Major stages in the development of plants, such as budding, leafing, and flowering are triggered by seasonal changes in temperature, moisture, and the amount of light. In southern Canada, plants begin to develop rapidly when average daily temperatures reach and stay above certain critical levels.

As a result, the timing of plant development varies from year to year with changes in weather conditions. The early arrival of warm weather results in plants developing sooner, while their development is slower if warm weather is delayed. Over the longer term, these changes in the timing of plant development make a good indicator of changes in climate. Farmers, ranchers, and gardeners are especially interested in these changes because of their effects on the way that crops, livestock, and garden plants have to be managed.

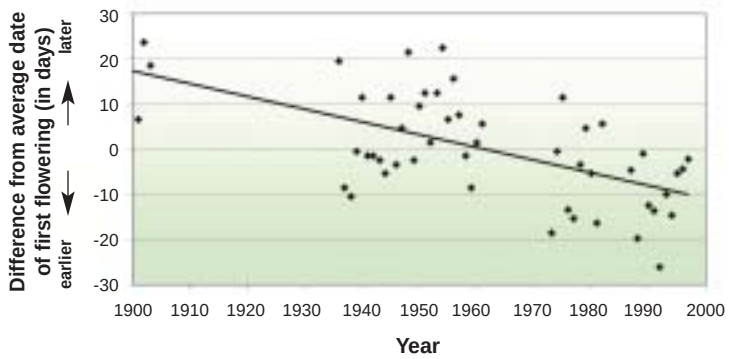
As our climate has changed, spring across much of the country has been getting warmer earlier. That should give most plants a head start on their development and result in the earlier arrival of noticeable events like budding and flowering.

FOCUS: Edmonton

At various intervals over the past 100 years, observers in the Edmonton area have recorded the flowering date for a common North American tree, the trembling aspen. Researchers from the University of Alberta put four of these sets of observations together to see if there had been any noticeable change in the flowering dates during the twentieth century. They found that between 1901 and 1997 the average date of flowering had advanced by about 26 days – from early May at the beginning of the century to early April at the end.

The trend towards earlier flowering coincides with warmer springs on the Prairies. During the twentieth century, daily high temperatures in spring increased, on average, by more than 2°C, and overnight lows increased even more. The city of Edmonton has warmed more than nearby rural areas, mainly because it has less green space and more asphalt and buildings. This "urban effect" may have also influenced the earlier flowering of the trembling aspen in the area.

Date of First Bloom: *Trembling Aspen*
Edmonton, Alberta



Source: *Adapted from Beaubien and Freeland, 2000*

The graph shows the difference between the average first-flowering date of trembling aspen in Edmonton (the zero line) and the flowering date for specific years between 1901 and 1997. Over the century, the first-flowering date advanced by about 26 days. Because flowering dates are not available for every year, this value is only approximate.

An aspen in full bloom.

THE BIGGER PICTURE

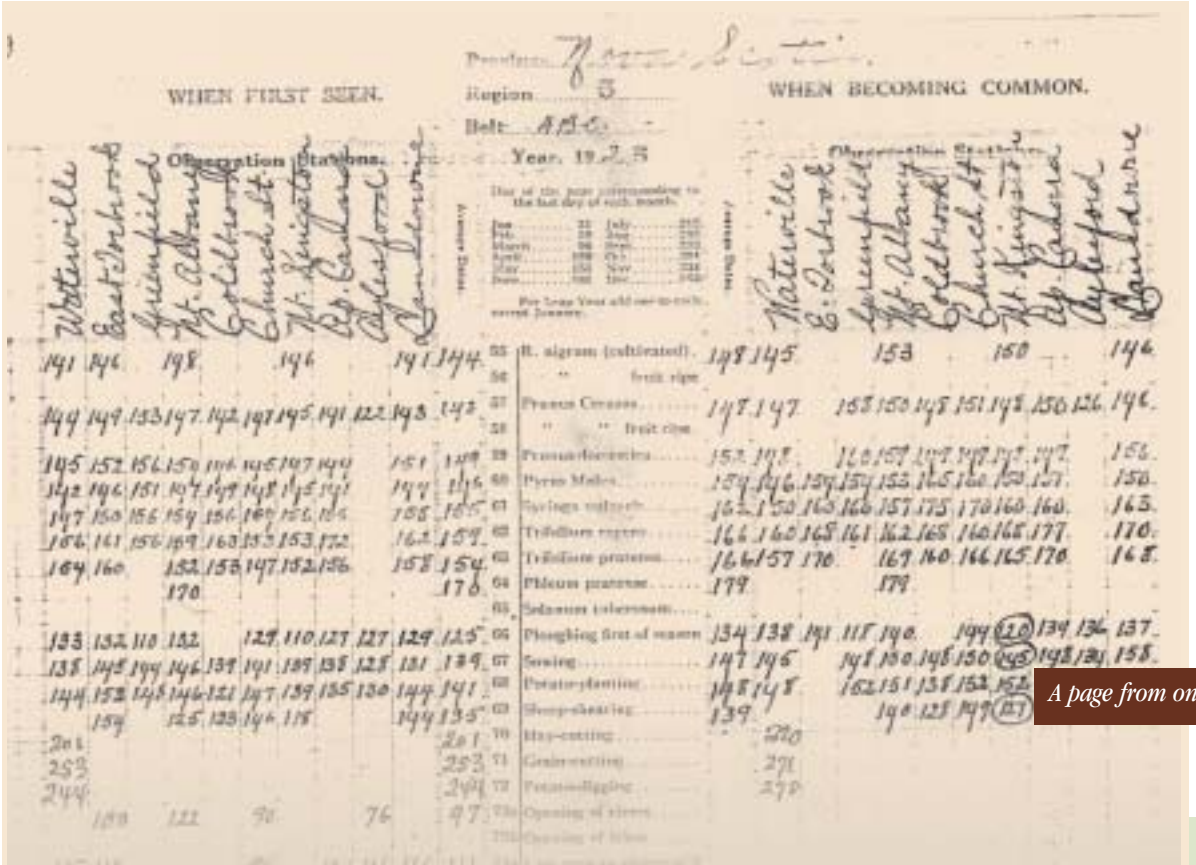
Most studies of plant development in Canada cover periods of about 20 years or less. Nevertheless, these and the few long-term studies that are available agree with what was seen in Edmonton – most plants are reaching major stages in their development earlier in the spring. Since 1937, for instance, the average date of full bloom for McIntosh apple trees in Summerland B.C. has advanced by about 5 days. Similarly, the average date when lilacs come into leaf in the United States and southern Canada advanced by 5–6 days between 1959 and 1993. In Europe, where more data covering longer periods are available, the trends are even stronger. Satellite observations also show an earlier greening of the Northern Hemisphere. Northern forests are now coming into leaf several days earlier and losing their leaves several days later than they did in the early 1980s.

These changes could have important consequences for ecosystems, agriculture, and human health. Earlier development means a longer growing season, which creates opportunities for growing new crops and improving farm yields. However, disease-carrying and crop-eating insects could become more of a problem since their breeding and growth are also affected by temperature. Hay fever sufferers could find their miseries starting earlier too. In addition, complex ecological relationships could be upset if interacting species, like plants and the insects that pollinate them or birds and the insects they eat, respond at different rates to climate change.

NOVA SCOTIA'S THOUSAND EYES

Between 1900 and 1923 hundreds of Nova Scotia students took part in a unique project that recorded more than 200 different seasonal natural events. It was the brainchild of Dr. Alexander MacKay, an innovative educator and naturalist and the province's superintendent of schools. The students recorded events as diverse as the flowering of plants, the emergence of butterflies, the return of migrating birds, and the occurrence of thunderstorms. Their observations were sent to Dr. MacKay and recorded in large, handwritten ledgers, which now provide an invaluable record of the seasonal behaviour of Nova Scotia wildlife in the early twentieth century.

A century later, Dr. MacKay's initiative has been revived as the Thousand Eyes Project. Once again, students are observing and recording natural phenomena, although this time other Nova Scotians can participate too. The project also uses the power of computers and an interactive web site to coordinate activities and to collate and report observations. As observations accumulate, it will be possible to compare today's results with those from 100 years ago. From these comparisons, scientists hope to get new insights into how Nova Scotia's climate is changing and how nature is responding.



A page from one of Dr. MacKay's ledgers, 1923.