

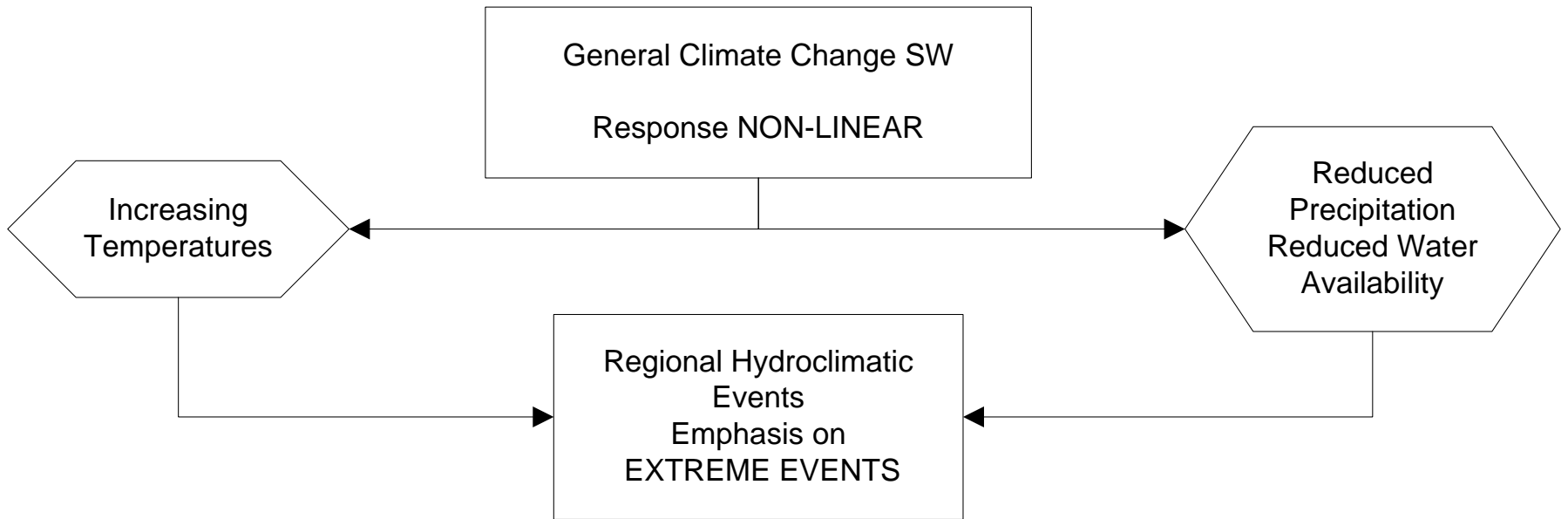
Climate Change and Riparian Ecosystems

A Synthesis

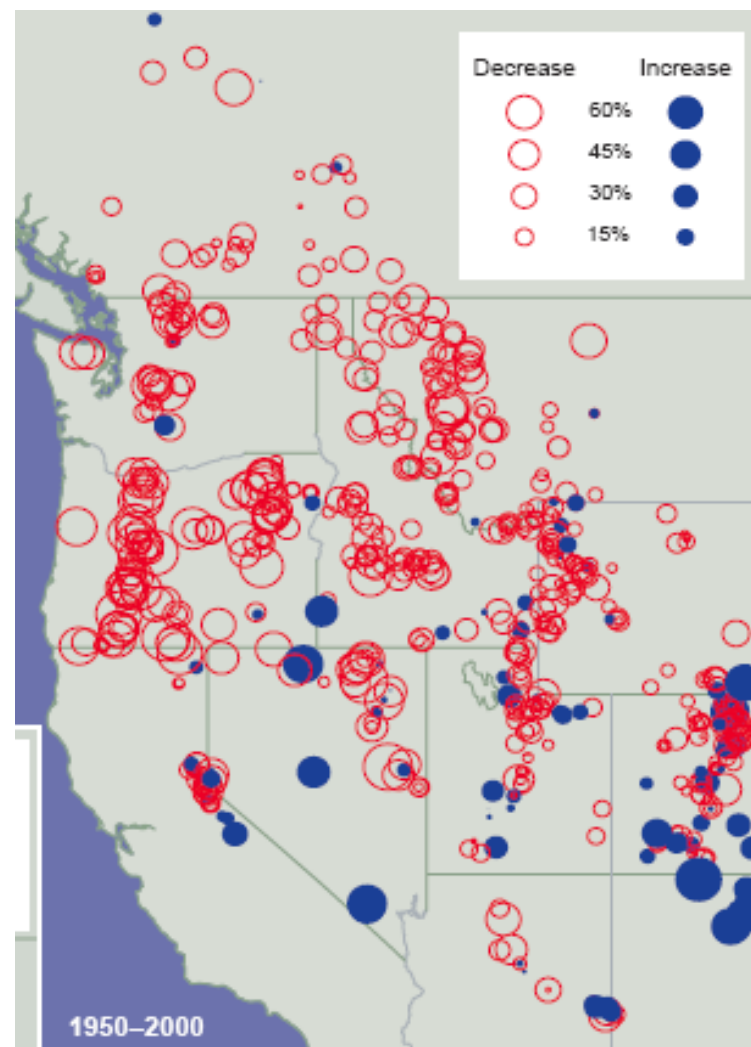
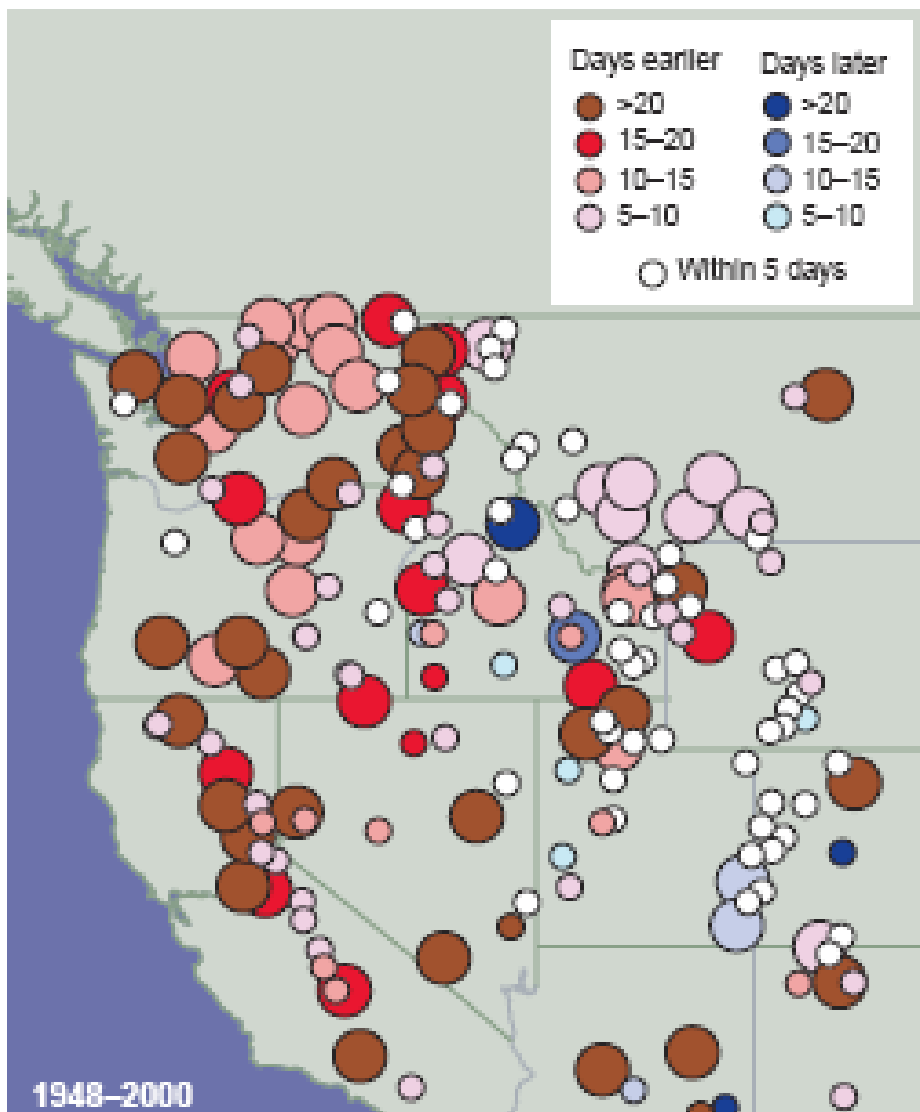
(and some other random thoughts)

- **What Drivers are Changing?**
- **What Responses are Changing?**
- **What More Do We Need to Know?**
- **How Do We Avoid a “Train-Wreck”?**
- **Where Might Management be Directed?**

- **What Drivers are Changing?**
A Review of Speaker Points



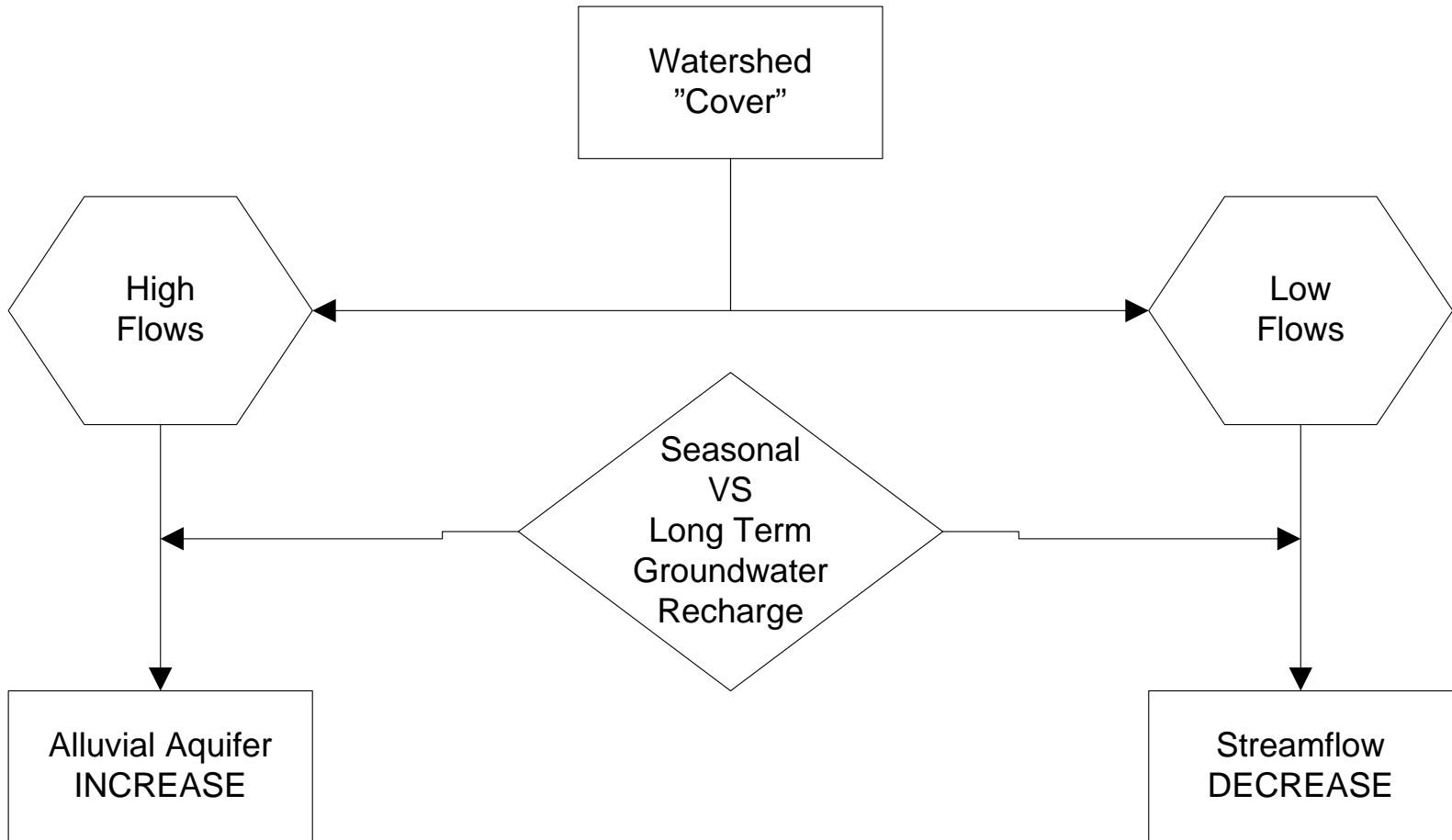
Graumlich and Hirschboeck



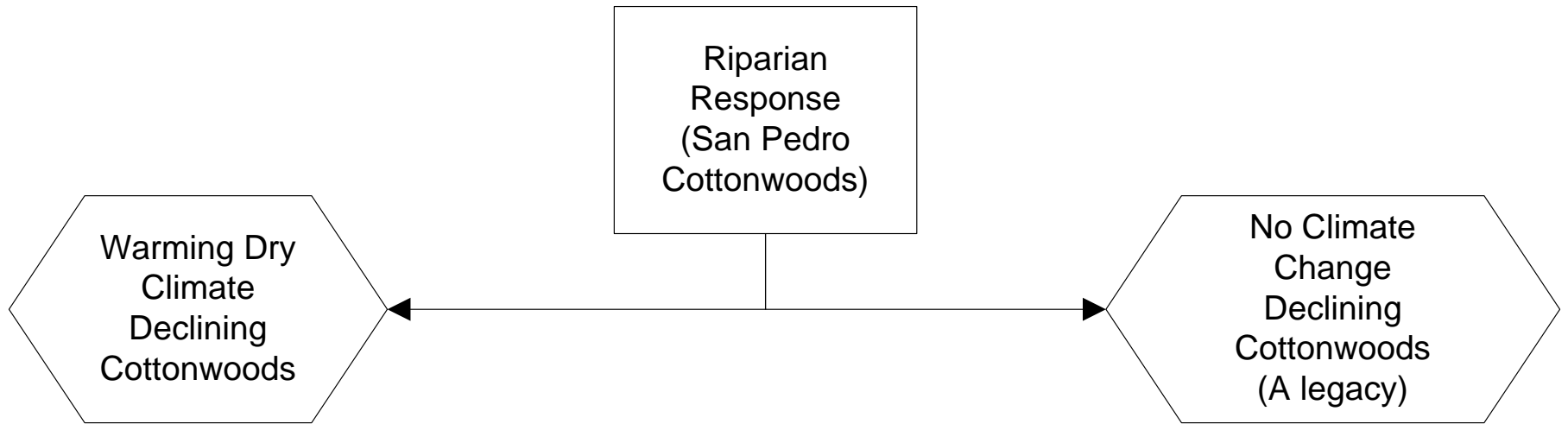
In retreat. A modest temperature rise since the 1950s has reduced spring snowpacks throughout the West (*top*) and shifted the peak snowmelt earlier in the year (*left*).

•**What Responses are Changing?**

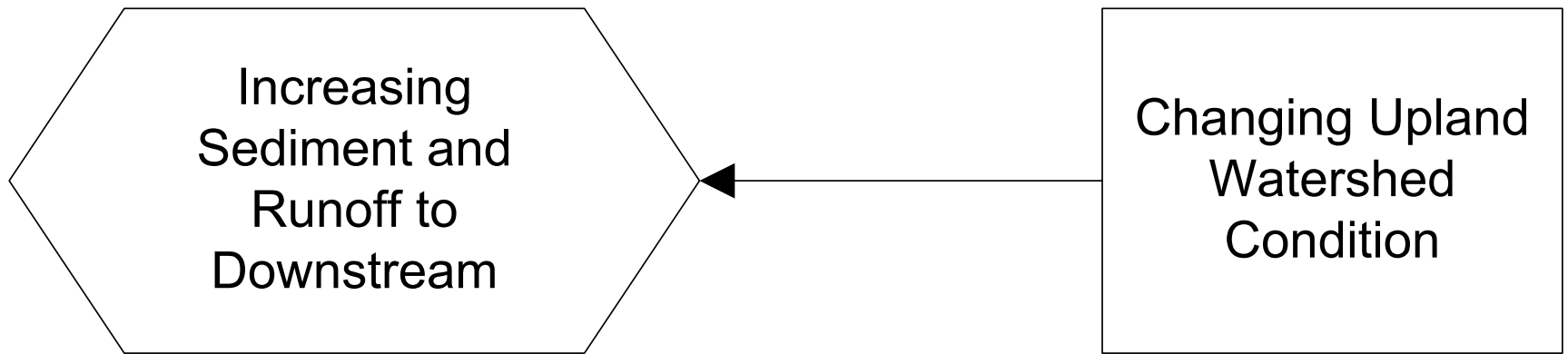
A Review of Speaker Points



Hogan



Dixon



Ffolliott

Graumlich

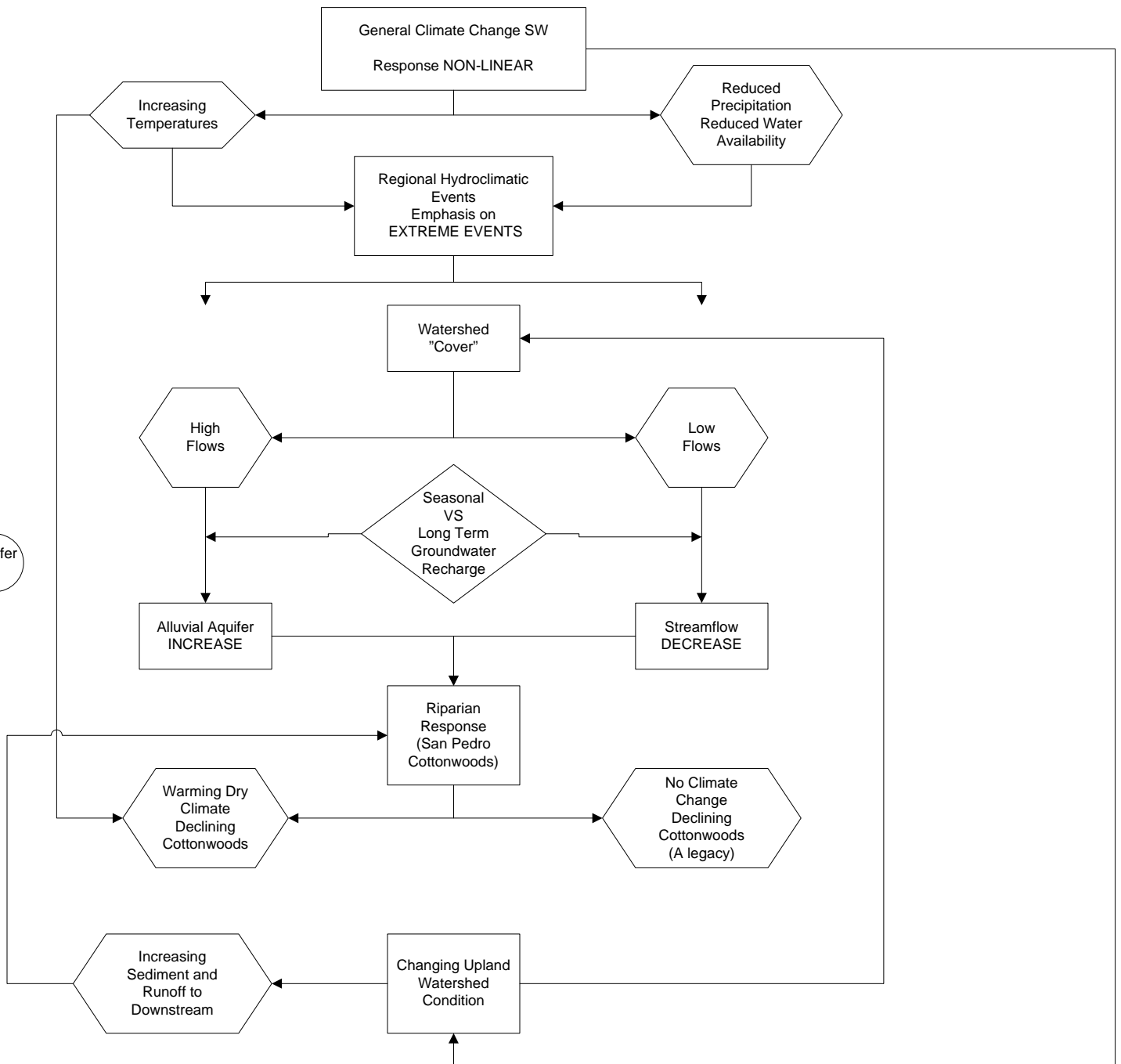
Hirschboeck

Hogan

Scale of River/Aquifer Interaction

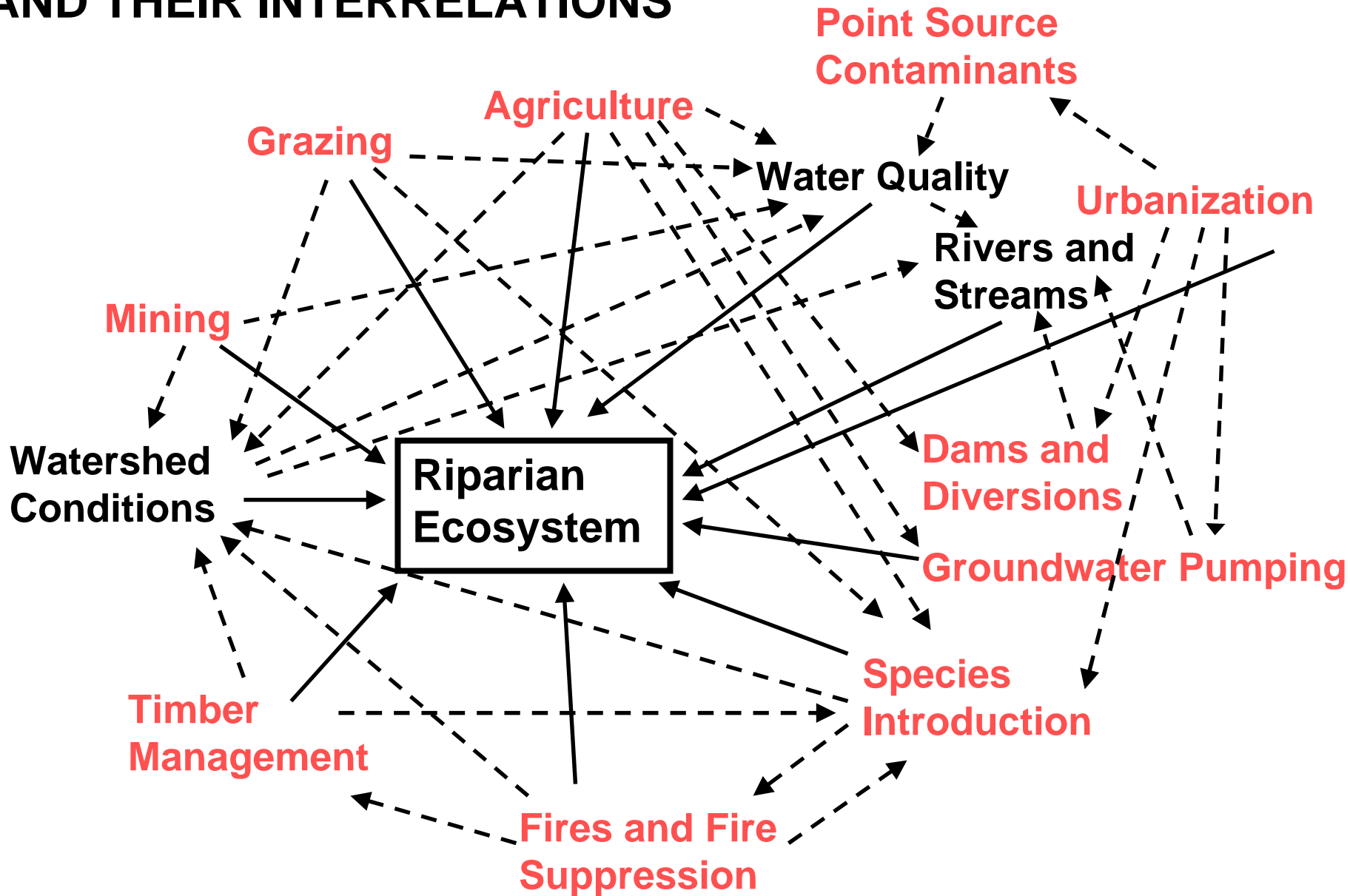
Dixon

Ffolliott

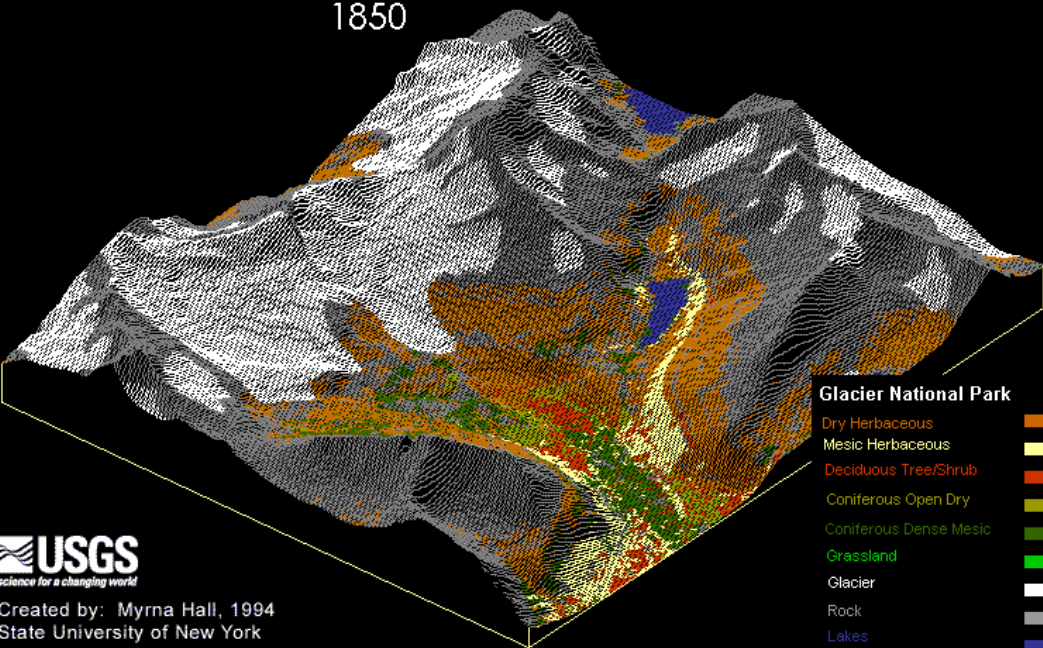


•What More Do We Need to Know?

UNDERSTAND STRESSORS AND THEIR INTERRELATIONS



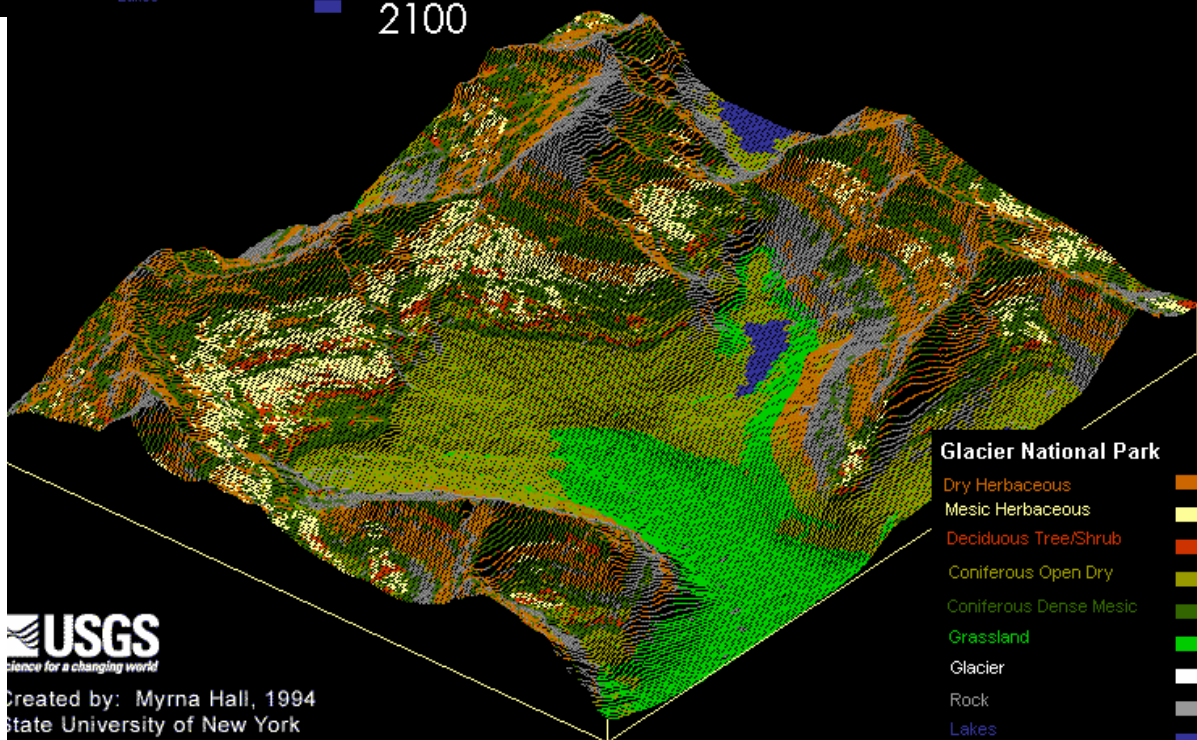
1850



Created by: Myrna Hall, 1994
State University of New York

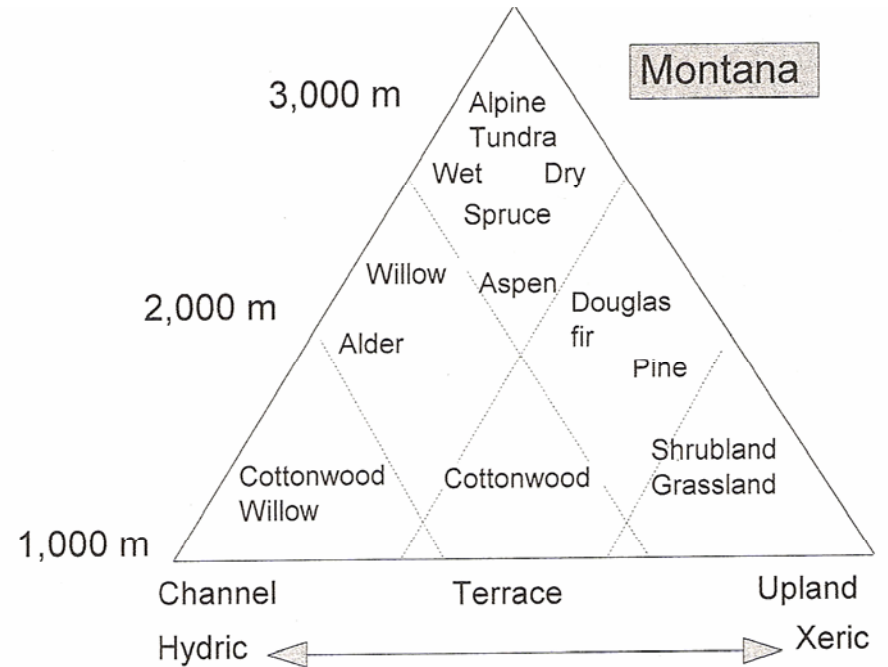
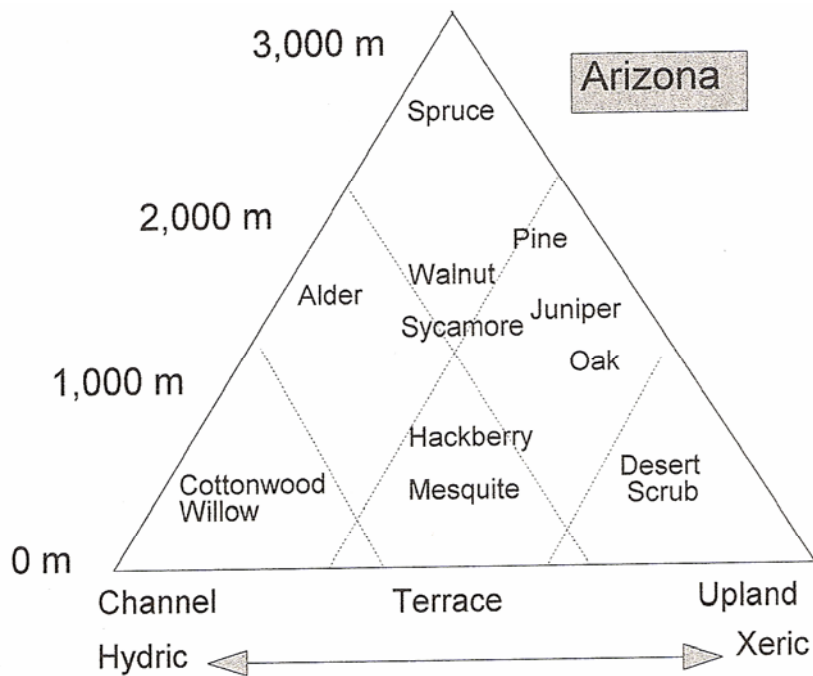
If Plant Communities Advance to Higher Elevations, Will Riparian Communities “Follow”?

2100



Created by: Myrna Hall, 1994
State University of New York

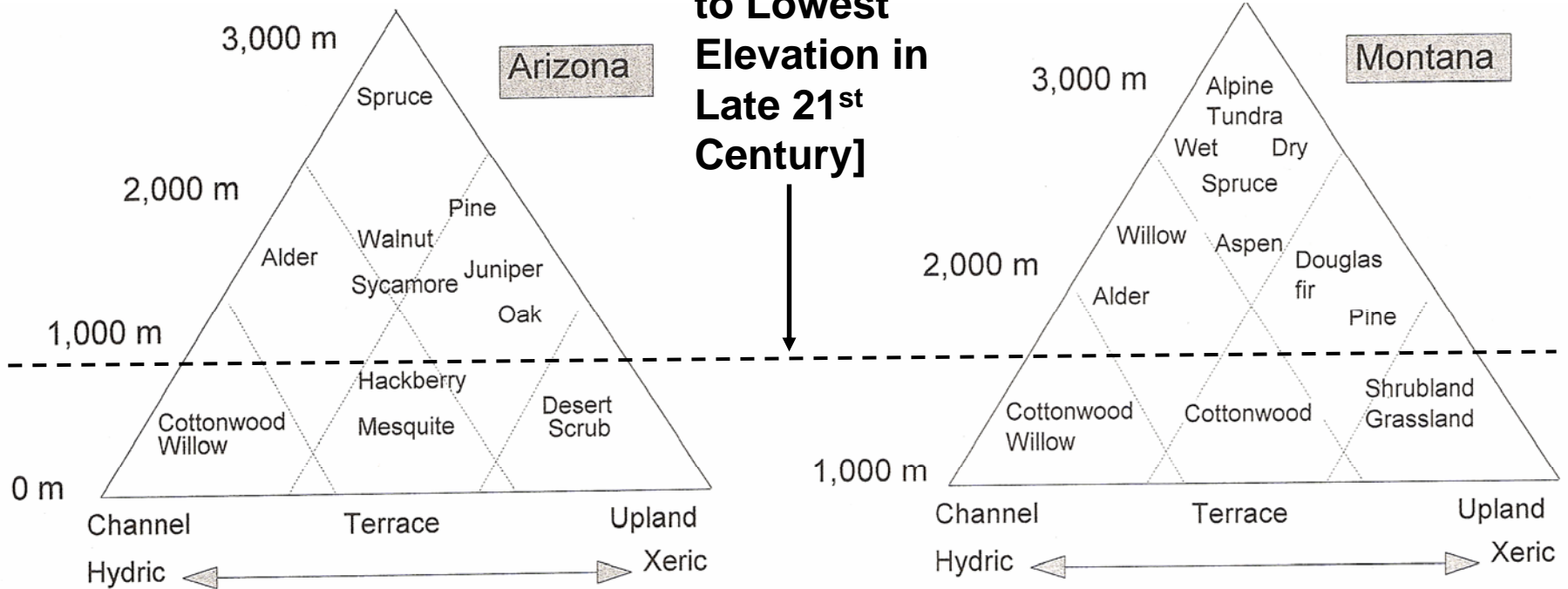
Glacier National Park 1850-2100 Models



Channel to upland gradients relative to elevation in Arizona and Montana

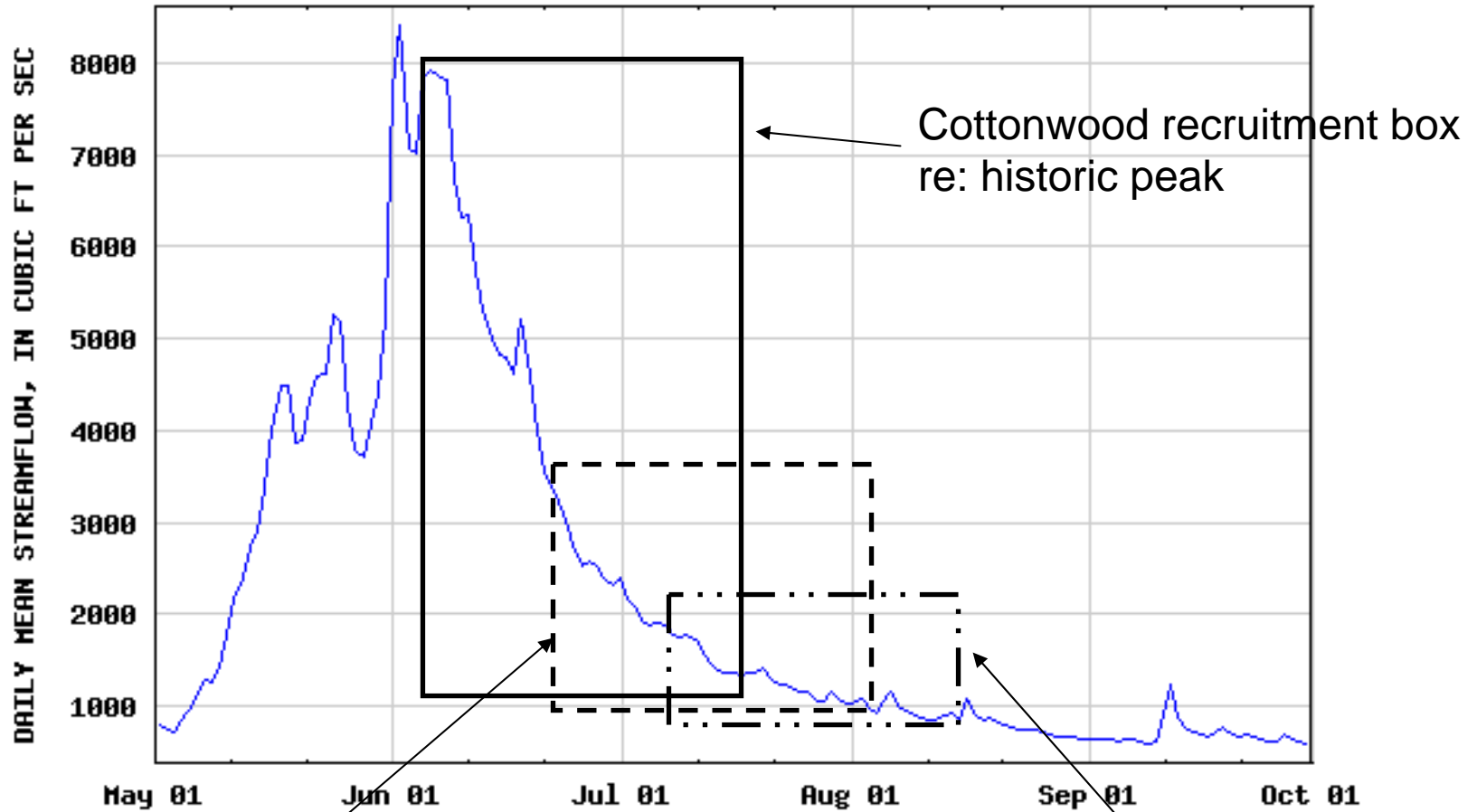
Potential Decline of Mid-Elevation and Loss of Low Elevation Riparian Communities as Temperatures Increase

[Equivalent to Lowest Elevation in Late 21st Century]



If Riparian Communities Migrate Up, What Will Replace Them At Lower Elevations?

USGS 06043500 Gallatin River near Gallatin Gateway MT



Recruitment box re: 20 day earlier peak

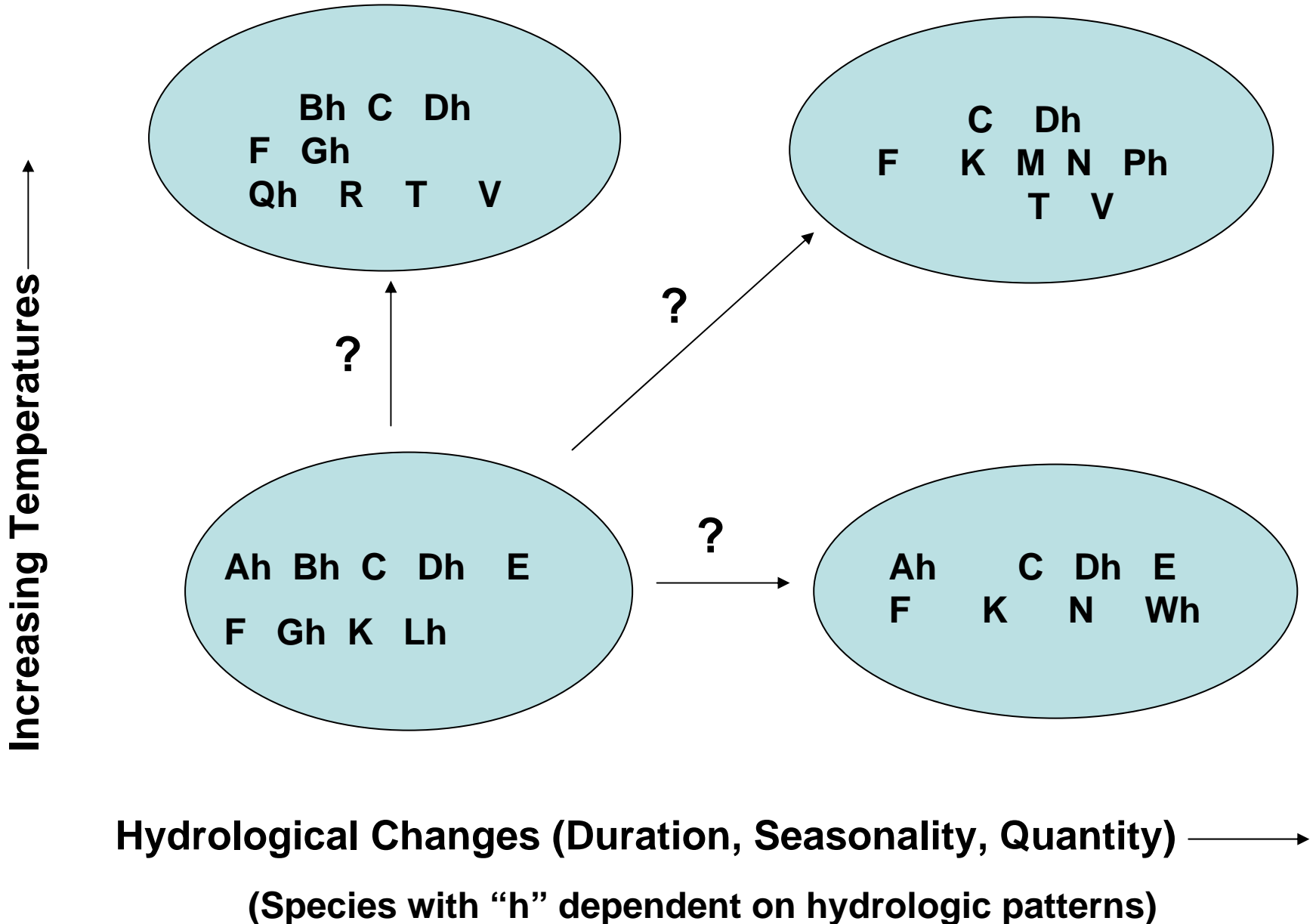
Recruitment box re: 40 day earlier peak

“society must recognize that **there will be losers from adaptation, and they must be compensated”**

Bas Jonkman, adviser to the Dutch Ministry of Water Management commenting on using low lying farms and nature areas for flooding from climate change.

Question: If there is adaptation in riparian ecosystems in response to climate change, will there be losers, and if so what are they? Will there also be “winners”?

Possible Changes in Species Composition of Riparian Communities (“Losers” and “Winners”)



•How Do We Avoid a “Train-Wreck”?

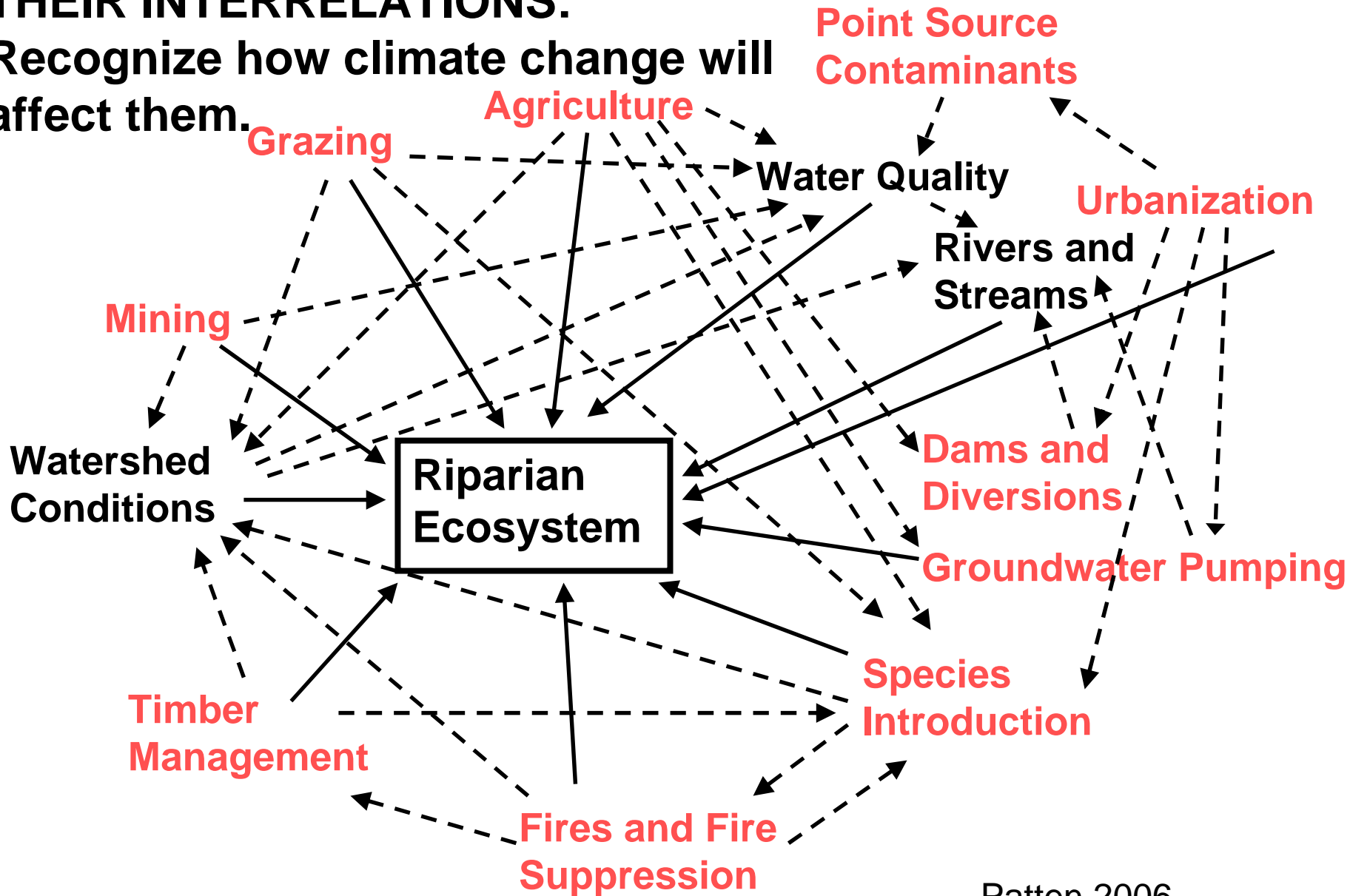
The fact remains, however, that understanding the complexity of potential impacts of climate change on natural ecosystems is essential if resource managers are to minimize the negative consequences of climate change and maximize the potential benefits that it may offer.

Burkett et al. 2005

•Where Might Management be Directed?

UNDERSTAND STRESSORS AND THEIR INTERRELATIONS:

Recognize how climate change will affect them.



Questions on Amount of Precipitation

If there is increased precipitation, should we manage for enhancing or restoring rivers that have been non-functional for a long time?

If there is decreased precipitation, should we manage rivers to enhance (elevate?) the alluvial or riparian water table?