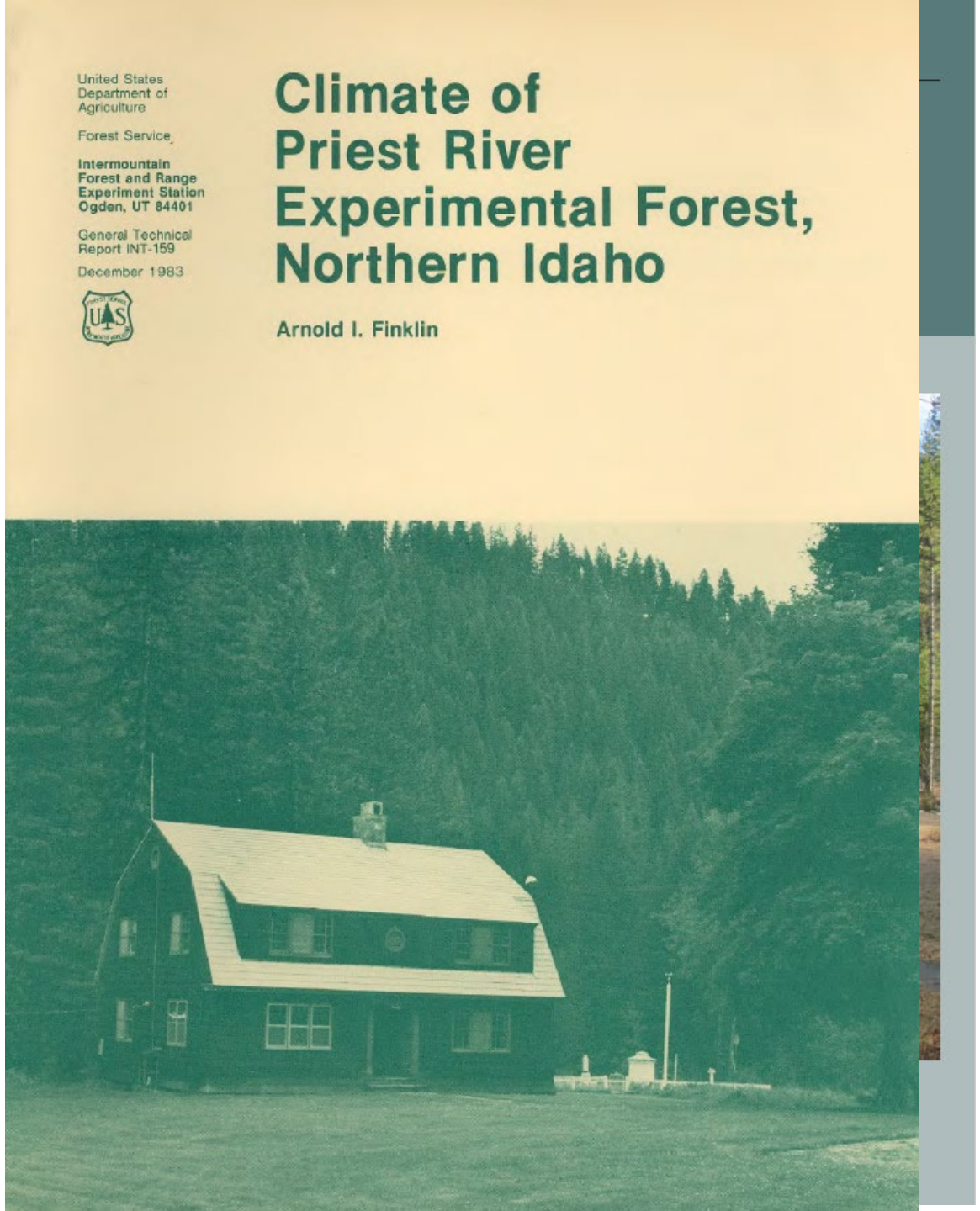
100 Year Climate Review

Priest River Experimental Forest

Brandon Glaza – USFS Hydrologist

Excerpts from…

Climate last summarized by Finklin in 1983. Climate of Priest River Experimental Forest, northern Idaho. GTR-INT-159

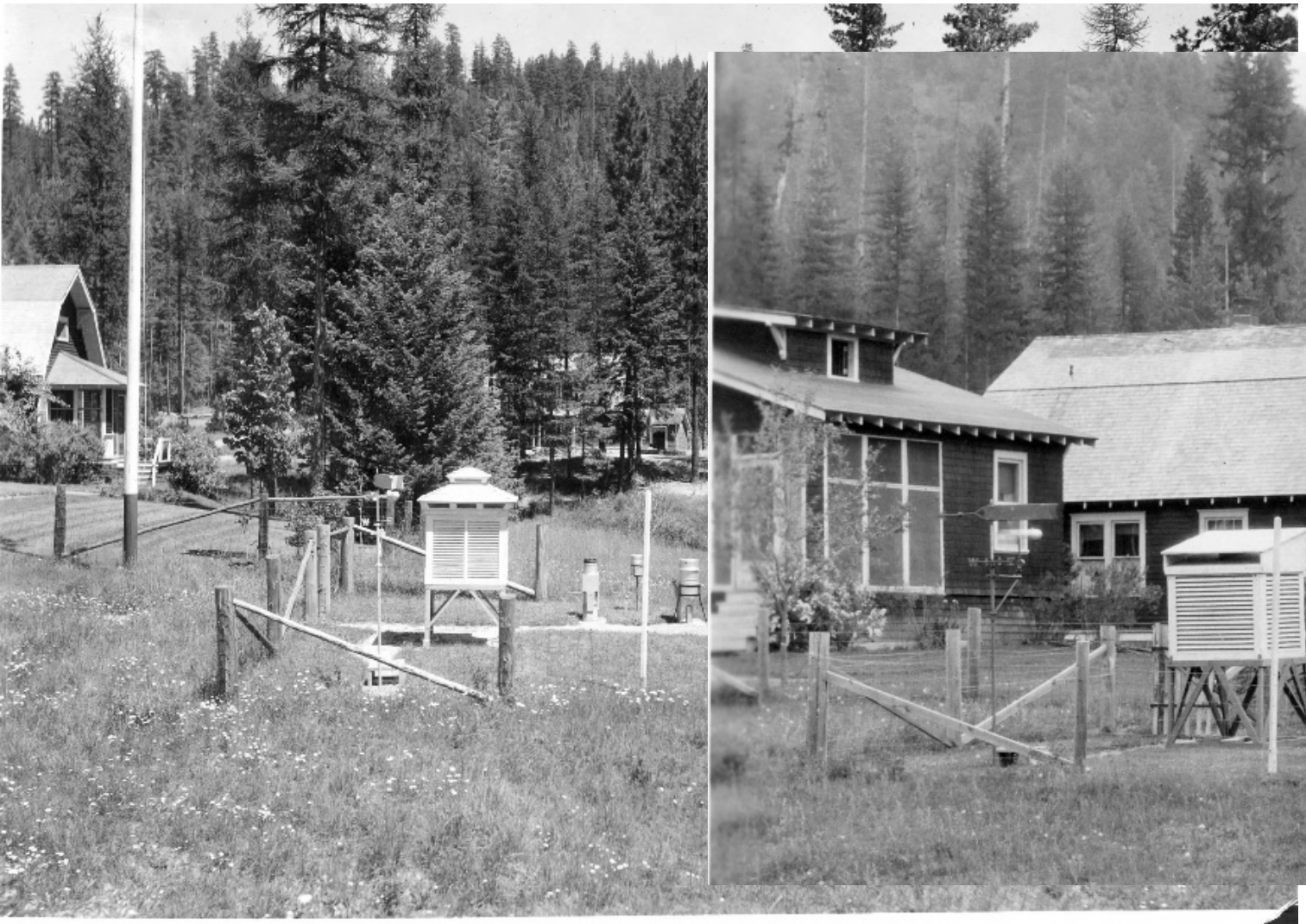


Priest River Experimental Forest

Established in 1911.

- Weather collected for 112 years from same location. Temperature, Precipitation, Humidity, Wind.
- Streamflow data collected for 83 years on Benton Creek since 1939.
- Snowpack measurements at low and high elevation continuously for 85 years.
- Other data collected intermittently.

Weather Station



The main weather station where daily measurements have been made since 1912. A summary of these records for 1912 to 1931, inclusive, is available upon request.

Weather Station

Weather Sta

Climate Data Summary-Temperature

Table 1—Monthly average and daily extreme temperatures (°F) at the PREF control weather station from 1911 to 2013.

	Averages			Extremes			
Month	Daily maximum	Daily minimum	Monthly	Highest	Year	Lowest	Year
Jan.	30.5	18.3	24.4	50	2003	-33	1950
Feb.	37.0	20.3	28.7	57	1947	-35	1933
Mar.	45.6	24.7	35.2	71	2004	-18	1945
Apr.	57.0	30.2	43.6	88	1934	-1	1936
May	66.8	37.3	52.1	97	1936	18	1954
June	73.6	43.4	58.5	97	1912	24	1918
July	82.8	46.2	64.6	102	1924	29	1917
Aug.	81.9	44.6	63.3	103	1961	26	1914
Sept.	71.3	38.3	54.8	97	1988	16	1926/1934
Oct.	55.8	32.1	44	83	1935/1943	-5	1935
Nov.	38.9	26.7	32.8	64	1965	-16	1955
Dec.	31.6	21.3	26.5	55	1933	-36	1968
Year	56.1	32	44.1	103	Aug. 1961	-36	Dec. 1968

Climate Data Summary-Temperature Trends

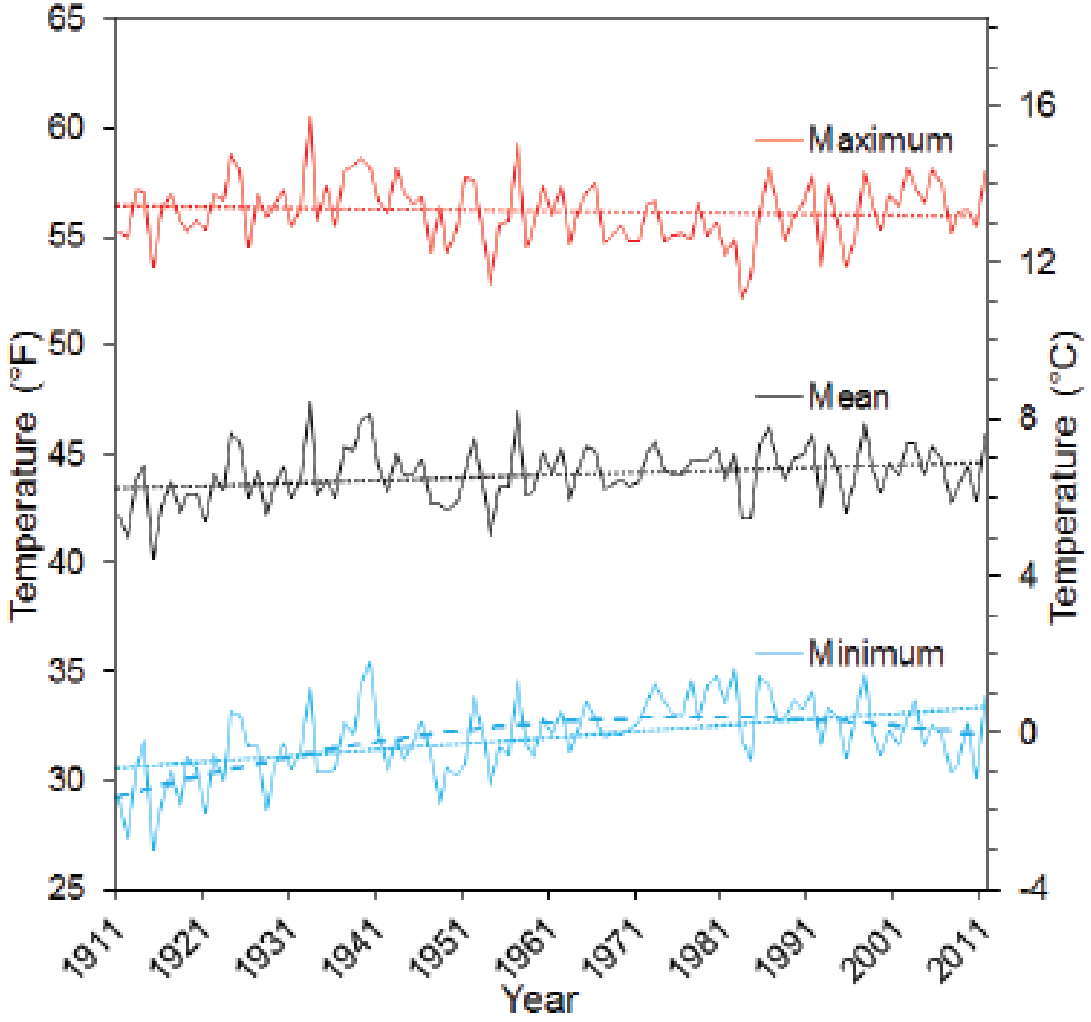
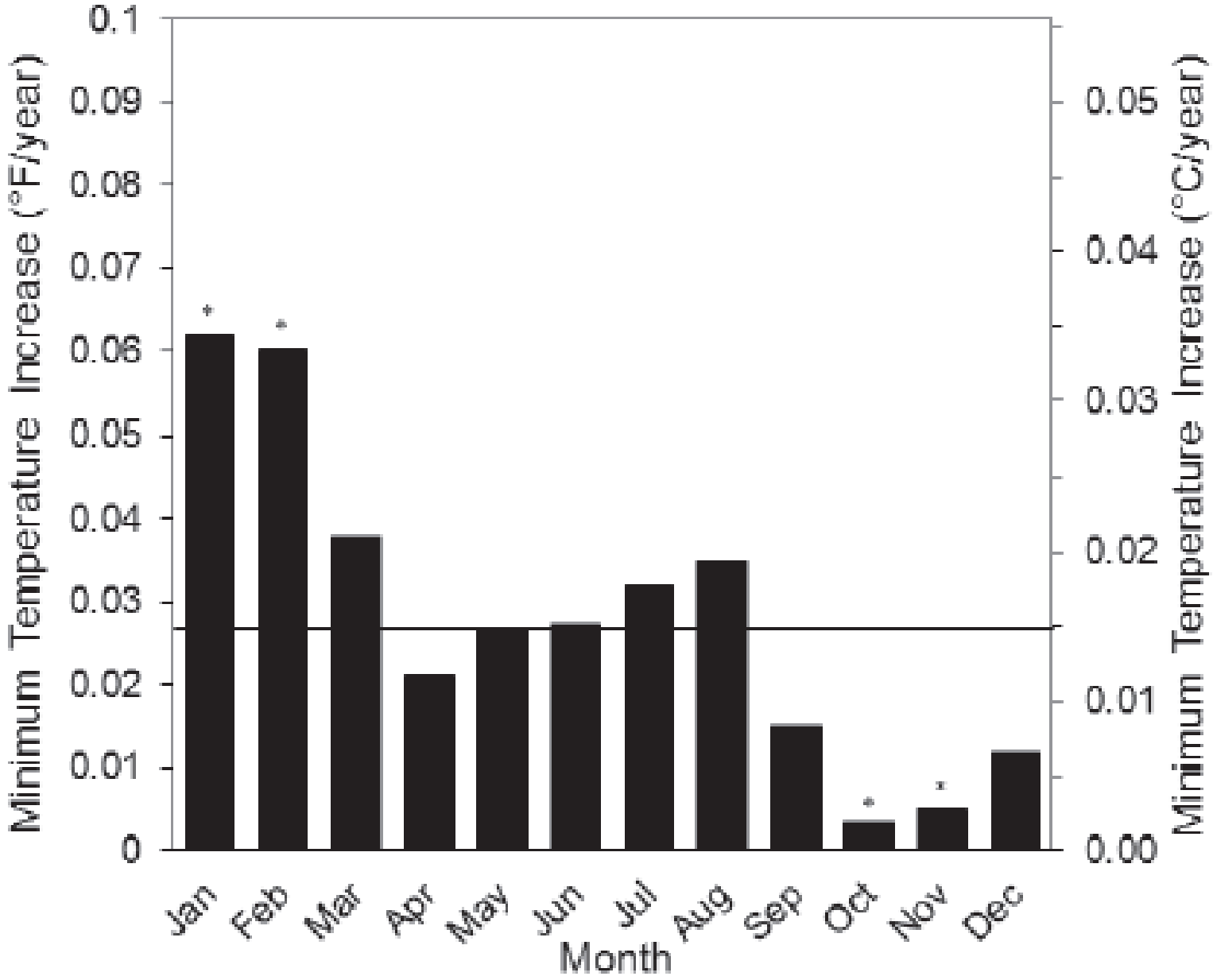


Figure 29—Annual average daily maximum, mean, and minimum temperatures for 1912 to 2012 at the control weather station in PREF, with lines of linear (dotted) and polynomial (dashed) regression overlaid. Analyses show no change in the maximum and mean daily temperatures, while annual daily average minimum temperatures have increasing by 2.8 °F over

- No change in daily maximum or daily mean temperatures over last century.
- Daily minimums have increased 2.8 degrees F since 1911.
- All months show increase in minimums but the coldest months, January and February have warmed more rapidly than the mean(6 degrees per century).
- 8.6 less days with 1 inch of snow since 1911.
- Found a daytime lapse rate of 4 degrees F per 1000 feet elev.

Tem


Minimum Temperature Increase (°F/year)
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Minimum Temperature Increase (°C/year)
0.05
0.04
0.03
0.02
0.01
0.00
*
*
*
*
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

Temperature - Extremes

New Record High For Month of August in 2018 - 105°

New Record High For Month of June and July 2021 - 108° and 105°. All time high for period of record.

New Record High For Month of December in 2021 - 57°

Record high temps for 6 of the 12 months set in the last 20 years. Most recent record low temp set 55 years ago.

Month	Extremes Highest	Year	Lowest	Year
Jan.	50	2003	-33	
Feb.	57	1947	-35	
Mar.	71	2004	-18	1945
Apr.	88	1934	-1	
May	97	1936	18	
June	97 **108**	1912 2021	24	
July	102 **105**	1924 2021	29	1917
Aug.	103 **105**	1961 2018	26	1914
Sept.	97	1988	16	1926/1934
Oct.	83	1935/1943	-5	1935
Nov.	64	1965	-16	1955
Dec.	55 **57**	1933 2021	-36	1968
Year	103	Aug. 1961	-36	Dec. 1968

Most Recent Record Low 1968

Temperature – Frost Free Days

20 more frost-free days since 1911 (Most in Apr and May).

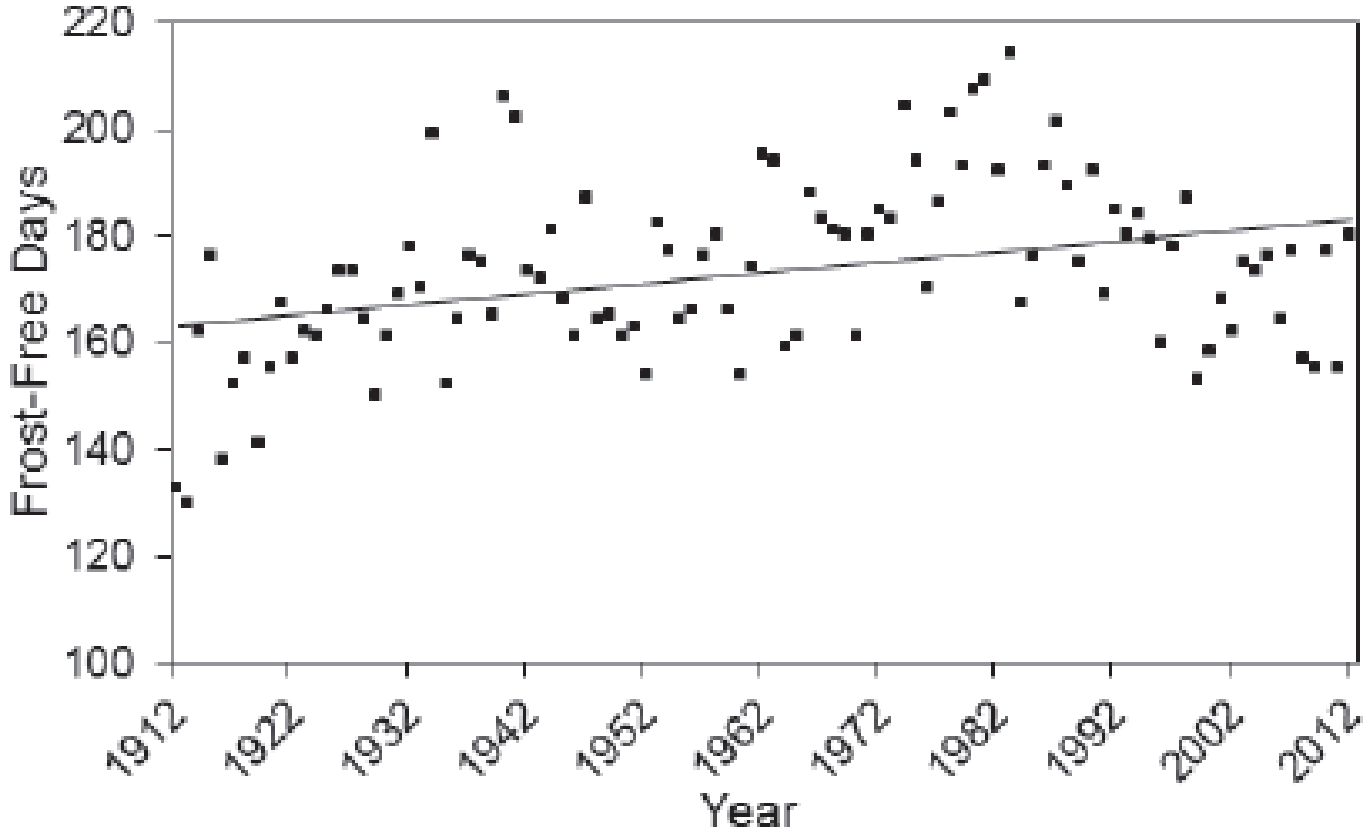


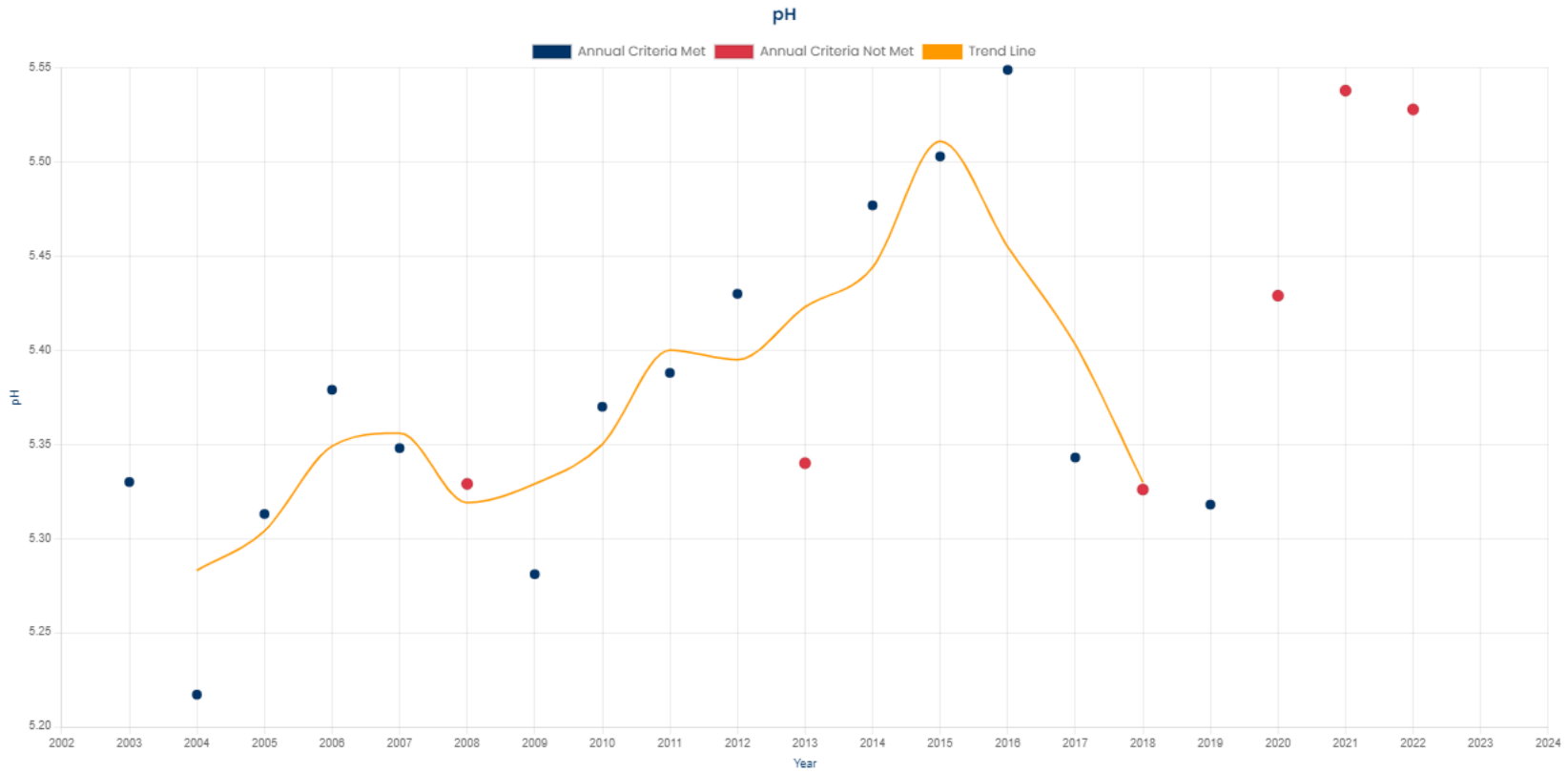
Figure 31—Number of frost-free days per year from 1912-2012; a day was counted if the minimum temperature did not go below 32 °F (0 °C). The line denotes a linear regression and shows that over the last century the growing season length has increased by approximately 20 days.

Precipitation

- Control receives an average of 31.4” per year with SD 5.6”
- Minimum of record 16” and Maximum of record 47.2”
- 40% comes in November, December, and January
- 13% comes in July, August and September
- Benton Spring (4800 feet elev) averages 13.5% more per year than control station (2400 feet elev)
- **No statistically significant trend in precipitation in the last century**

Site NTN ID02

Data | Trend Plots | Photos | Documents



WHAT TO PLOT

Concentration

◉ pH ○ SO_4 ○ NO_3 ○ NH_4 ○ Ca ○ Mg ○ K ○ Na ○ Cl

SITE INFO

Site ID:	ID02
Site Name:	Priest River Experimental Forest
County:	Bonner
State/Province:	ID
Start Date:	2002-12-31
Stop Date:	
Latitude:	48.3518
Longitude:	-116.8397
Elevation (m):	726
Status:	A
Site Class:	I

Operating Agency
Priest River Experimental Forest
Sponsoring Agency
U.S. Forest Service

MORE INFORMATION

Annual Criteria:
The annual weighted mean concentrations and depositions are characterized as meeting or not meeting the NADP's data completeness criteria for each 1-year period.

1. Valid samples for 75% of the time period
2. Valid samples for 90% of the precipitation amount
3. Precipitation amounts for 75% of the time period

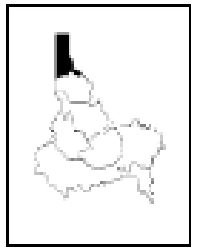
Trend line:
The trend line is a smoothed 3-yr moving average with a one-year time step. The line is only displayed where the minimum data completeness criteria is met for the 3-year period.

Snowpack

- 2 manual snow courses- Benton Meadow at the control weather station at 2300’ elevation and Benton Spring on Gisborne Mountain at 4800’ elevation
- Established in 1937 measured once per month
- Benton Spring March 1st snowpack depth averages 51.5” while Benton Meadow averages 18.6”
- Cooperative with NRCS.

Figure 1: Monthly Precipitation

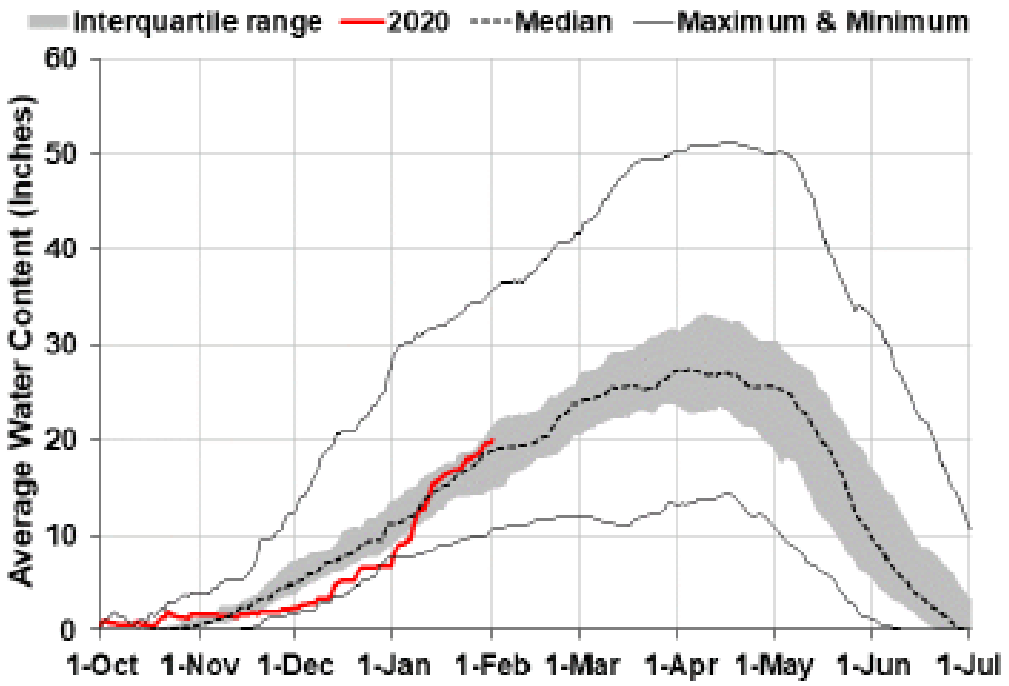
Figure 3: Percent of Median



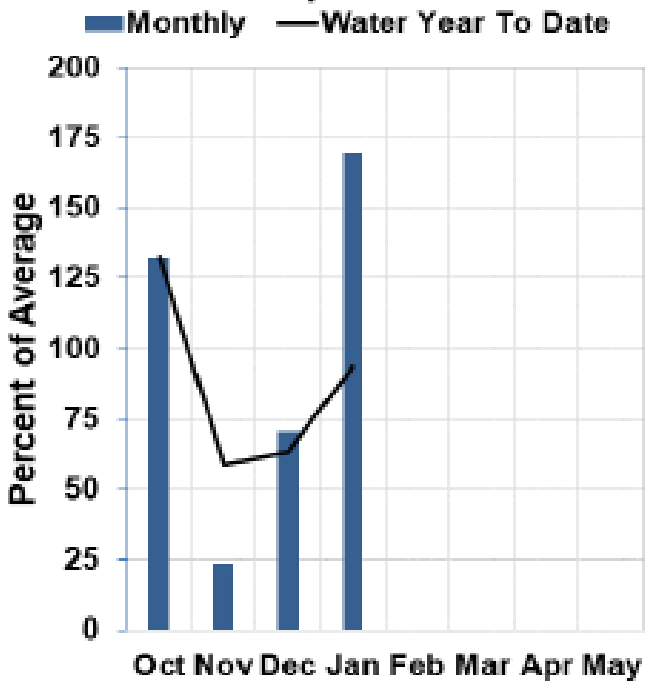
Panhandle Region

February 1, 2020

Current Snowpack and Historic Range



Precipitation



WEST CENTRAL BASINS

SNAKE BASIN

SOUTHSIDE SNAKE RIVER BASINS

0 25 50 100 150 200 Miles

This map is prepared by the USDA-NRCS Idaho Snow Survey Office.
http://www.nrcs.usda.gov/wps/portal/nrcs/main/id/snow/

Snowpack- Snowcourse

Snowpack-Snowfall

Low Elevation snowfall has declined by 20 inches.

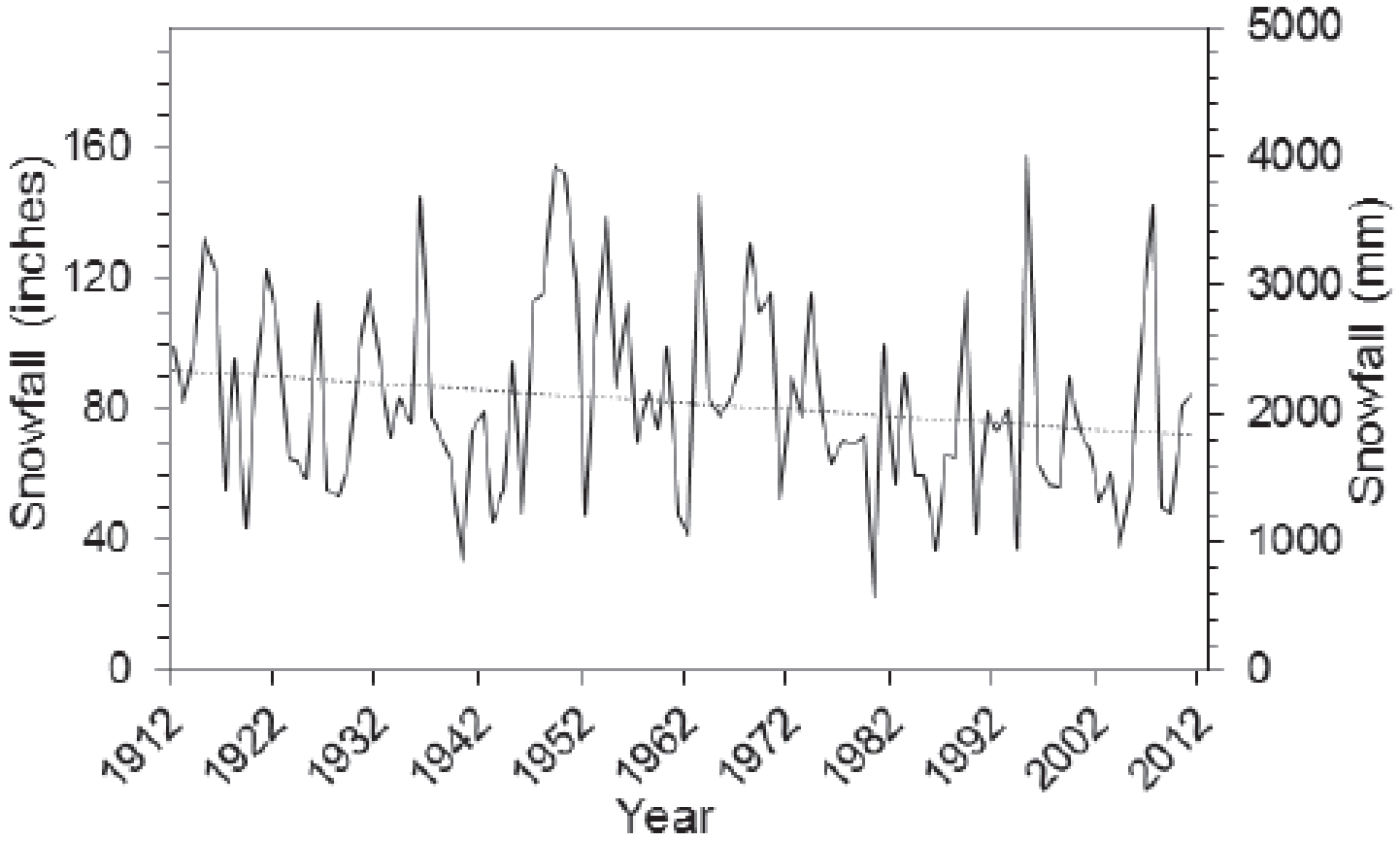


Figure 21—Cumulative annual snowfall at the low-elevation control station for 1912 to 2012, with a linear regression line plotted through the data. Over the last century cumulative snowfall at the lower elevations of the watershed has declined by approximately 20 inches.

Snowpack

- Benton Meadow (2300’ elev.): Snow depth and SWE at March 1st declining 0.11 inch per year since 1930s. This is 30% reduction or 1/3 less water than the 1930s.
- Benton Spring (4800’ elev.): March 1st Snowpack regression shows a negative slope but no significant decline.

Snowpack

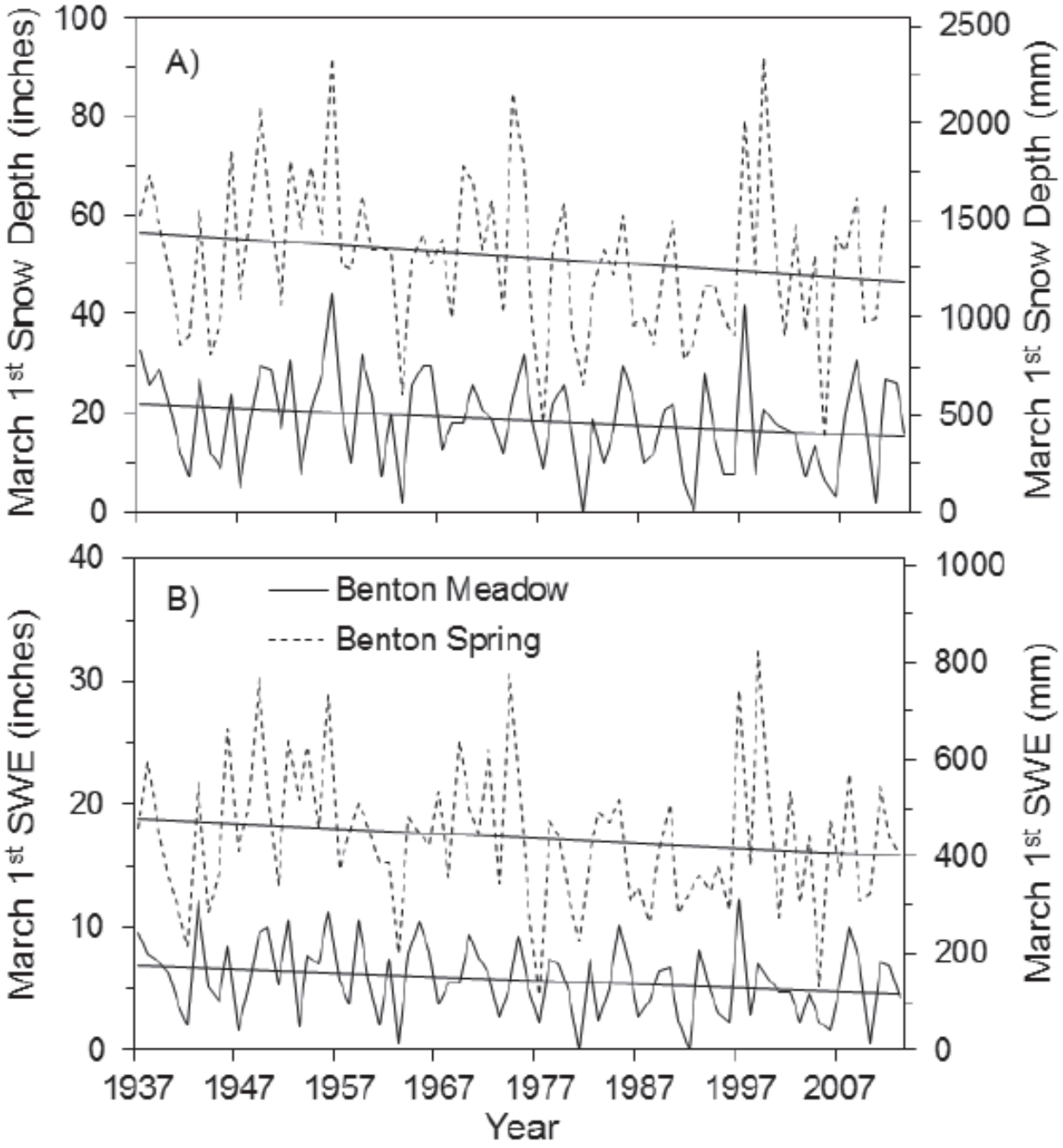


Figure 22—Comparison of the low elevation Benton Meadow (solid line) and high elevation Benton Spring (dashed line) snow courses from 1937 to 2013. The comparisons show the March 1st (A) snowpack depth and (B) snow water equivalent (SWE), where the line through each dataset represents a linear regression.

Str

- Str
- 95
- ~2
- Av
- His
- Ev

Streamflow

Peak Flow Usually Mid May, lowest flows in Early October

April and May account for 48% of annual streamflow

September and October account for ≤ 4% of annual streamflow

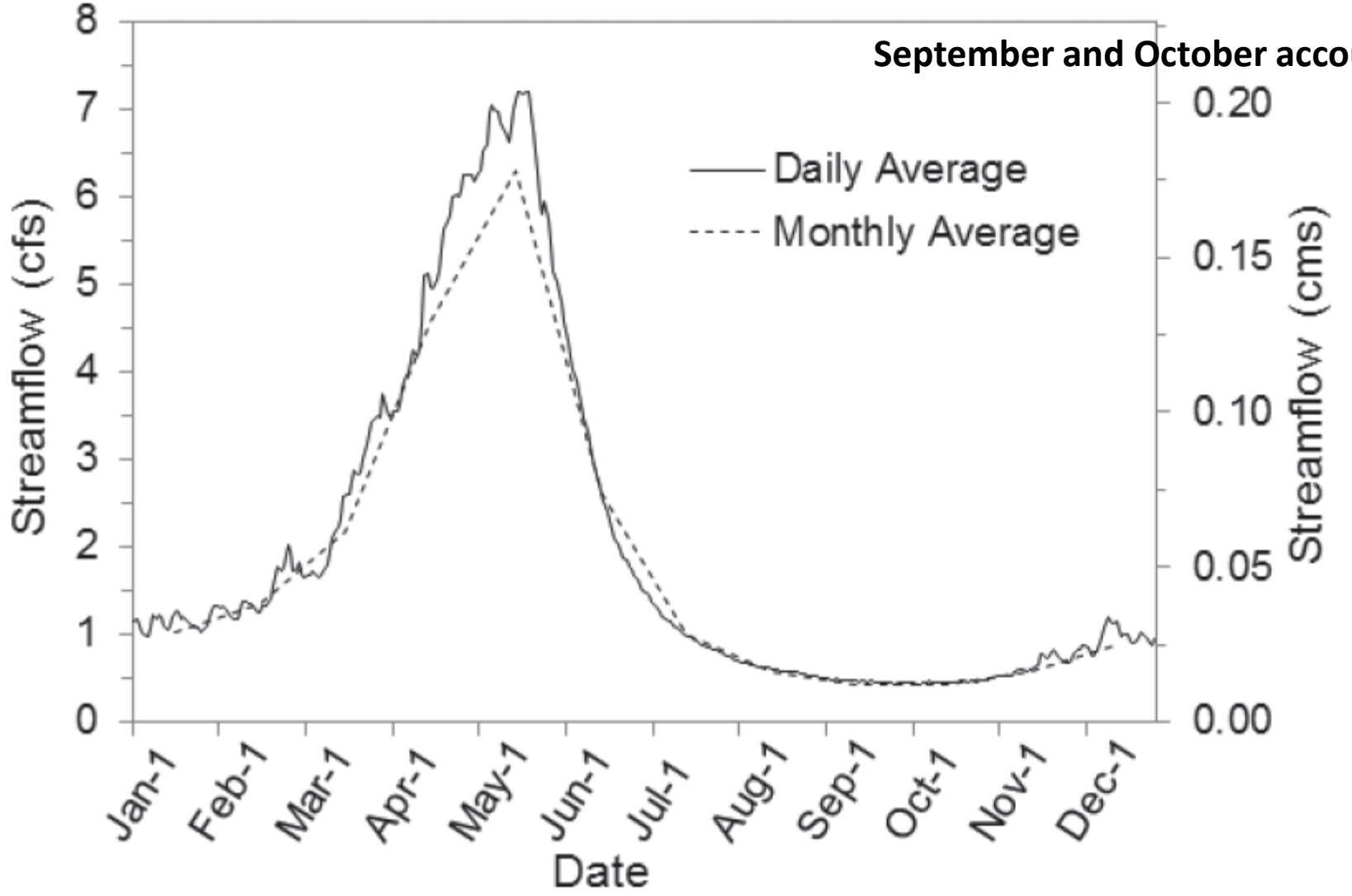


Figure 23—Seasonal distribution of streamflow in both cubic feet per second (cfs) and cubic meters per second (cms) averaged monthly since 1939 and daily since 1955 until early 2012 at the Benton Dam gauging station.

Streamf

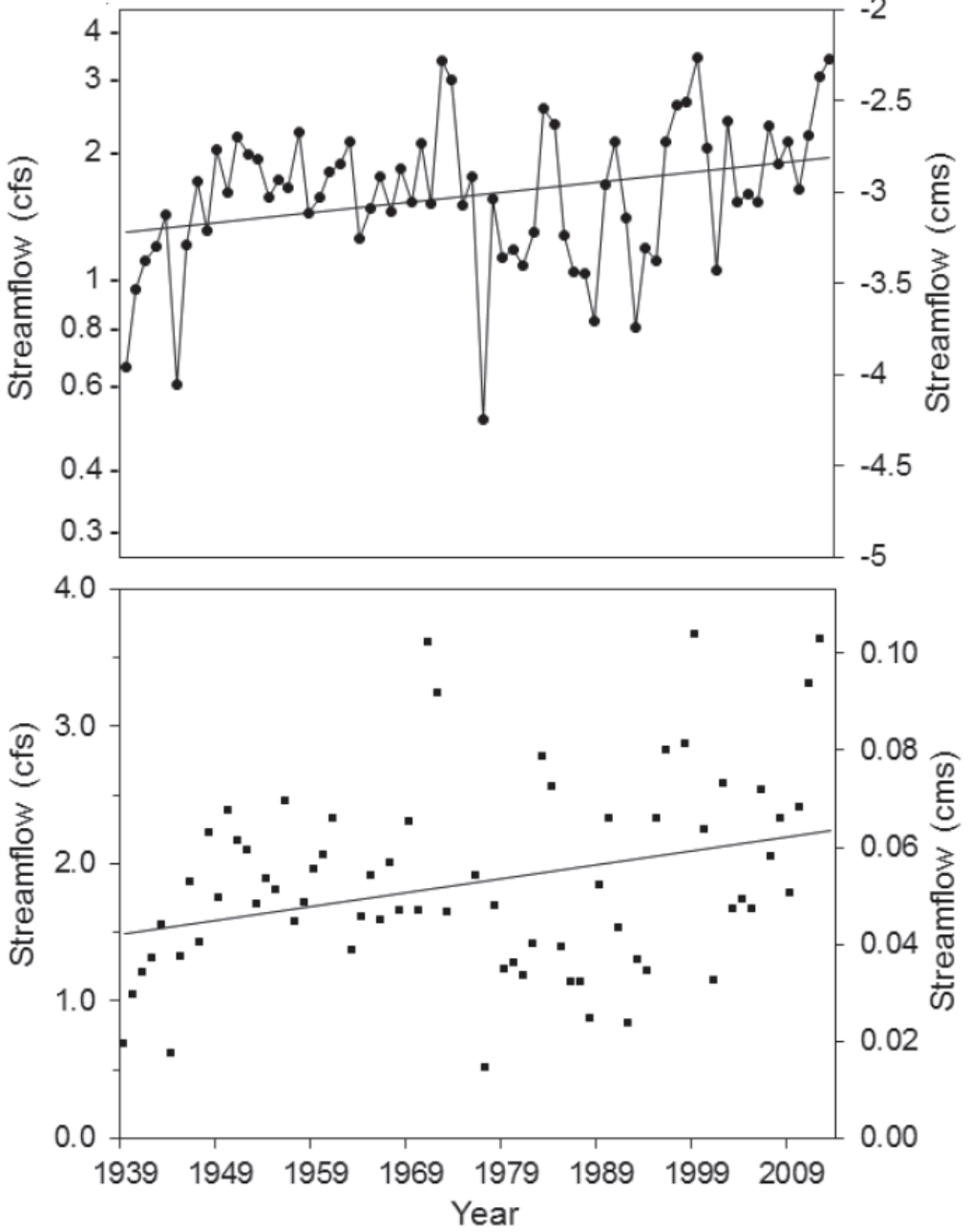


Figure 25—Average annual stream flow from 1939 through 2012, log transformed on top and presented as the raw data on bottom. Both graphs are plotted with a linear regression through the data, showing an approximate 33% increase in streamflow over the 73 years of observation.

Variability has increased;
1983 max min =25.3” and 6”
2015 max min =33.5” and 4.6”

33% increase in average annual runoff over 73 years

Streamflow

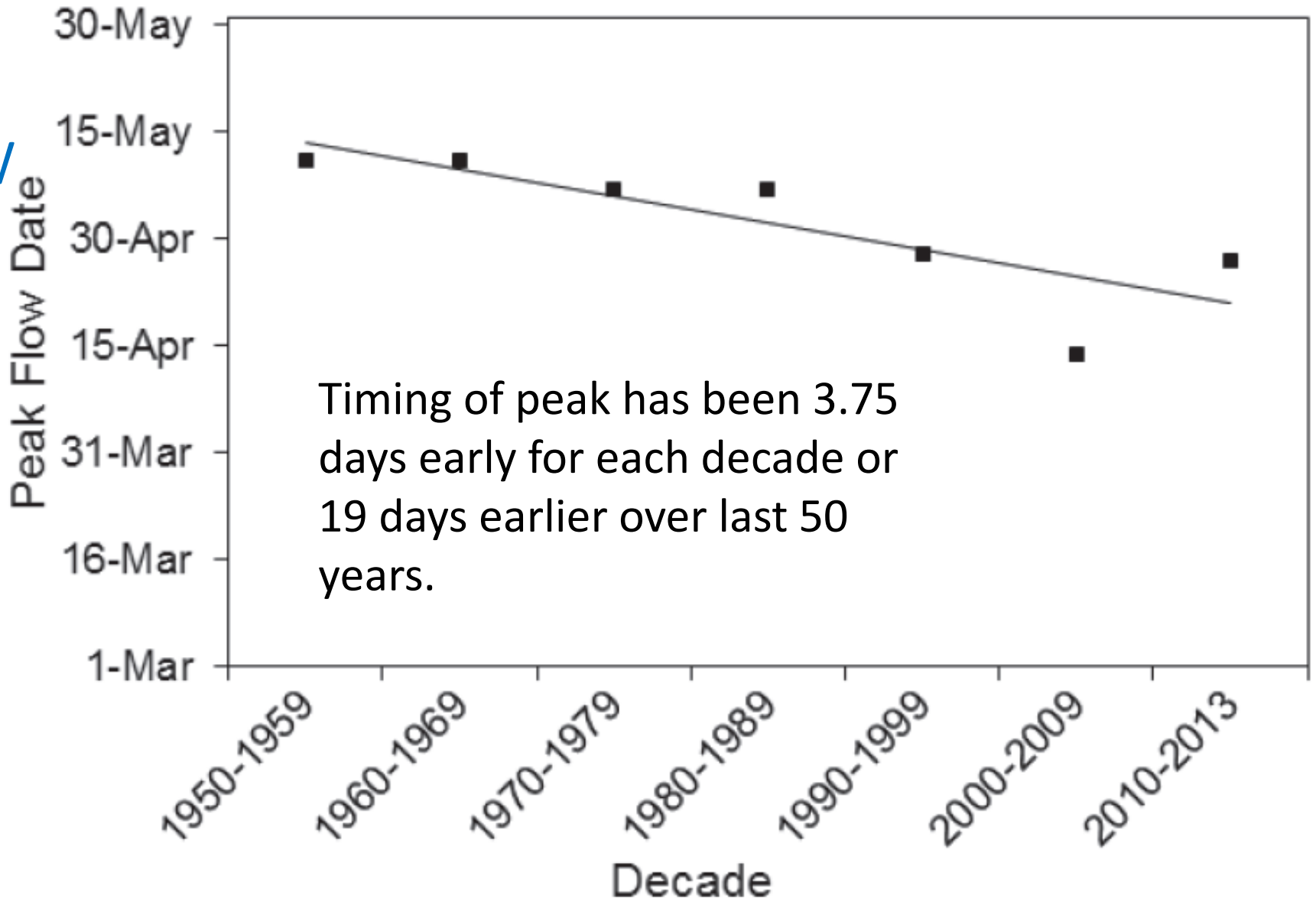


Figure 27—Timing of peak decadal streamflow over the last 60 years, with a linear regression plotted through the data. The regression shows that peak streamflow has shifted 3.75 days early each decade.

Streamflow Discussion

- Streamflow increased with no measureable increase in precipitation.
- Luce and Holden (2009) & Clark (2010) found decreasing streamflow in large basins.
- Birsan et al. (2005) and Jones (2011) found similar results to Benton Cr.
- Canopy and deep drainage likely haven’t changed much.
- Change due to tree species composition? White Pine to Douglas Fir/ Western Red Cedar dominated.
- Instrumentation error possible

Summary

- Temperature : No change of daily maximum or daily mean over the century. Daily minimum temps have increased. Record high temps for 6 of 12 months set in past 20 years.
- Precipitation : No change over the century. More as rain.
- Snowpack: 30% less March 1st SWE and snow depth since 1937.
- Streamflow : Possible increase in annual runoff, more variability, and later seasonal peak flow.

Thank you. Questions?

- Answers?

- Copies of these publications available.

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- Priest River Experimental Forest – Story Map

- Historic photographs of PREF available at...

www.lib.uidaho.edu/digital/expforest/