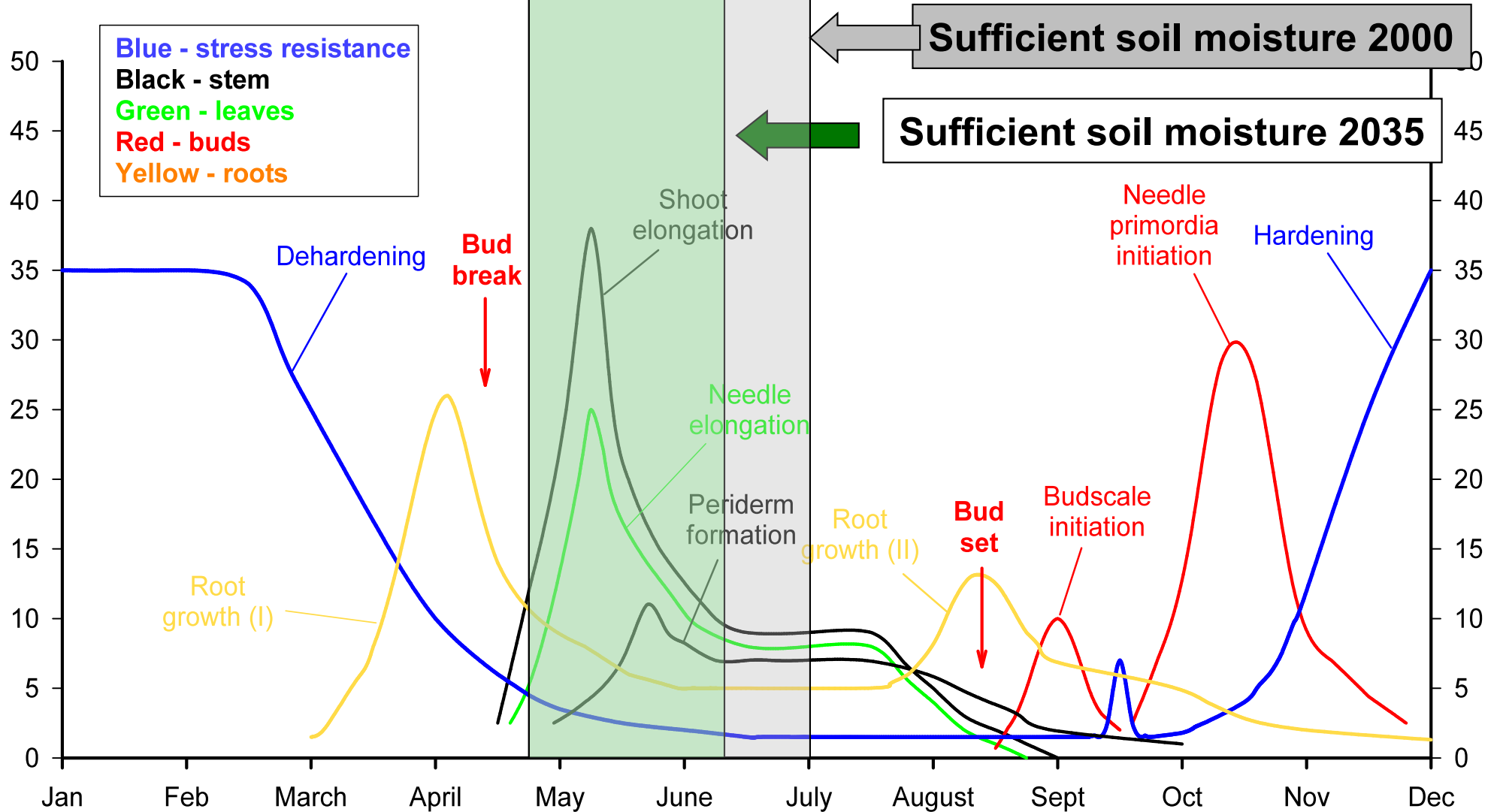
Seedling Physiology Cycle



Seedling Physiology Cycle



Seedling Physiology Cycle

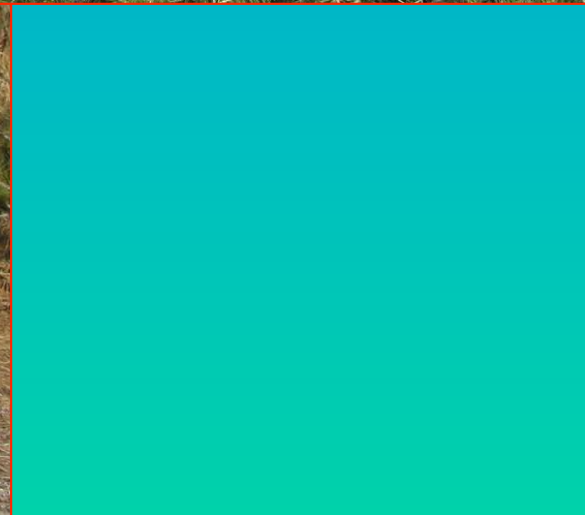


Forest Renewal Challenges

- Seedbed and site conditions
 - Regeneration failures
 - Regeneration delays
 - Early mortality
- PMS shut down - reduced growth potential
- Damage and mortality (winter desiccation, snow / ice loading, frost damage)



Example: Extremes of Winter Temperature or Humidity Fluctuation



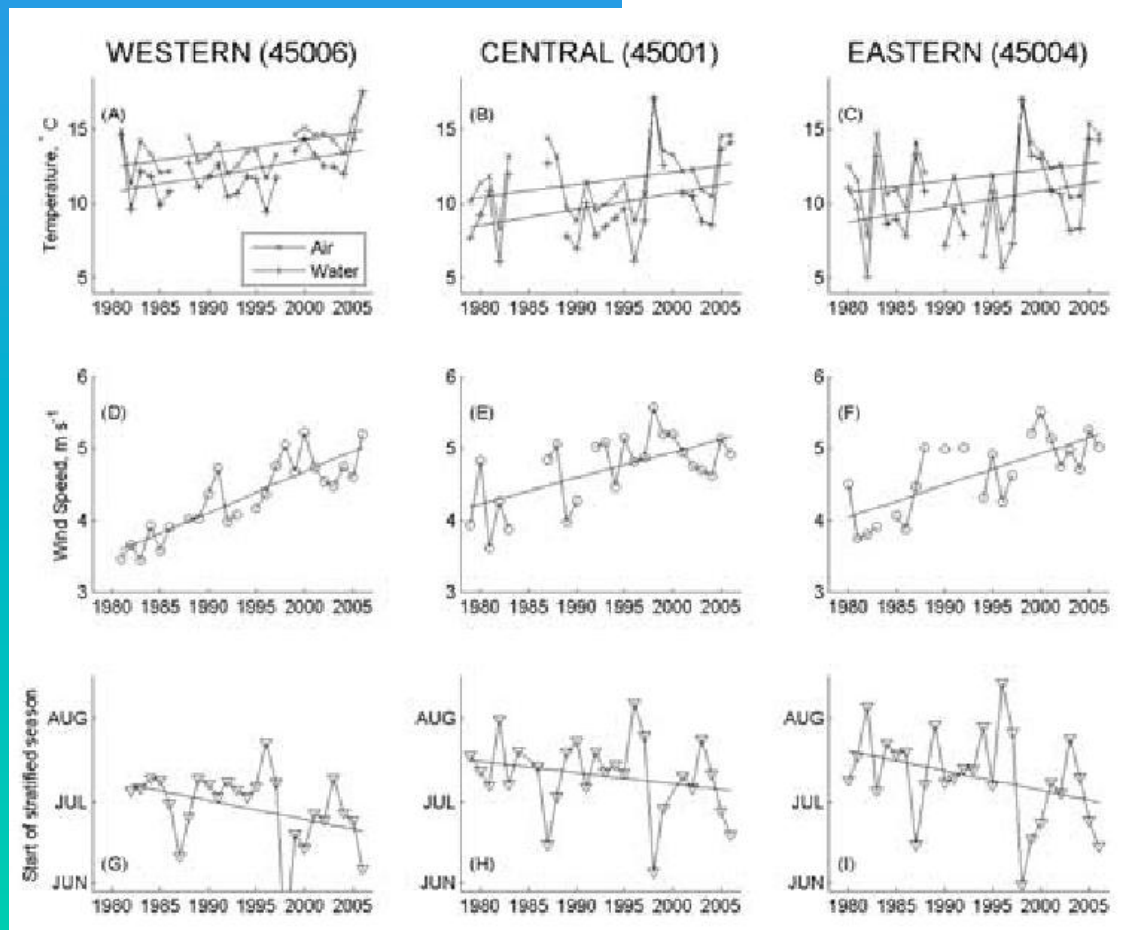
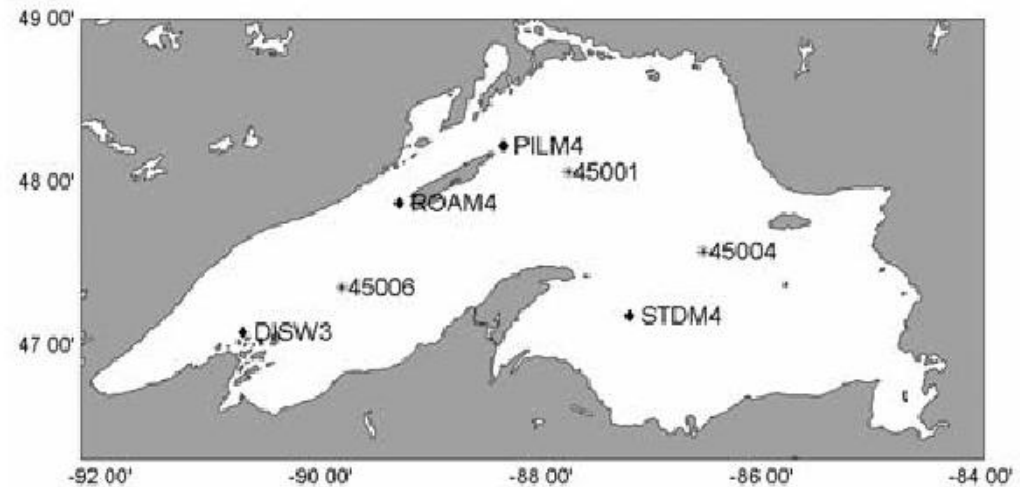
Temperature, Water and Fish

A 10% increase in rainfall is needed for each 1° C of warming in order to maintain existing water levels.

- We have seen a 1.6 C increase in average water temp in Experimental Lakes Area since 1970
- We have a 14% increase in GDD in Atikokan and Sioux Lookout in the early 21st Century vs 1970s and 1980s

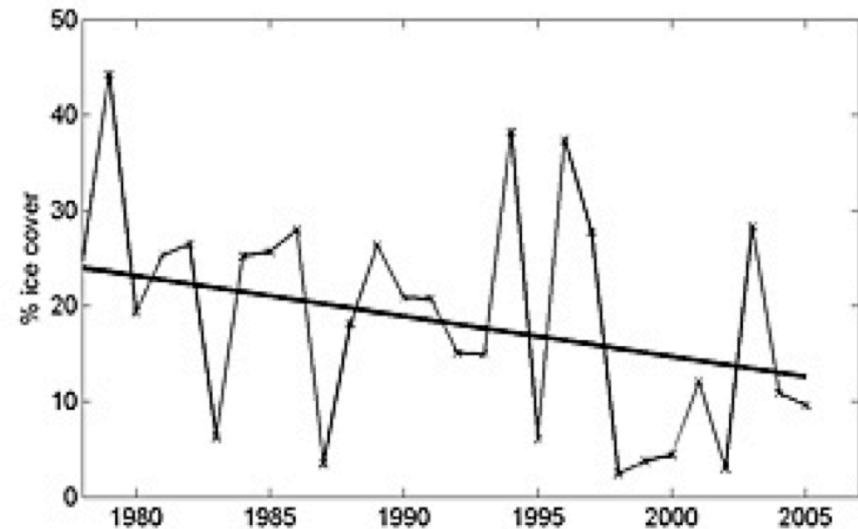
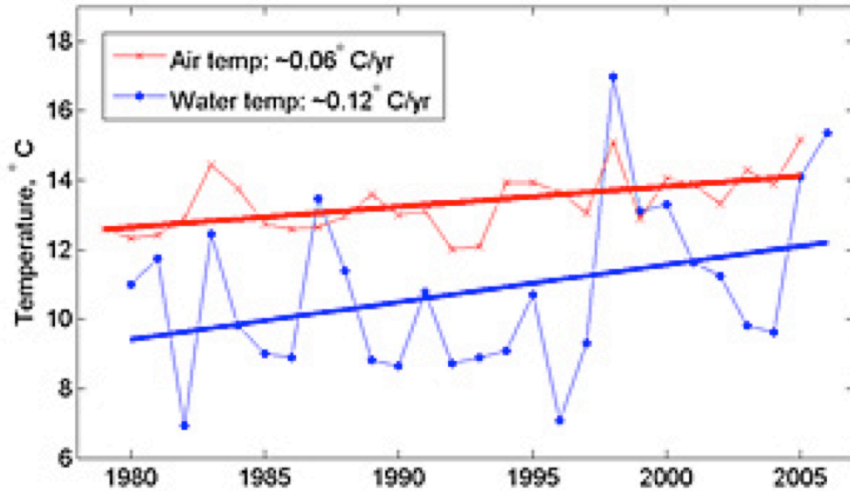
- **Less Fresh Water**
- **Longer Ice Free Period**
- **Warmer, Open Waters**
- **Retraction at southern limit (lake & brook trout)**
- **Expansion at northern limit (sm bass)**

Water Temperature (Lake Superior)



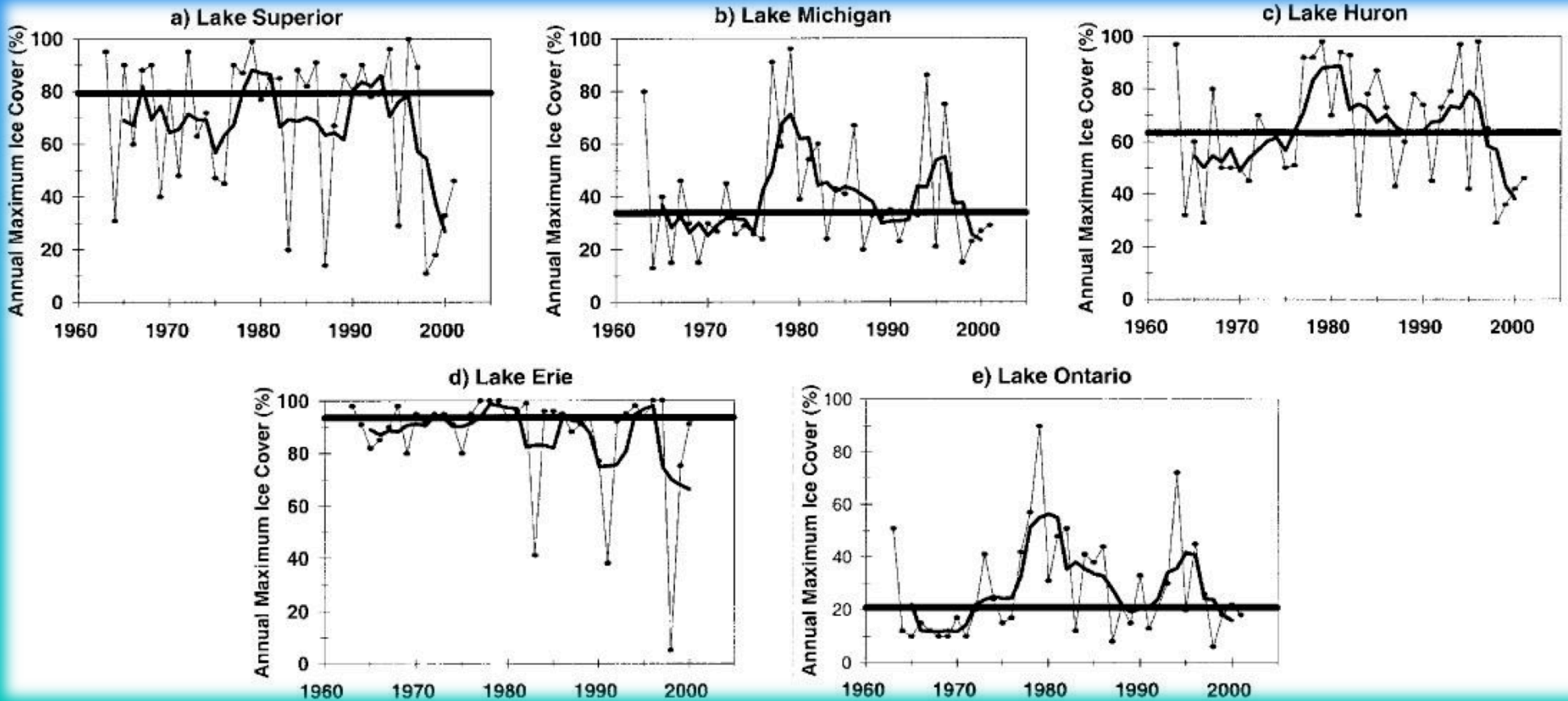
(Austin and Colman 2007)

Temperature and Ice Cover (Lake Superior)



(Austin and Colman 2007)

Ice Cover (Great Lakes)



(Assel et. al 2003)



**Lake trout - preferred temperature range
10 - 15 C**

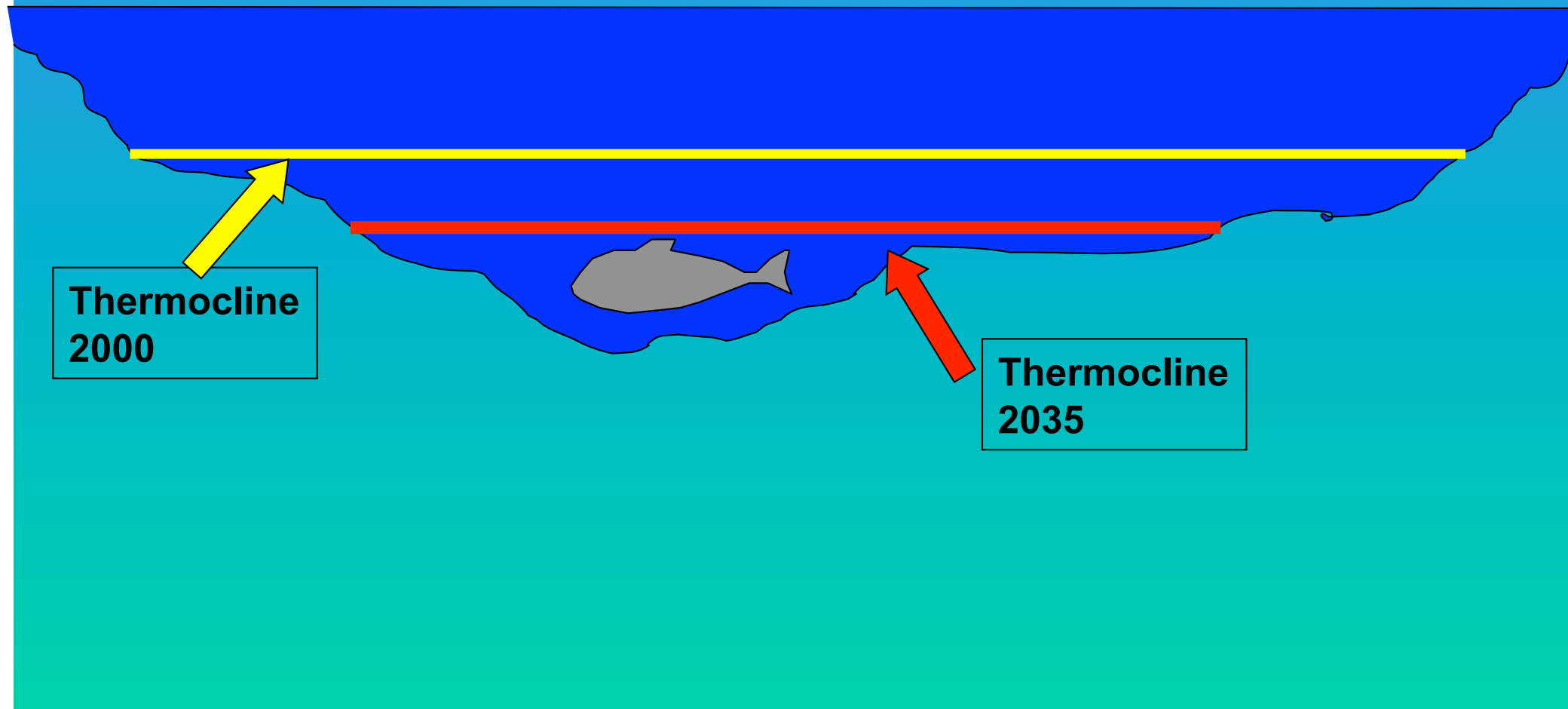


**Walleye - preferred temperature range
20-25 C**

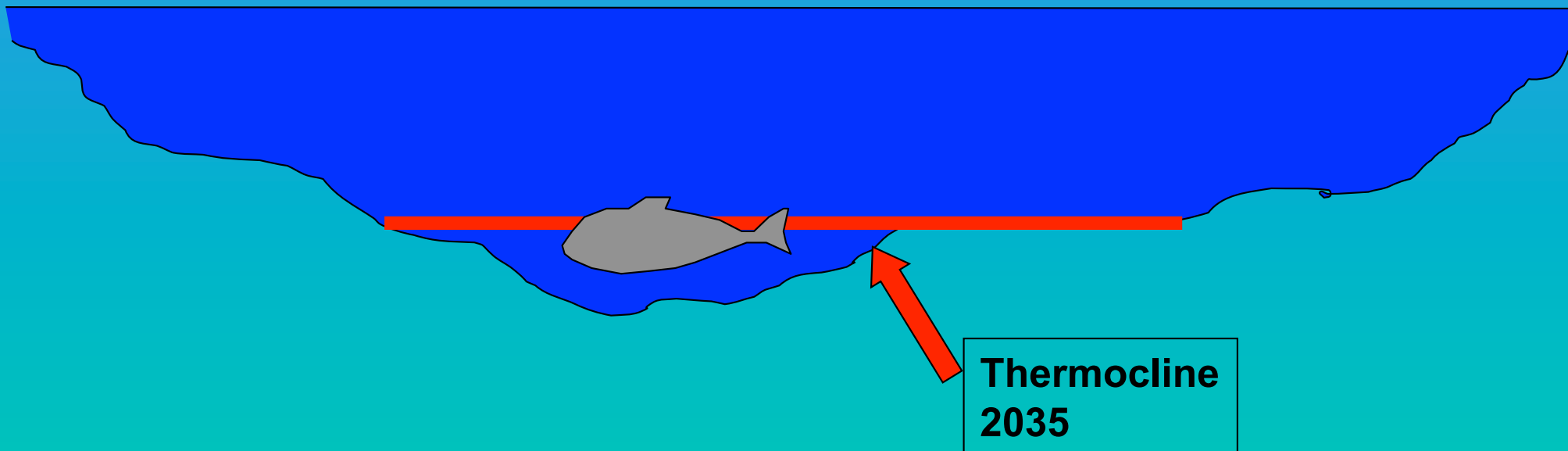


**Smallmouth bass - preferred temperature range
26 - 31 C**

Effective Lake Trout Habitat

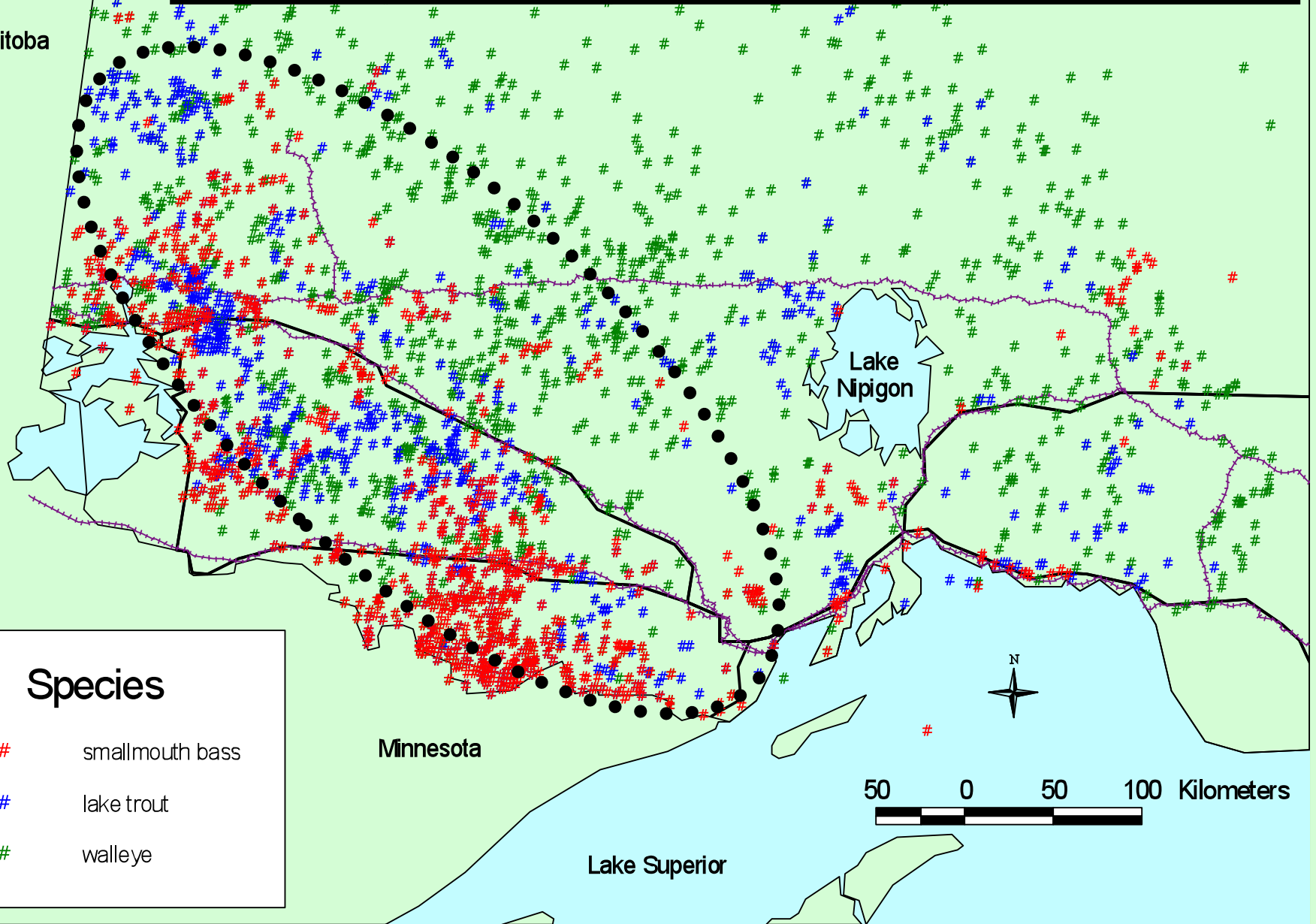


Effective Lake Trout Habitat



Bass, Walleye & Lake Trout

Manitoba



Species

- # smallmouth bass
- # lake trout
- # walleye

Minnesota

50 0 50 100 Kilometers

Lake Superior

Lake Nipigon

What have we learned?

- Virtually no debate on the direction of change
- Some debate on magnitude of change (+/- 30%)
- Hot discussion on mitigation measures (Kyoto – Paris: December 2015)
- About 18 years history of adaptation debate
- Yet **profound** implications for:
 - Forest stewardship
 - Wildlife, fish and ecosystem conservation
 - Societies and governments

The Challenge - Adaptation

Adjustments in ecological, social or economic systems in response to actual or expected climate change stimuli, their effects or impacts

Reduce risks

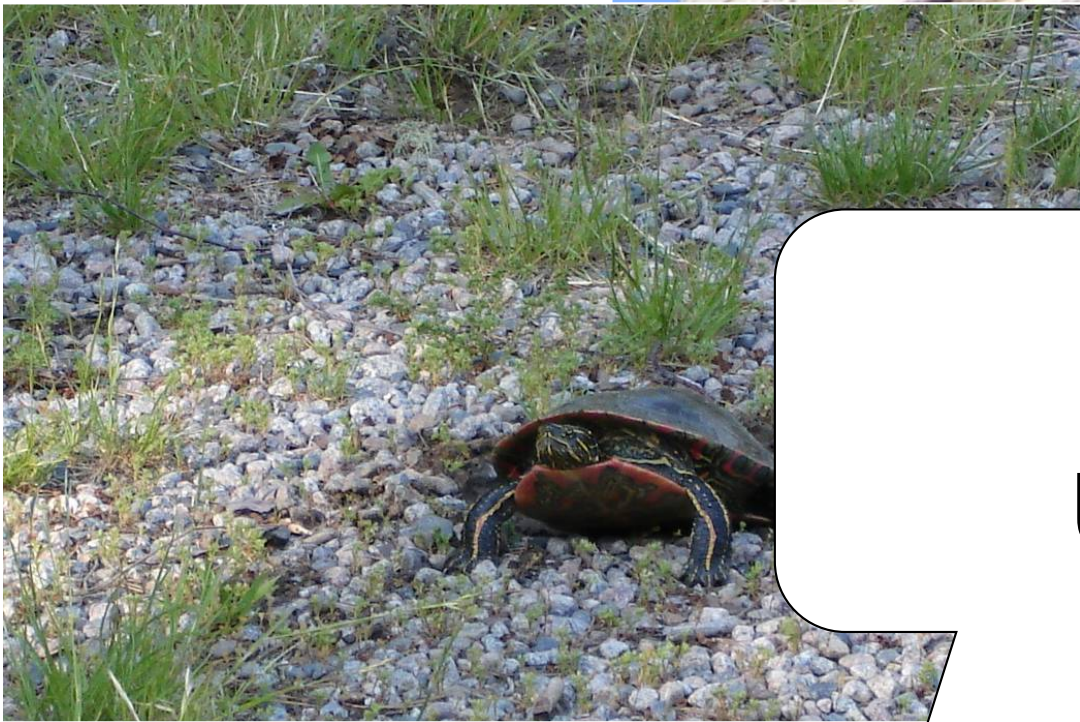
Moderate damages

Realize opportunities

Challenges

“Climate change seldom acts in isolation but interacts with other environmental and social factors.”

(Secretariat of UN Permanent Forum on Indigenous Issues 2007)



**We're
up to it!**

