

*Flowing to the Future:
Climate change, snow-packs and river flows
in the Crown of the Continent*

Stewart Rood

Elk River

University of
Lethbridge



Climate Change is Certain



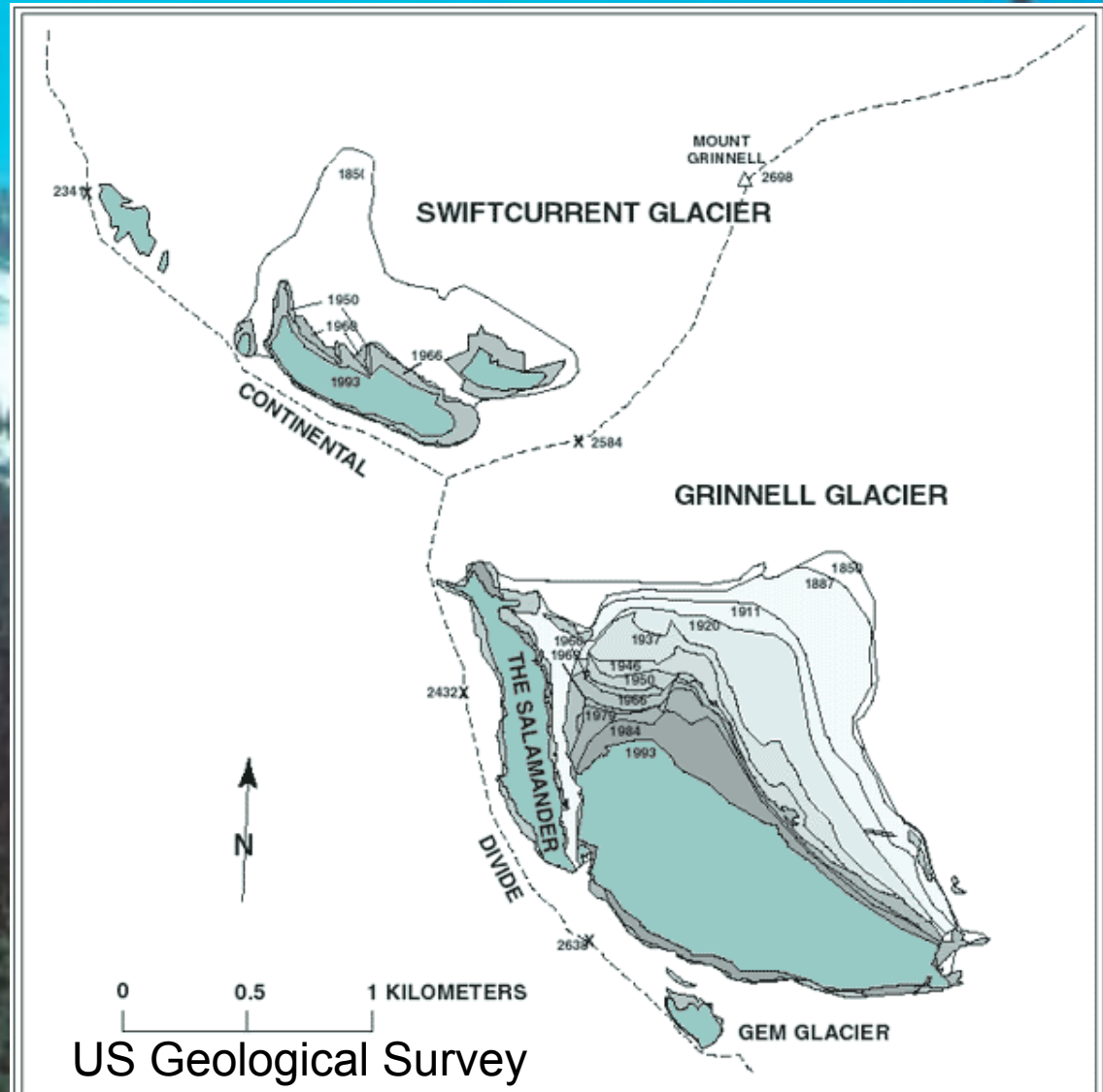


Climate Change has
probably accelerated

Athabasca Glacier
Columbia Icefield

Many Glaciers Glacier National Park

Glacial recession
after 1850



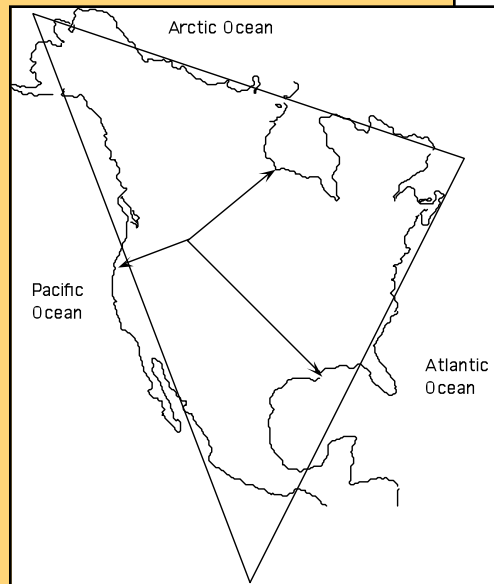
Are water supplies from the Rocky Mountains changing?

- Mountains as water towers – water for humans and ecosystems
- Rivers integrate precipitation over watersheds
- Environmental sentinels



Castle River

The Crown of the Continent: A unique study system



Hydrographic Apex
of North America

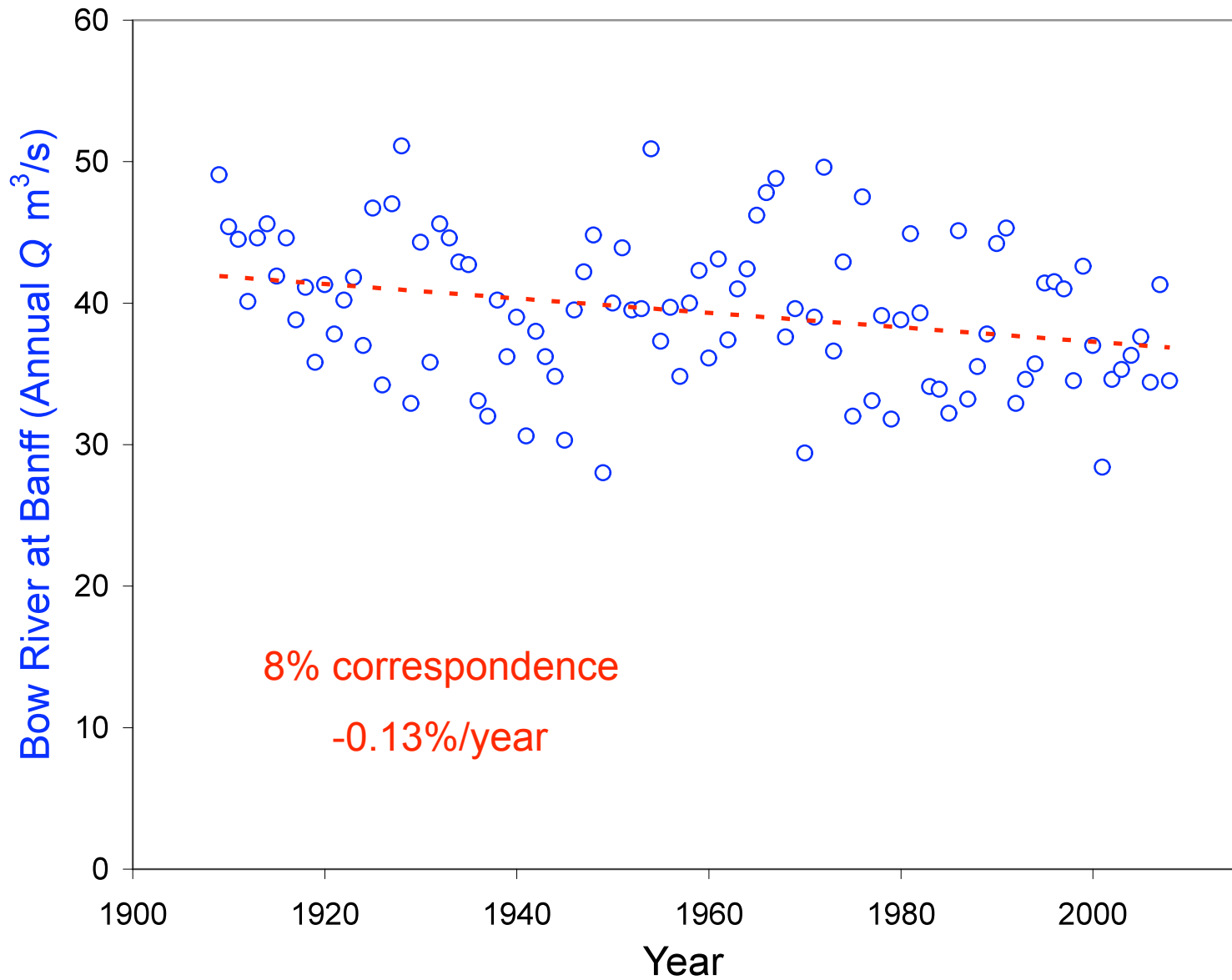


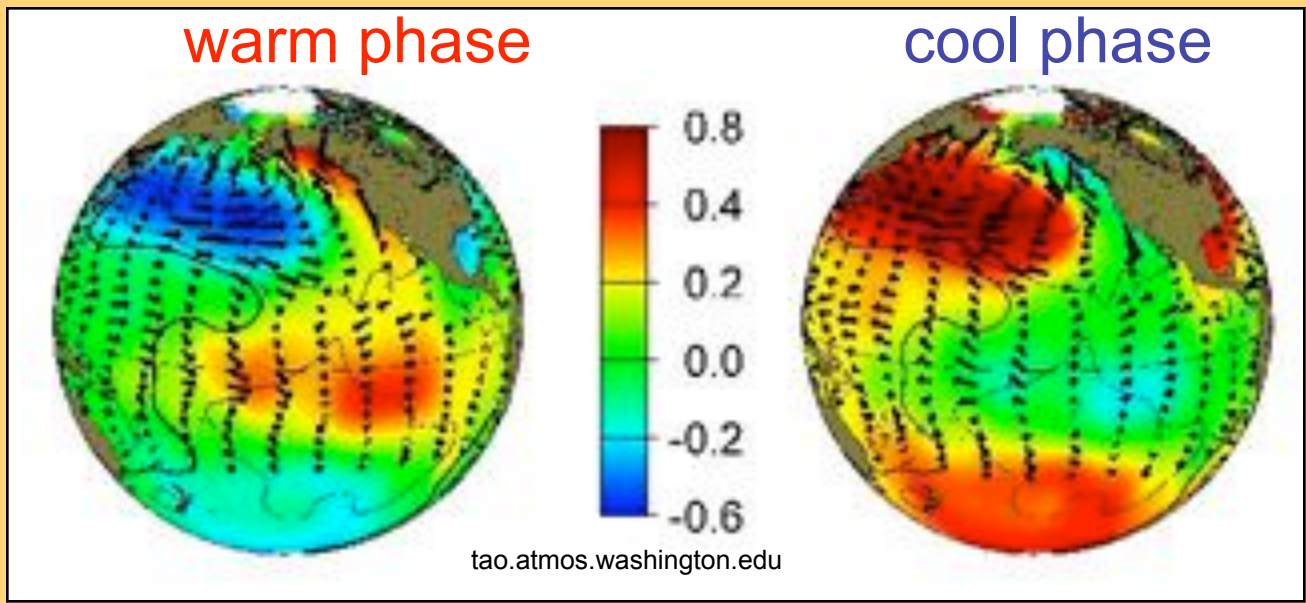


Study design:

- Headwater streams
- Pristine watersheds
- Free-flowing reaches
- Sufficient records

St. Mary River





PDO
Pacific
(Multi) Decadal
Oscillation

Streamflows are coordinated with Pacific Ocean temperatures

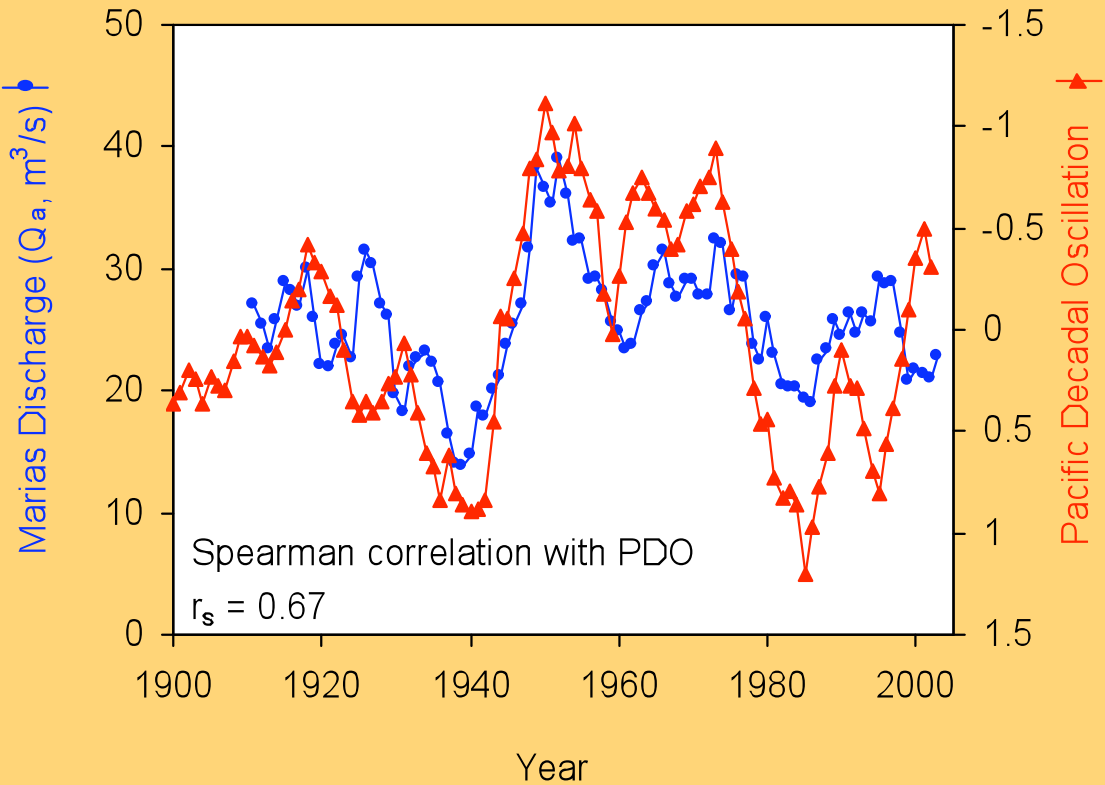
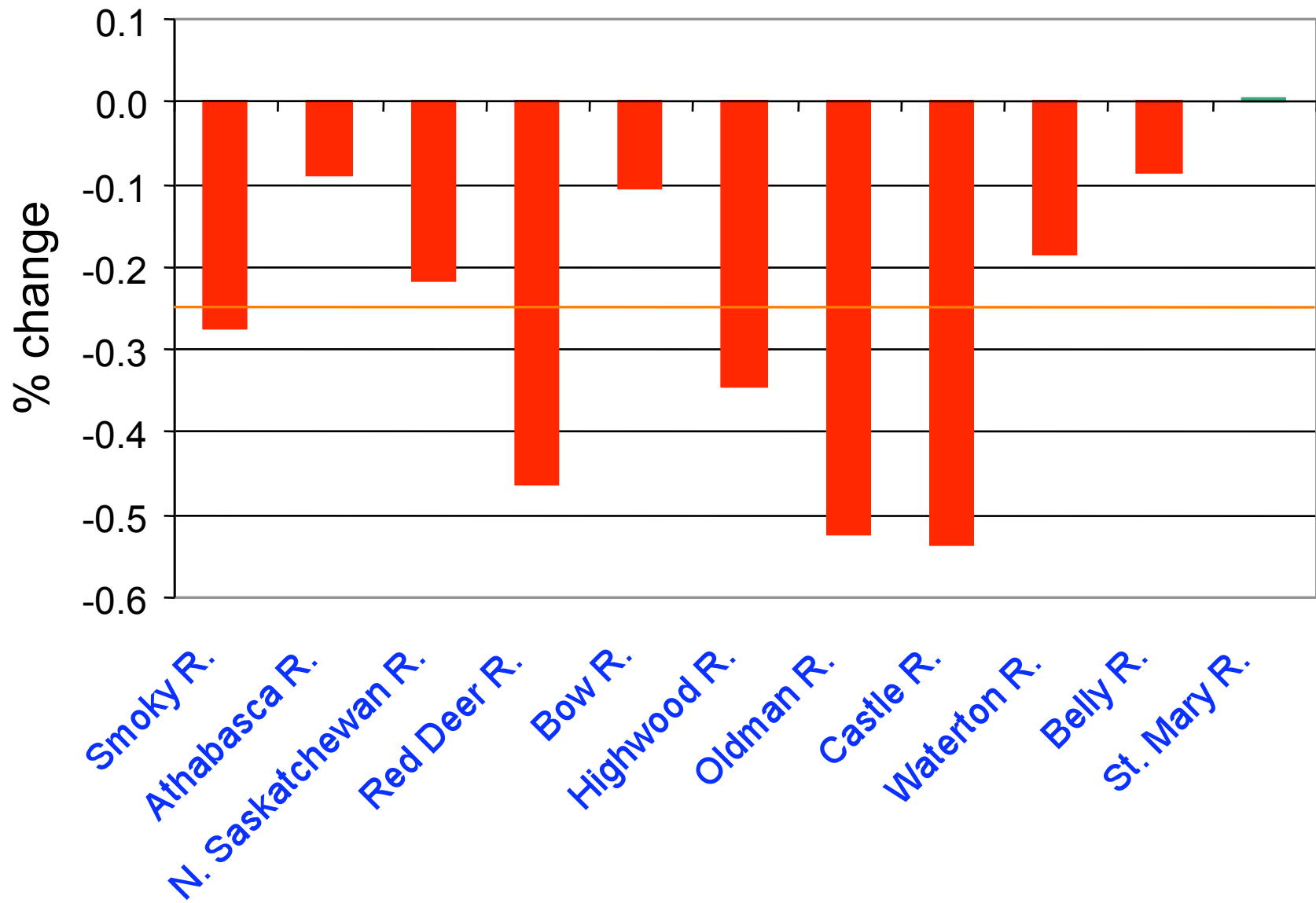


Fig. 10.



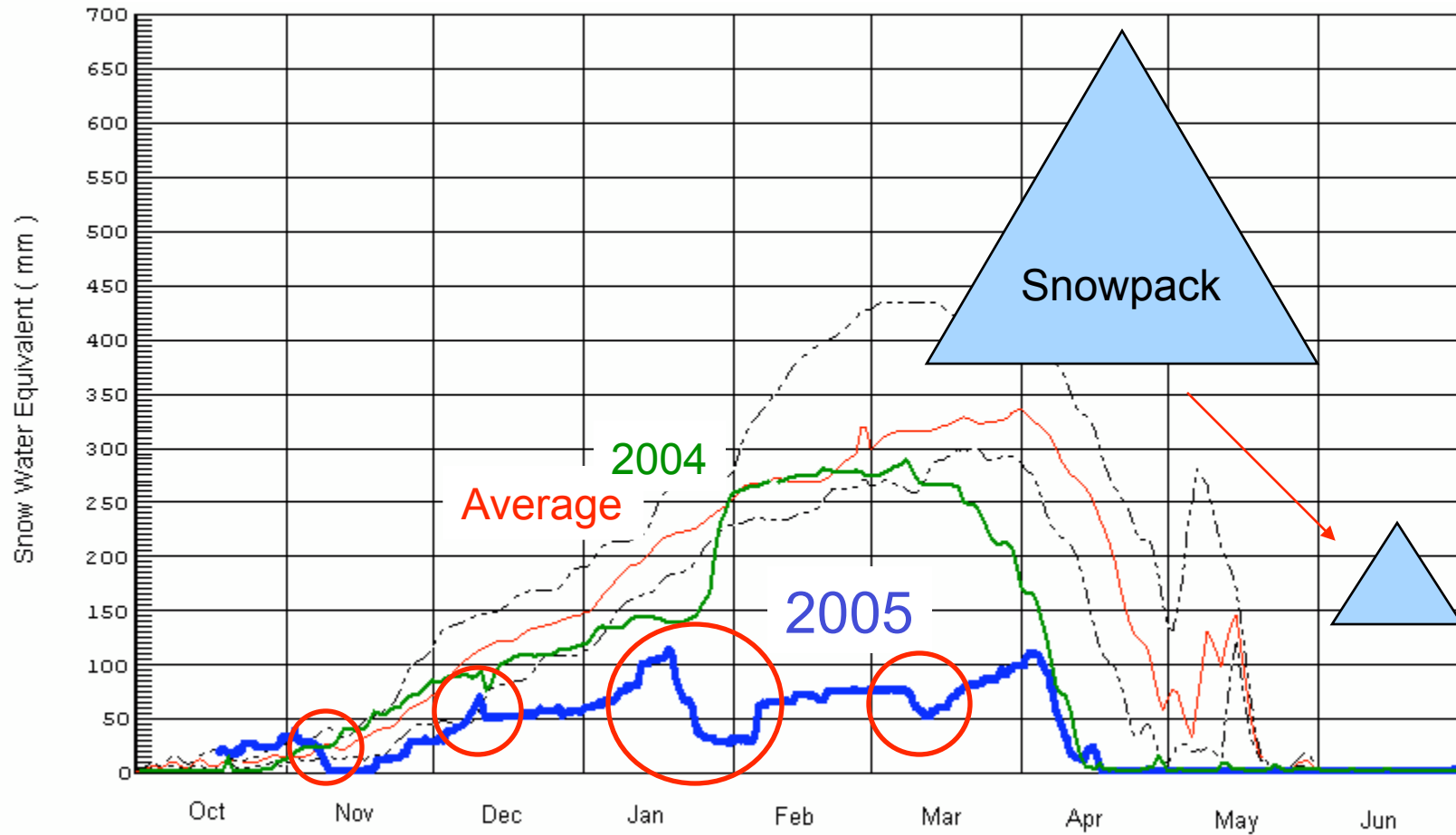
What about streamflow seasonality?

Winter warming increases
rain vs. snow



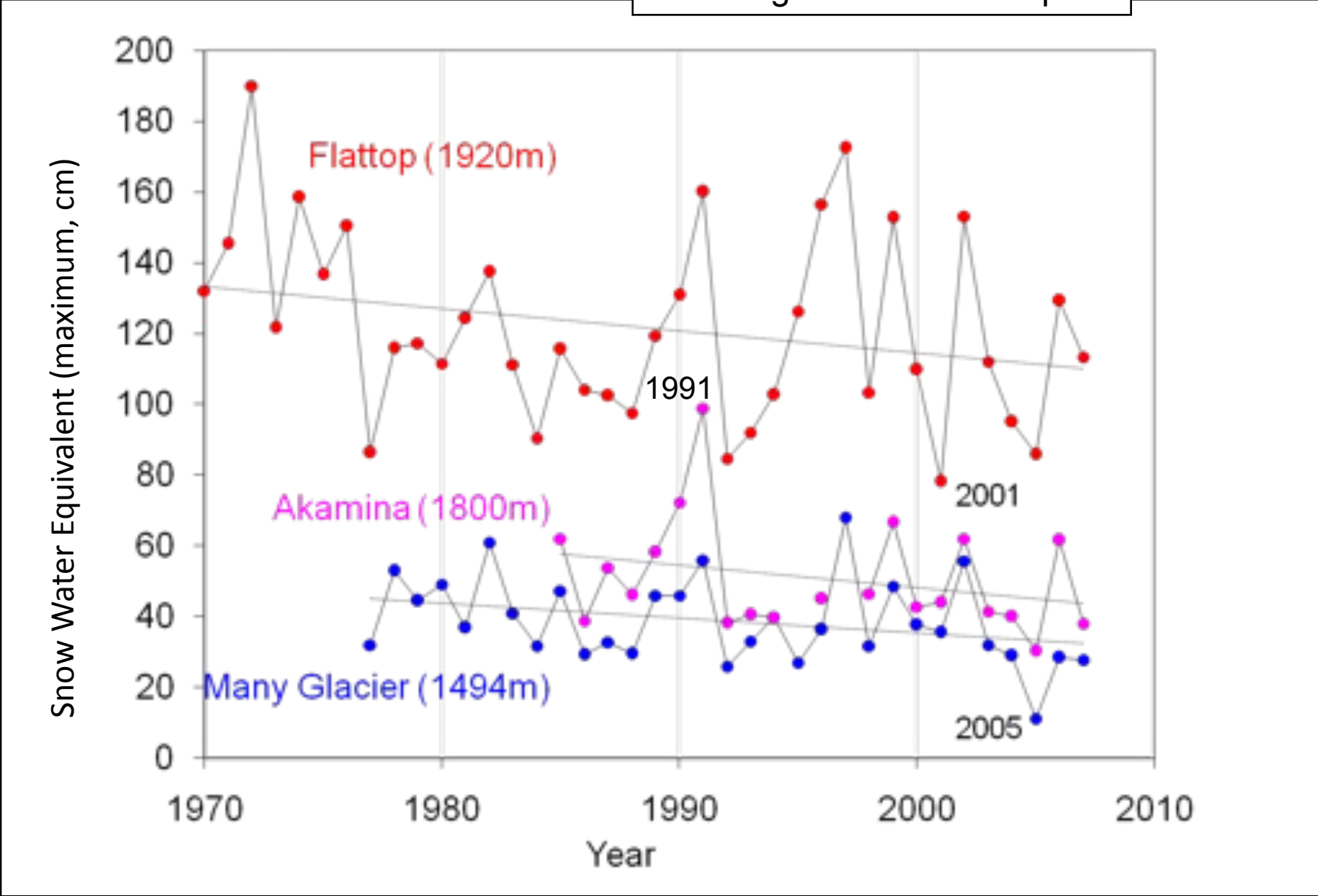
Many Glacier, Swift Current Ck.
Nov. 8, 2009 (USGS)

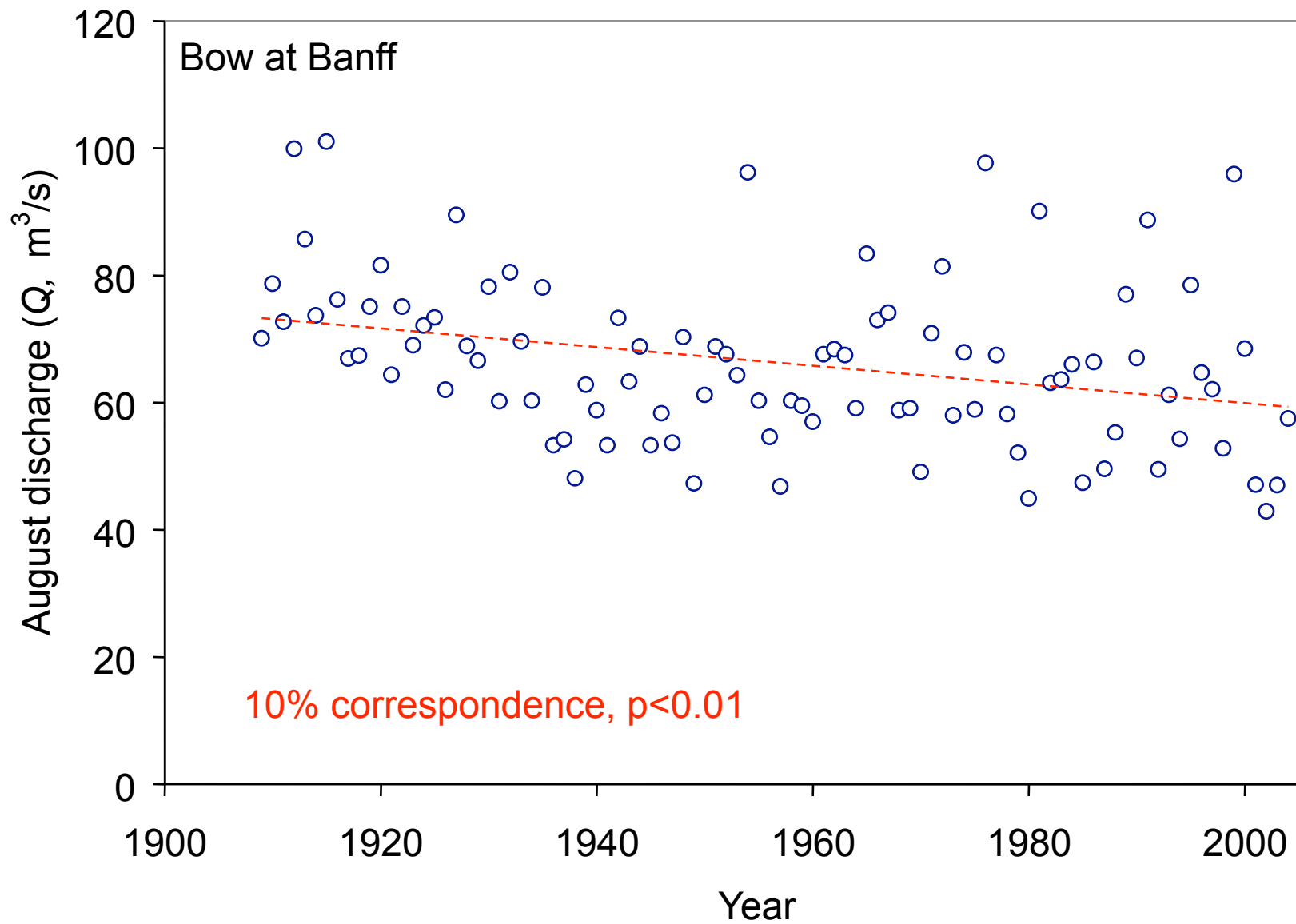
Many Glacier – Snow Pillow



○ rain/melt

Declining Mountain Snowpack

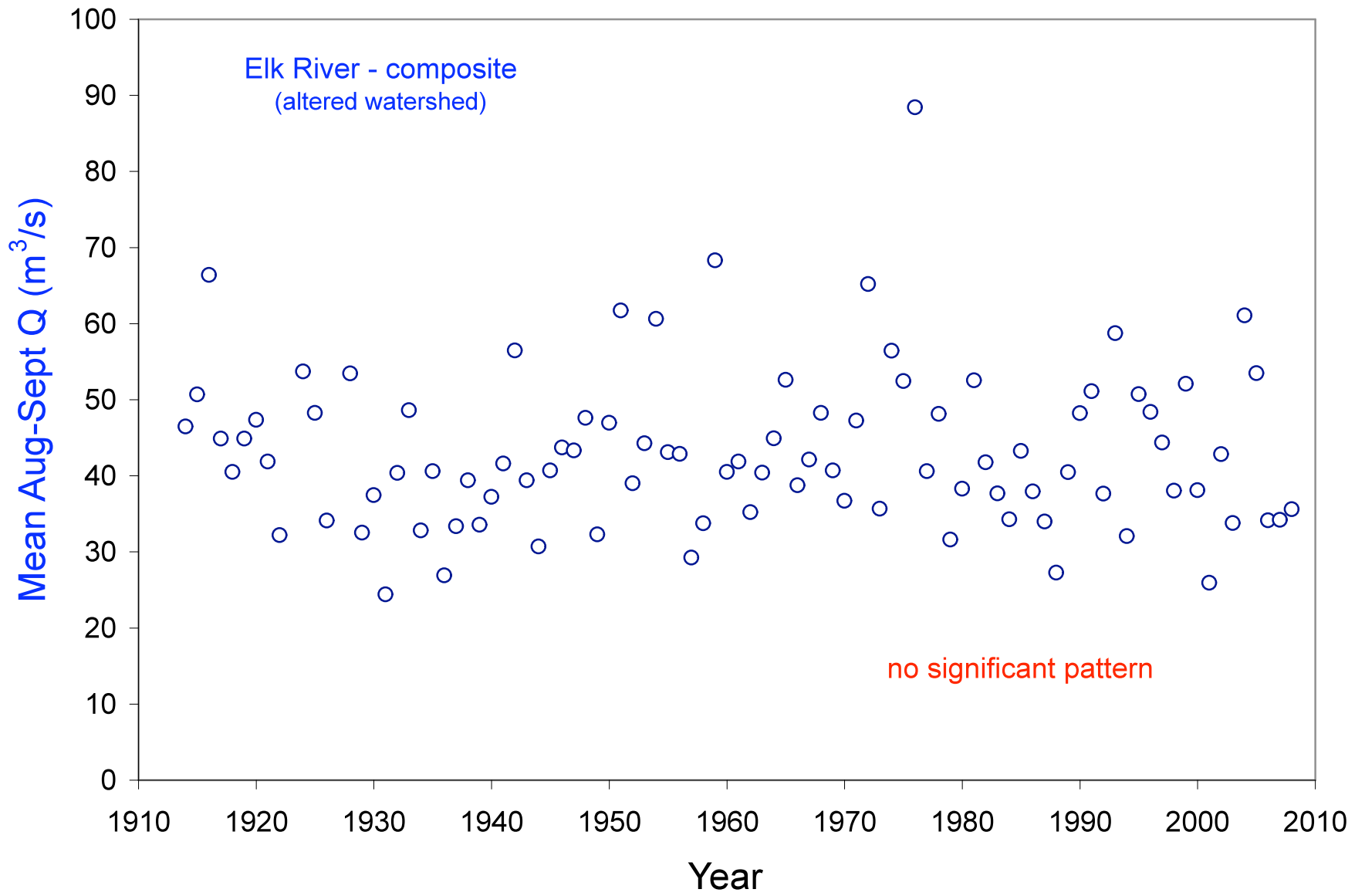




	Red Deer	Bow	Highwood	Castle	Waterton	Belly	overall
Jan			n/a				
Feb			n/a				
Mar							4/6 +
Apr							
May							6/6 -
Jun							6/6 -
Jul							6/6 -
Aug							6/6 -
Sep							6/6 -
Oct							6/6 -
Nov			n/a				
Dec			n/a				

no change

decrease	increase	
		P < 0.1
		P < 0.05
		P < 0.01



Forecasting future river flows: How do we know?

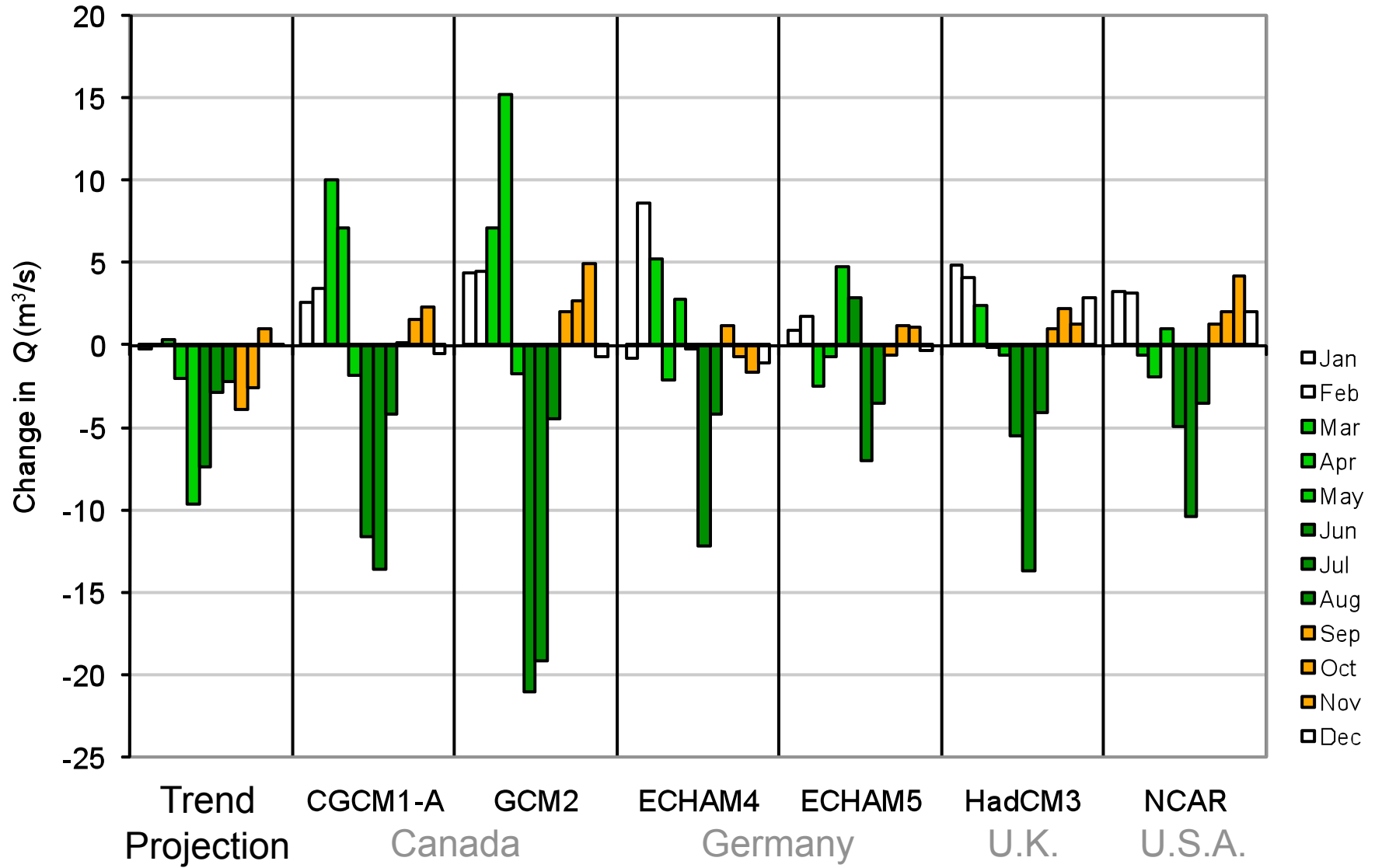
1. Empirical Trend Projection
 - The near-future will extend the recent past
2. Modeling – downscaled Global Circulation Models (GCMs)
 - GCMs simulate continent-scale processes

University of Lethbridge
Alberta Agriculture & Food
Alberta Environment
Red Deer River Watershed
Alliance

Anita Shepherd
& Karen Gill

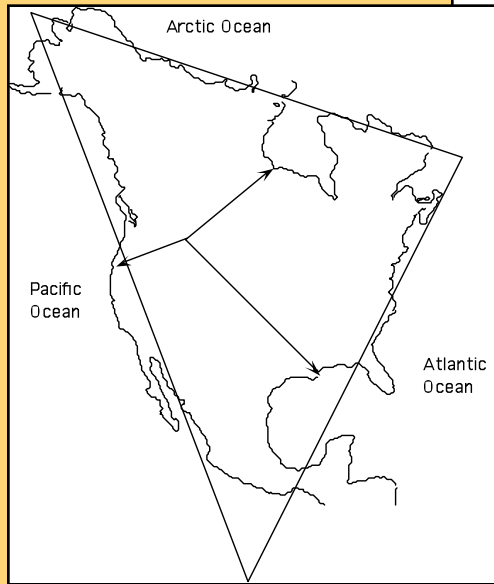


Waterton River – 1975 to 2055

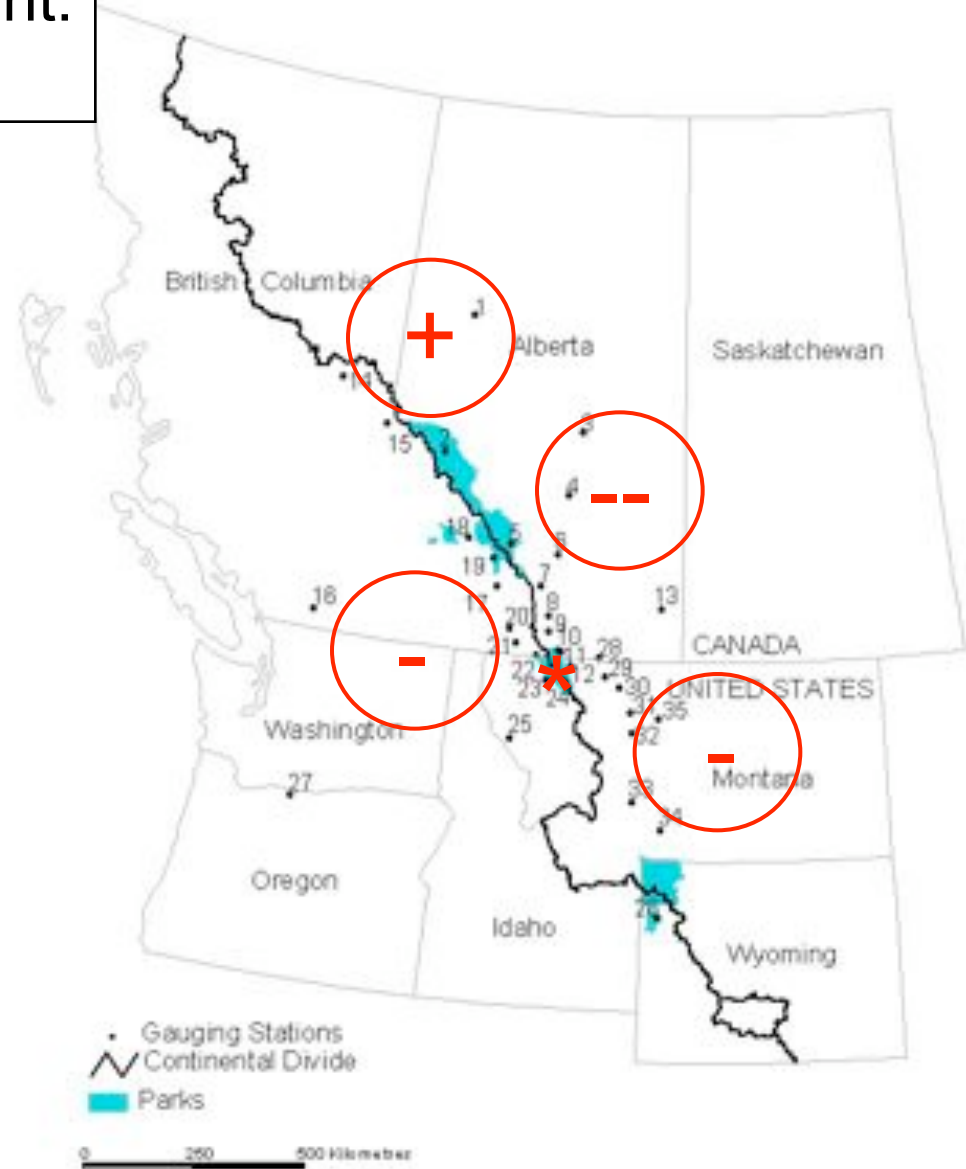


Overall 2005 to 2055: Trend Projection = -8% GCM = -3%

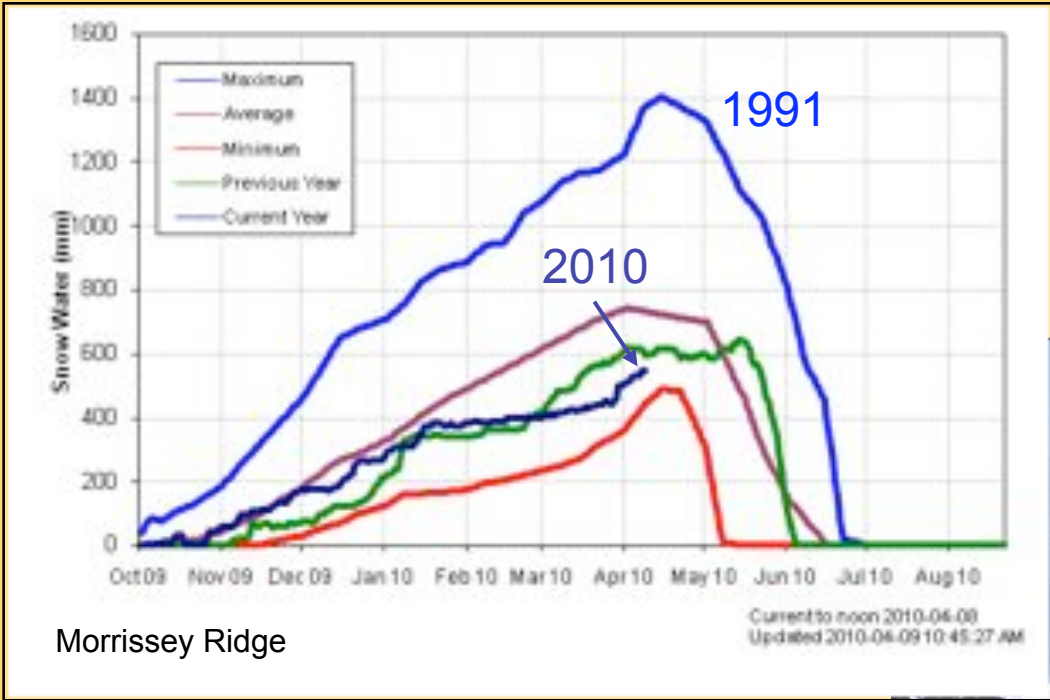
The Crown of the Continent: A unique study system



Hydrographic Apex
of North America

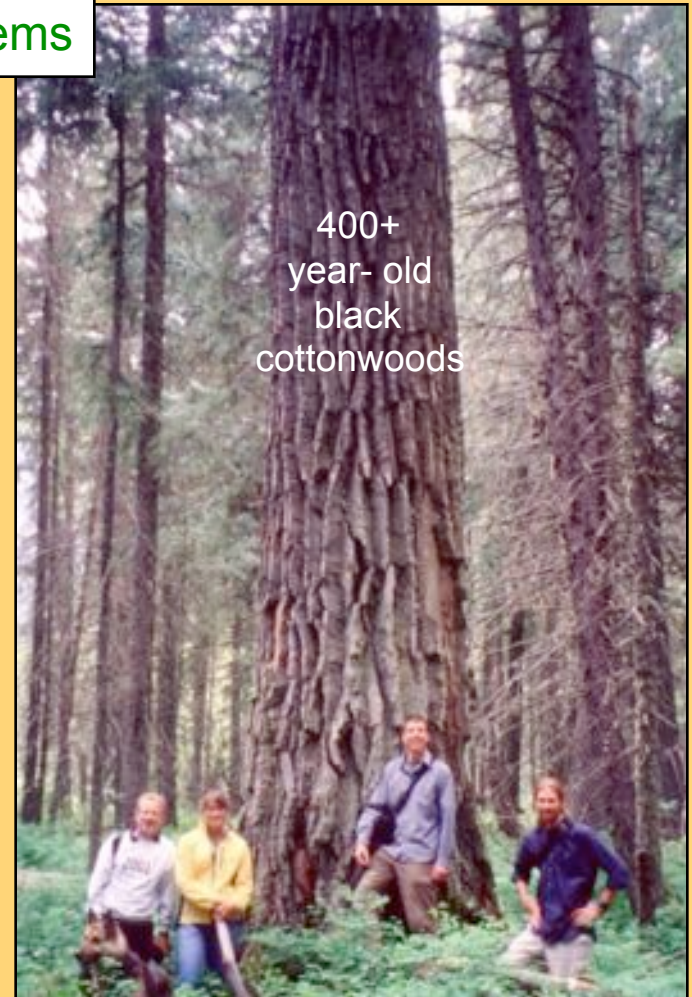


So what ... who cares?

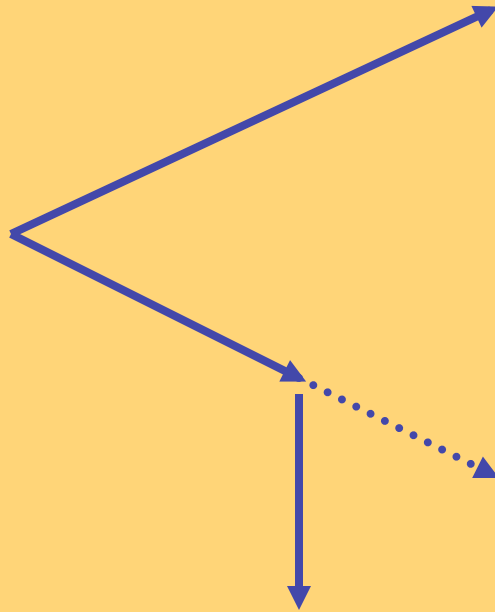


So what ... who cares?

1. Winter activities
2. Trout & trees – aquatic and riparian ecosystems



Big Lost River
Idaho



So what ... who cares?

1. Winter activities
2. Trout & trees
3. Reduced hydroelectric power generation

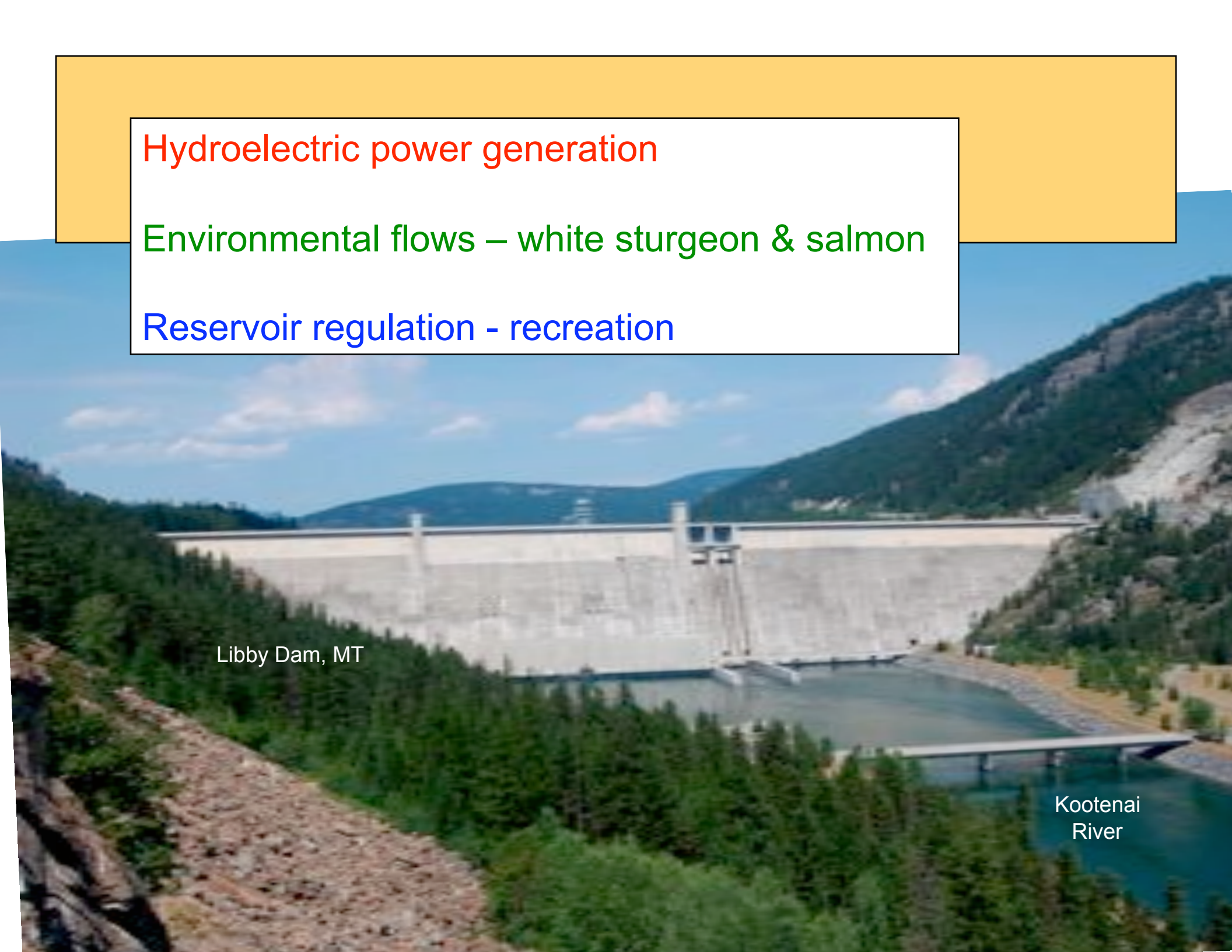
Hydroelectric power generation

Environmental flows – white sturgeon & salmon

Reservoir regulation - recreation

Libby Dam, MT


Kootenai
River



So what ... who cares?

1. Winter activities
2. Trout & trees
3. Hydroelectric power generation
4. River flooding

Climate change and floods -
Insufficient record for trend analysis

An aerial photograph showing a wide, shallow river valley. The river is significantly flooded, with water covering large areas of the surrounding landscape. The water is a light, milky color, contrasting with the dark green of the trees and the lighter green of the fields. The terrain appears to be a mix of forested areas and open fields. The sky is overcast and grey.

Oldman River
June 1995

So what ... who cares?

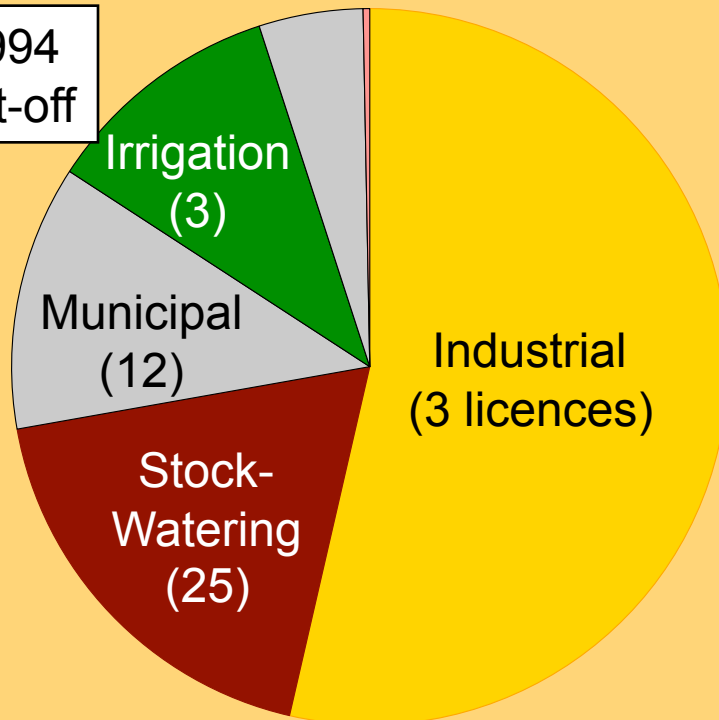
1. Winter activities
2. Trout & trees
3. Hydroelectric power generation
4. River flooding
5. Water for irrigation and other uses

Southern Tributaries – ‘Sharing the Shortage’

← All users received 60%

- Extensive allocation (St. Mary River 118% of median)
- Shallow snow-packs in spring 2001 - anticipated water shortage
- Major irrigation districts – *‘first in time – first in right’*

Post-1994
to be cut-off



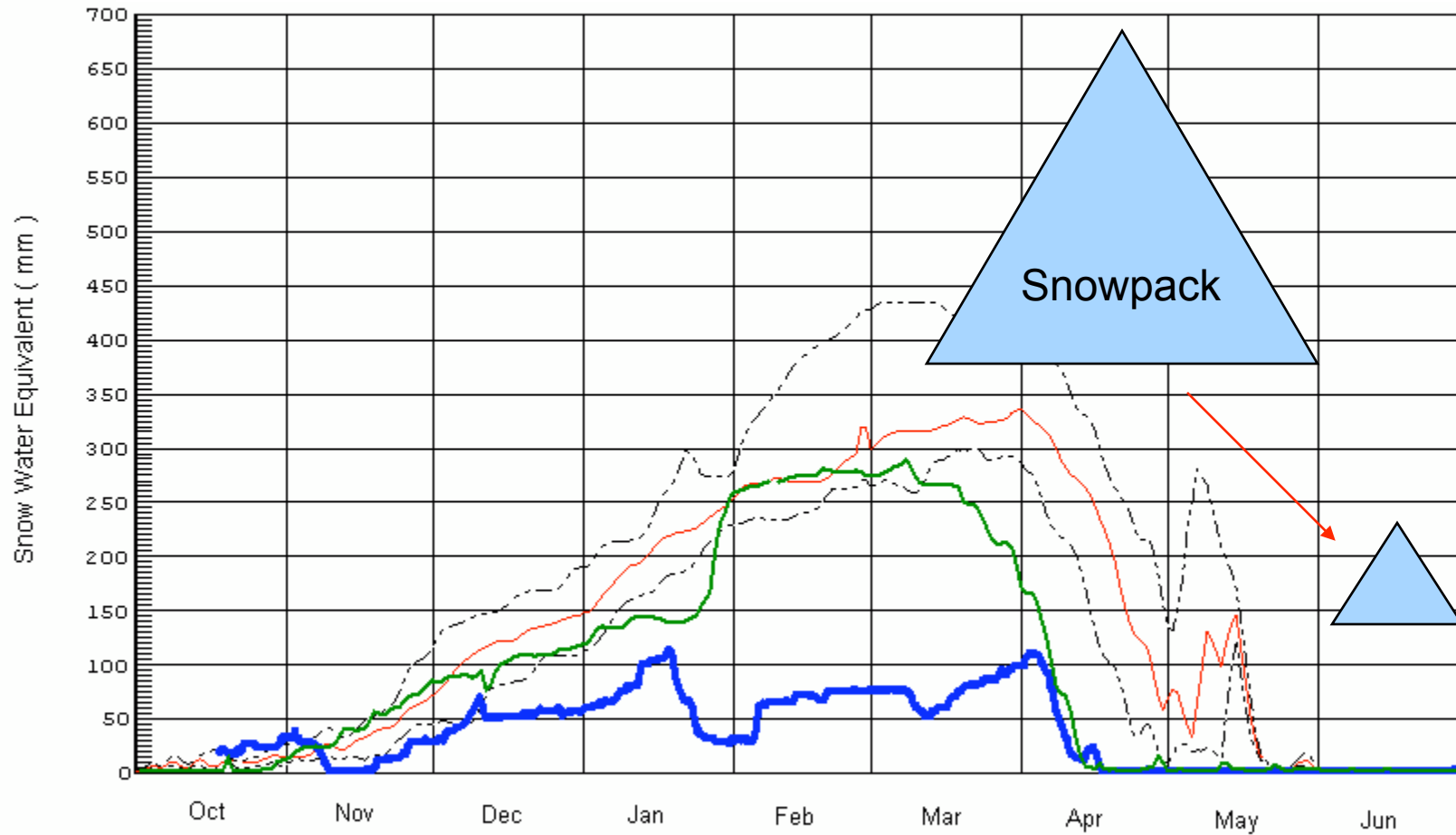
1999 factory near Taber
2000 acre-feet water licence

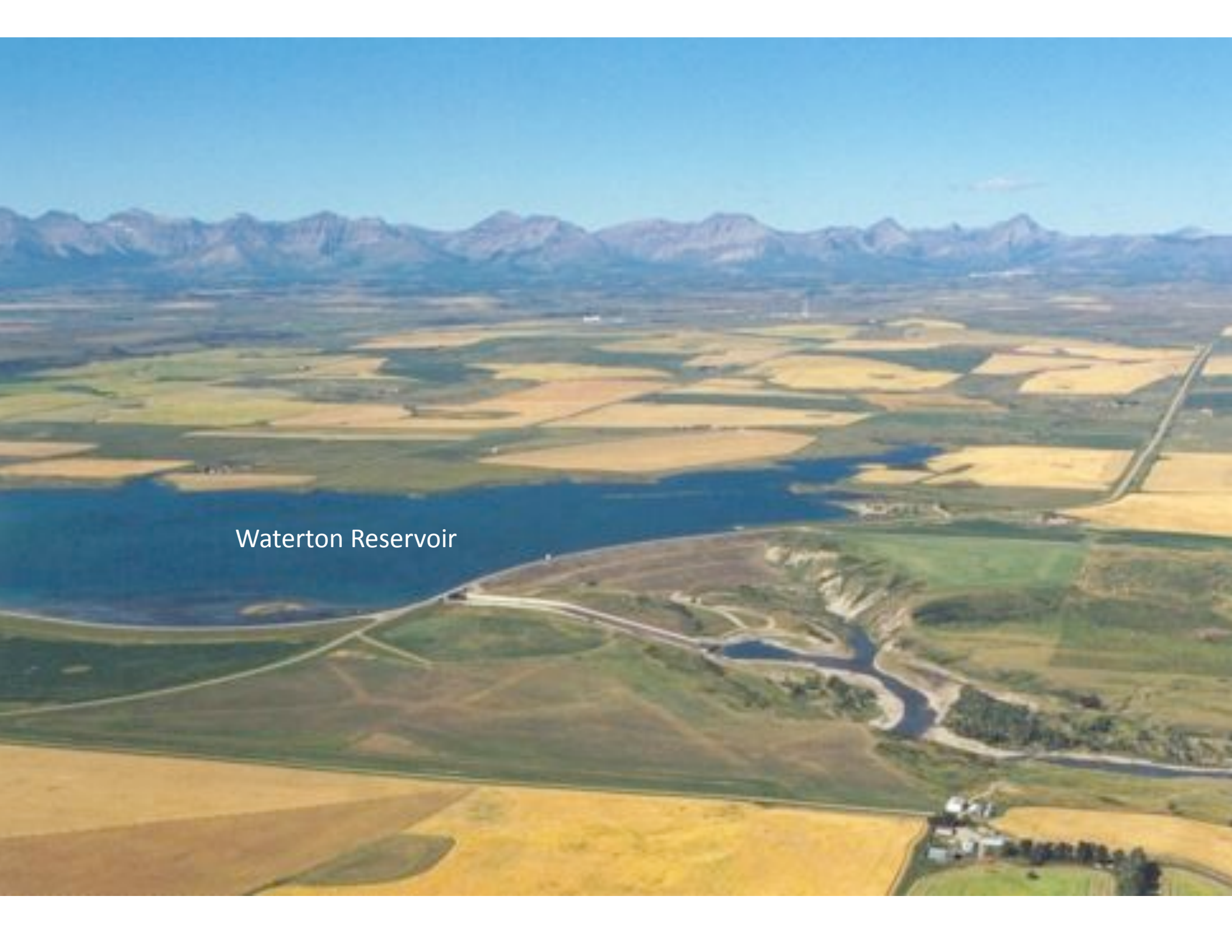


So what ... who cares?

1. Winter activities
2. Trout & trees
3. Hydroelectric power generation
4. River flooding
5. Water for irrigation and other uses
6. Forest fire hazard
7. ...

Many Glacier – Snow Pillow





Waterton Reservoir

1991 increased minimum flows

1993 flow ramping

1995 flood

Saplings - 2006



The internet age – public data:

Snow pillows

- AB - Alberta Environment
- BC - BC Environment
- MT - US – SNOTEL

River flows

- Water Survey of Canada
- United States Geological Survey

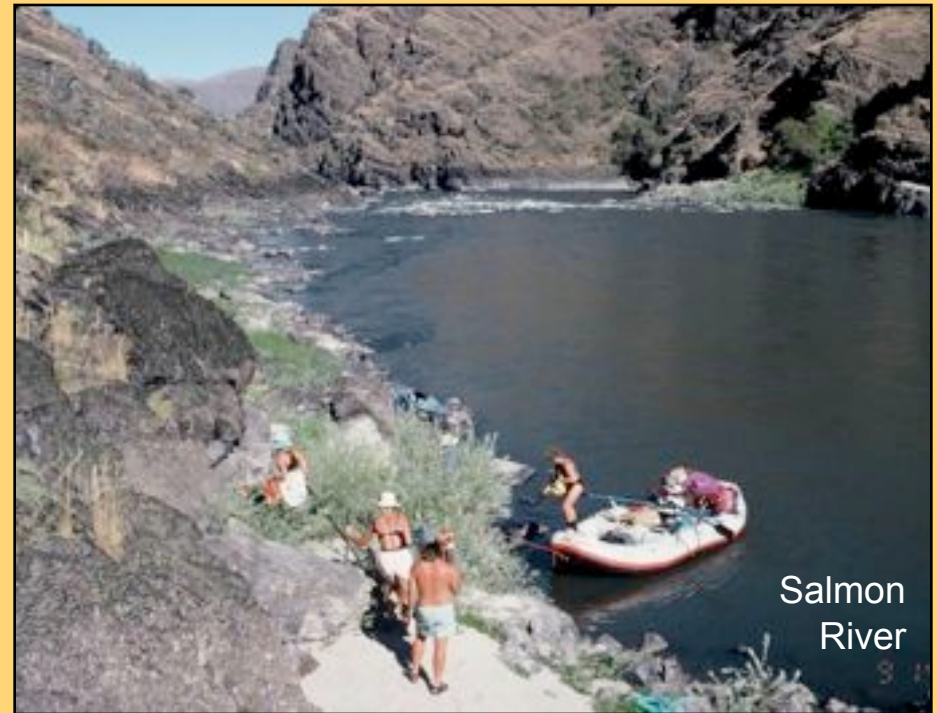


University of Lethbridge students:

- Ryan Caine - Cranbrook
- Krista Coombs - Fernie
- Ann Delyea - Fernie
- Colleen Phelan – Cranbrook
- Mary Louise Polzin – Baynes Lake

Thanks (Fernie):

- Blair Craig
- Steve Kuijt
- Lynn Muller
- Robin Siggers



Salmon River

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