Introduction

White Spruce in Interior Alaska: Variability and Response of Climate

200-Year Perspective of Climate Variability and Response
Climate Recontruction and the Ring-Width Characteristics

Figure 2.3. (A) Annual mean precipitation and growth (October-February) of the largest trees in the region. The period of record at Prather's, Nevada, is 200 years. Annual average precipitation and growth data are superimposed with a 10-year running mean. The interdecadal timescale is shown.

The potential of climate variability and growth response 233
There are few consistent differences in the simple sizes of major species at 1850 versus 1860, but a notable exception is the 1860s. The 1860s were characterized by significant changes in the marine environment, including increased upwelling and changes in ocean currents, which affected the growth and distribution of marine species. For example, the 1860s saw a decline in the populations of certain species of whales, which had been abundant during the 1850s.

Figure 12.4 (A) (B) (C) (D) (E) (F) (G) (H) (I) (J) (K) (L) (M) (N) (O) (P) (Q) (R) (S) (T) (U) (V) (W) (X) (Y) (Z)

200-Year Perspective of Climate Variability and Response

The Intraseasonal Timescale

With some displays...
Overall, the 20-year perspective of the climate variability and response to climate change suggests that periods of higher temperatures and increased variability are likely to continue. This is evident from the observed trends in temperature and precipitation across different regions. The impact of climate change on ecosystems and human activities is becoming increasingly evident, with rising temperatures leading to shifts in species distribution and altered growing seasons. The interdecadal perspective highlights the need for adaptive management strategies to mitigate the effects of climate change and ensure sustainability.
Little information is available to identify potential major white spruce cone/seed crops before the Fairbanks climate record began in 1906. The ring-width V index serves as a working hypothesis about which years may have been dates of major cone/seed crops, a sort of paleocrop proxy. It is interesting to observe that the intervals between major ring-width V signals from 1827 to 1892 are 9, 13, 18, 11, and 14 years (figure 12.8), intervals that are very consistent with those between major seed-fall years during the BNZ monitoring period of 1957 to the present (13, 17, 11 years).

Of course, steep single-year growth reductions may occur across a population of trees for reasons other than climatic signals or allocation of photosynthates to cone maturation. In stem cross sections at several locations in Interior Alaska, the very low radial growth in 1878–1879 (figure 12.4) is also marked by indications of physical trauma and a change in the status of some trees from slow growing to fast growing and vice versa. These responses are consistent with a wind or snow breakage event and subsequent growth release or suppression, depending on the damage to the stem and its neighbors. Snow breakage is reported as happening in BNZ in 1967 (Van Cleve and Zasada 1970), and a major breakage event was observed again in 1990–1991. So, the V index for 1878 may not represent a reproductive event but a growth reduction from mechanical injury.

Several older white spruce stands in and near BNZ that have been clearcut allow large numbers of low stump surfaces to be ring counted. Many of these stump counts cluster at dates just after 1805 and 1810. Allowing for a few years for establishment and early growth, we can reasonably infer that major seed crops were produced in 1805 and 1809.

Conclusions

The ecology of white spruce growth and reproduction at BNZ is an excellent example of important ecological responses related to climate variability. The long time series available allows the identification of repeated outcomes of a system that includes as its interacting parameters climate (indicated by recorded data and reconstructed climate), tree growth (indicated by ring-width), seed crop timing and abundance, and stand age cohorts. The consistency of the response of the system across multiple cycles ("realizations" in time series analysis) is strong evidence in favor of an underlying causative mechanism rather than random patterns.

Several of the years of key events described in this chapter happened during El Niño years. For example, the 1941, 1958, 1983, 1987, and 1998 seed crops were initiated and/or matured during strong El Niños. Since 1940, 15 out of the 17 years with the greatest area burned in Alaska occurred during moderate to strong El Niños (Hess et al. 2001). The contribution of the El Niño signal to the climate–growth–reproduction system described here should be further examined. Strong and moderate El Niños produce positive temperature anomalies in Interior Alaska but generally below normal precipitation, particularly in the winter (Hess et al. 2001; Ropelewski and Halpert 1986). El Niños represent a deepening and an expansion of the Aleutian Low, so that El Niño conditions are simply an amplification of the system we have already described. However, the El Niño effect is not completely consistent in Interior Alaska, which may relate to the path the Aleutian Low takes as it approaches Alaska.

Changing climate sensitivity in the boreal forest is potentially a big issue for the future. Across the Northern Hemisphere, conifer trees at tree line have experienced a loss in climatic sensitivity at some sites (Briffa et al. 1998), causing reduced growth during warmer years as compared to the past. At least some tree-line populations of white spruce in Alaska have lost sensitivity as well (Jacob et al. 1999). The changing sensitivity typical of that experienced in regime 20.3 continues, changing sensitivity could become a widespread phenomenon with deep implications for resource management and the ecology of the Alaskan boreal forest. It also means that tree-line climate reconstructions should be viewed with caution.

The original logical inference about the strategy of periodic reproduction was that it was designed to time infrequent reproductive events to particularly favorable periods and to minimize reproductive costs otherwise. So, what would be particularly favorable for white spruce reproduction in the pattern of timing described in this chapter? The key cue of environmental variability for white spruce is a critical period of warm and dry early summer weather in successive years (figure 12.7). The plant has an internal, hormonally driven system to detect and respond with maximum reproductive effort to the relatively infrequent intervals when strong stress is generated (e.g., by drought) (Owens and Molder 1979; Owens and Molder 1977). This same dry early spring weather and clear weather during the long days near the summer solstice represent fire weather (Johnson et al. 1992). It appears that the described reproductive timing of white spruce maximizes the odds that seeds will be released into a landscape in which fires have occurred recently.

The thick organic mat of the forest floor of the boreal forest is a significant obstacle to white spruce seedling germination, survival, and growth (Zasada 1968). The reduction or removal of coarse or refractory organic material by fire or other methods can significantly improve white spruce seedling germination, growth, and survival (Zasada et al. 1992). The area of boreal forest burned annually in Interior Alaska reaches a distinct peak about every 10 years (Juday et al. 1998). Total area burned in Alaska is relatively well correlated with the May through August temperature in Fairbanks (Juday et al. 1998). The two years with the highest total area burned in Alaska since records began in 1955 are 1957 and 1969 (Juday et al. 1998)—years that are especially well matched to the large cone crops of 1958 and 1970. Surviving trees around the fire margin in both years, 1958 and 1970, released large seed crops onto well-prepared and receptive seedbeds.

Clearly, a disproportionate share of the living young white spruce trees less than 50 years old in Interior Alaska are the result of reproduction in only four years (1958, 1970, 1987, 1998), based simply on probability. If an interval of 12 years is maintained between large white spruce seed crops over the life of a typical BNZ 200-year-old mature white spruce stand and the trees do not become reproductive
References
2007 Perspectives of Chinese Vending and Response

Westchester, December 2006

After 1.7% growth in the middle of another American recession (Q3-95, Q4-94, Q3-93, Q4-92, Q3-91, Q4-90, Q3-89, Q4-88, Q3-87, Q4-86, Q3-85, Q4-84, Q3-83, Q4-82, Q3-81, Q4-80, Q3-79, Q4-78), the leading edge of the Chinese Vending industry is again experiencing growth.

A. Revenues from Chinese Vending Products, 1995-2016

B. Market Size, 1995-2016

C. Chinese Vending Industry Growth, 1995-2016

D. Chinese Vending Industry Trends, 1995-2016
Salmon and Climate

Salmon live part of their lives in freshwater environments and part in marine environments. The salmon life history starts with hatching eggs. Upon hatching, the eggs hatch and develop into fry, which then swim downstream to freshwater streams and rivers to feed and grow. These fry eventually make their way to the ocean, where they begin their life as juveniles, known as smolts. The smolts migrate back to freshwater streams to spawn and release their eggs. The lifecycle of salmon is characterized by these migratory patterns between freshwater and marine environments.

David Creelman

Decadal Climate Variations

and Coho Salmon Catch

When comparing smoothed data for the period 1925 to 1955, there is a noticeable trend in salmon catch over time. The data shows an increase in salmon catch during the 1930s and 1940s, followed by a decline in the 1950s. This pattern may be related to changes in environmental factors such as temperature and precipitation, which can affect salmon populations. Understanding these trends is crucial for managing salmon populations and ensuring their sustainability.