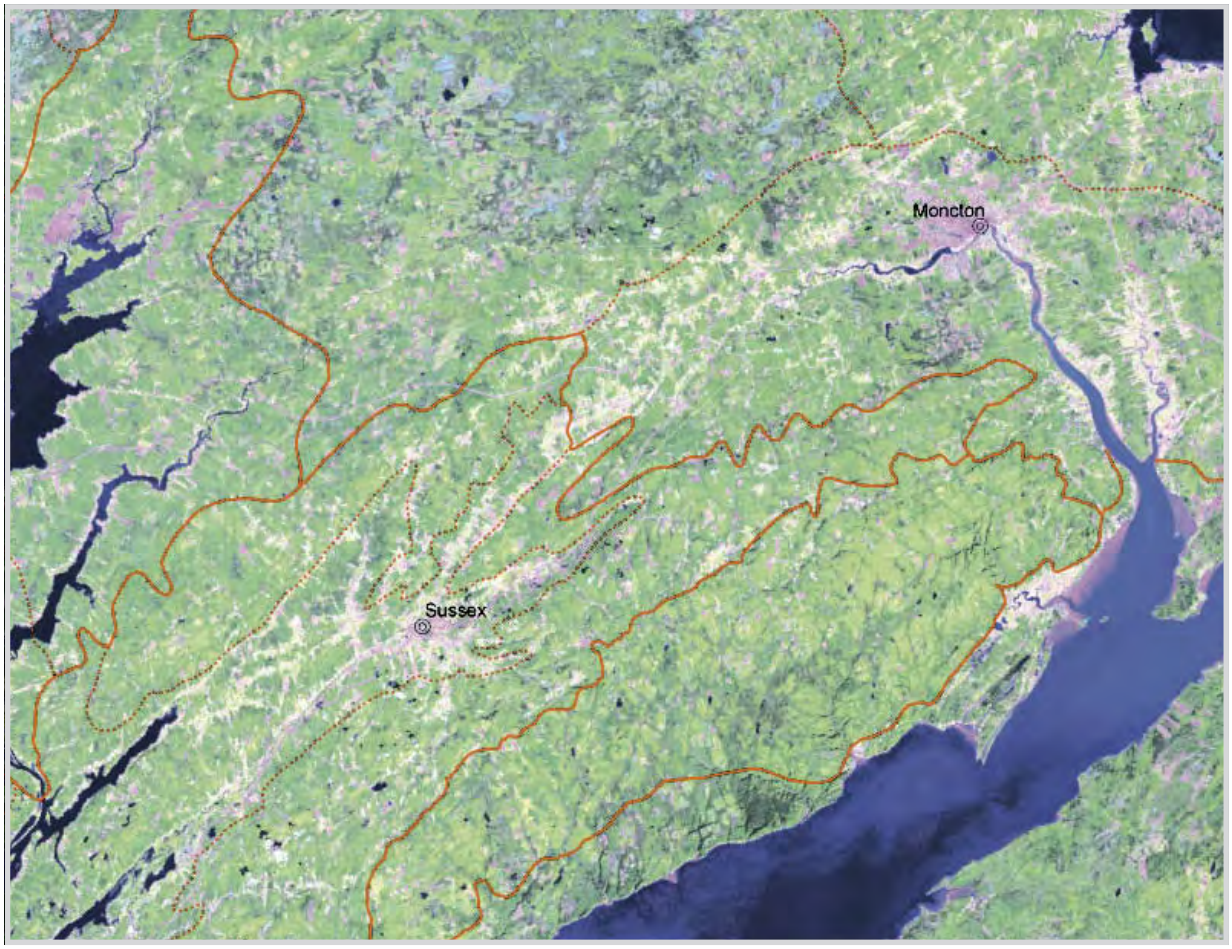


The view of the inner Bay of Fundy from the Landsat 7 satellite reveals the emergence of ecoregion-scale patterns. *2003 ©Government of Canada with permission from Natural Resources Canada.*

Chapter 6

Overview of New Brunswick Ecoregions

The previous chapter presented the concept of ecological gradients, relating the distribution of species and ecosystems to landscape characteristics such as topoclimate, soil moisture, soil nutrient regimes, wetland flooding, and wetland disturbance. The information provided the general principles that underlie ecological land classification in New Brunswick.

The present chapter introduces the seven New Brunswick ecoregions, those being the Highlands, Northern Uplands, Central Uplands, Fundy Coast, Valley Lowlands, Eastern Lowlands, and Grand Lake ecoregions. Ecoregions are defined primarily by their climatic differences as shaped by major landforms, elevation, latitude, marine influences, and broad aspect. Ecoregions

The ecological regions of North America, as determined by the Commission on Environmental Cooperation. *Source: www.cec.org.*

also are distinguished on the basis of species distribution patterns influenced by the various climate-related factors.

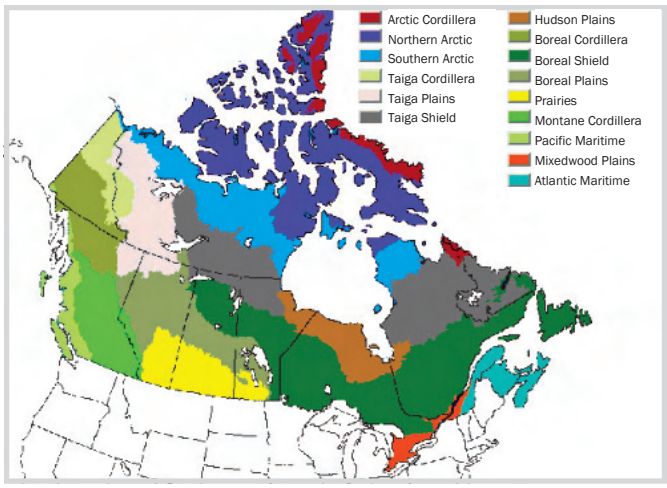
In this chapter, we briefly compare the ecoregions in terms of their climatic differences, distribution of forest vegetation species, distribution of wetlands, distribution of animal species; and species phenology.

Climatic Differences

At the continental scale, climate is the overriding influence that determines which areas of North America are forest, grassland, desert, tundra, or other ecosystem type. Three major subdivisions of forests in eastern North America have been recognized: the subtropical forest of southern Florida, the temperate broad-leaved forest covering most of the eastern United States and extending into Canada, and the boreal forest (taiga) of Québec, Ontario, Newfoundland, and Labrador. New Brunswick falls within the temperate broad-leaved forest category but is situated far enough north to have several boreal elements, including the prominence of balsam fir, jack pine, tamarack, and spruce species.

Since the immediately post-glacial period, the Appalachian Mountains have remained above sea level and thus have served as an effective north–south migration corridor. This has resulted in a blending of northern and southern floral and faunal elements in the Atlantic region. The unique mixture of forested and non-forested ecosystems in the Maritimes has been recognized by Canadian and North American classification frameworks as a definable forest region called the Acadian Forest or, more recently, the Atlantic Maritime Ecozone.

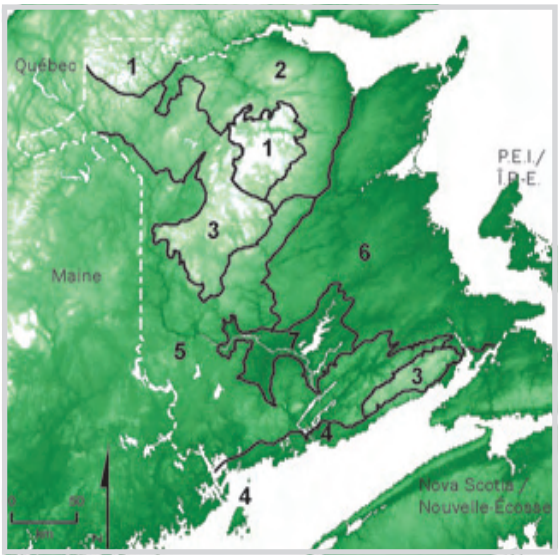
The terrestrial ecozones of Canada, developed by Environment Canada.



In New Brunswick, the climatic gradients characteristically are determined by a combination of elevation above sea level and proximity to the ocean. The Fundy Coast Ecoregion is strongly influenced by effects of the cool Bay of Fundy. Elsewhere, the

mean temperature tends to decrease with increasing elevation.

Precipitation in the Fundy Coast Ecoregion is high relative to other ecoregions, except in late summer. The driest ecoregion is the Northern Uplands Ecoregion, which lies in the rain shadow of the highlands of the Gaspé region. The Central Uplands Ecoregion has high mean precipitation values, but this average obscures an important difference between the two, geographically separate, areas that make up the ecoregion: the Madawaska Uplands in the north and the Caledonia Uplands in the south. The Caledonia Uplands are proximal to the Bay of Fundy; their precipitation is consequently higher than in the Madawaska Uplands, approaching that of the Fundy Coast Ecoregion.

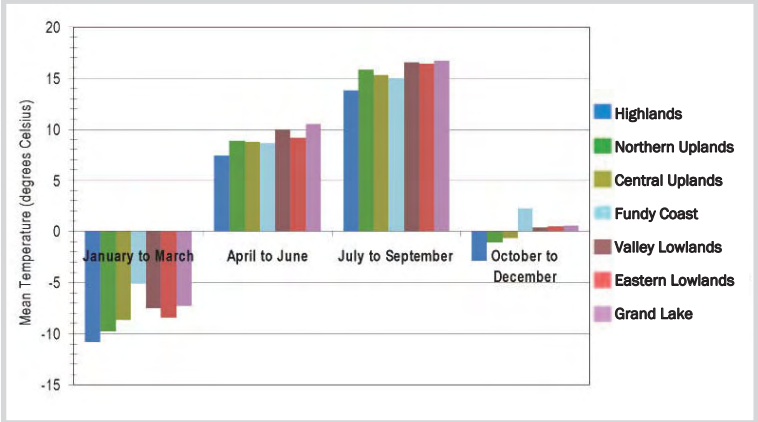


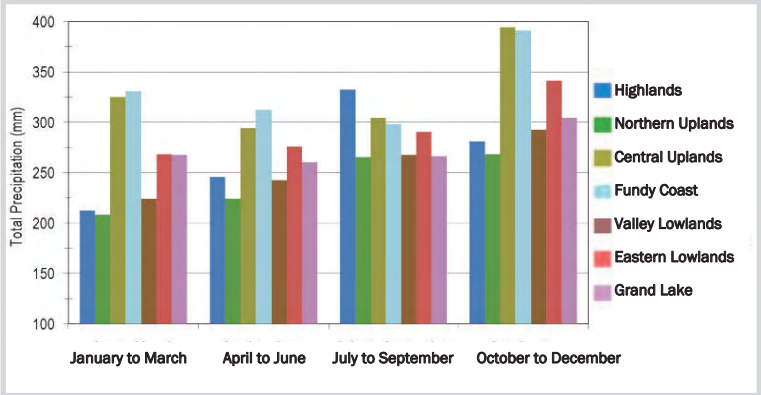
Ecoregions. 1—Highlands, 2—Northern Uplands, 3—Central Uplands, 4—Fundy Coast, 5—Valley Lowlands, 6—Eastern Lowlands, 7—Grand Lake. Higher elevation land denoted by lighter shades .

Distribution of Forest Trees

The distribution of forest tree species in New Brunswick is well know relative to that of other species in the province, because its forests have long been the object of intensive survey efforts. High-quality inventory data exist for the more common commercial species. The provincial data set used to generate the maps and figures in this report (that is, the forest inventory survey data) incorporates field information gathered from approximately 20,000 forest stands.

Mean temperature (top) and total precipitation (bottom) by season for the New Brunswick Ecoregions. *Environment Canada data.*





Needle-leaved Species

At the broadest scales, it is interesting to note the widespread distribution of both red spruce and balsam fir throughout the province, especially the prevalence of fir in the north and northwest, as compared with the predominance of red spruce in the east and southwest. The continental range of red spruce extends north to the southern Gaspé Peninsula and the north shore of the

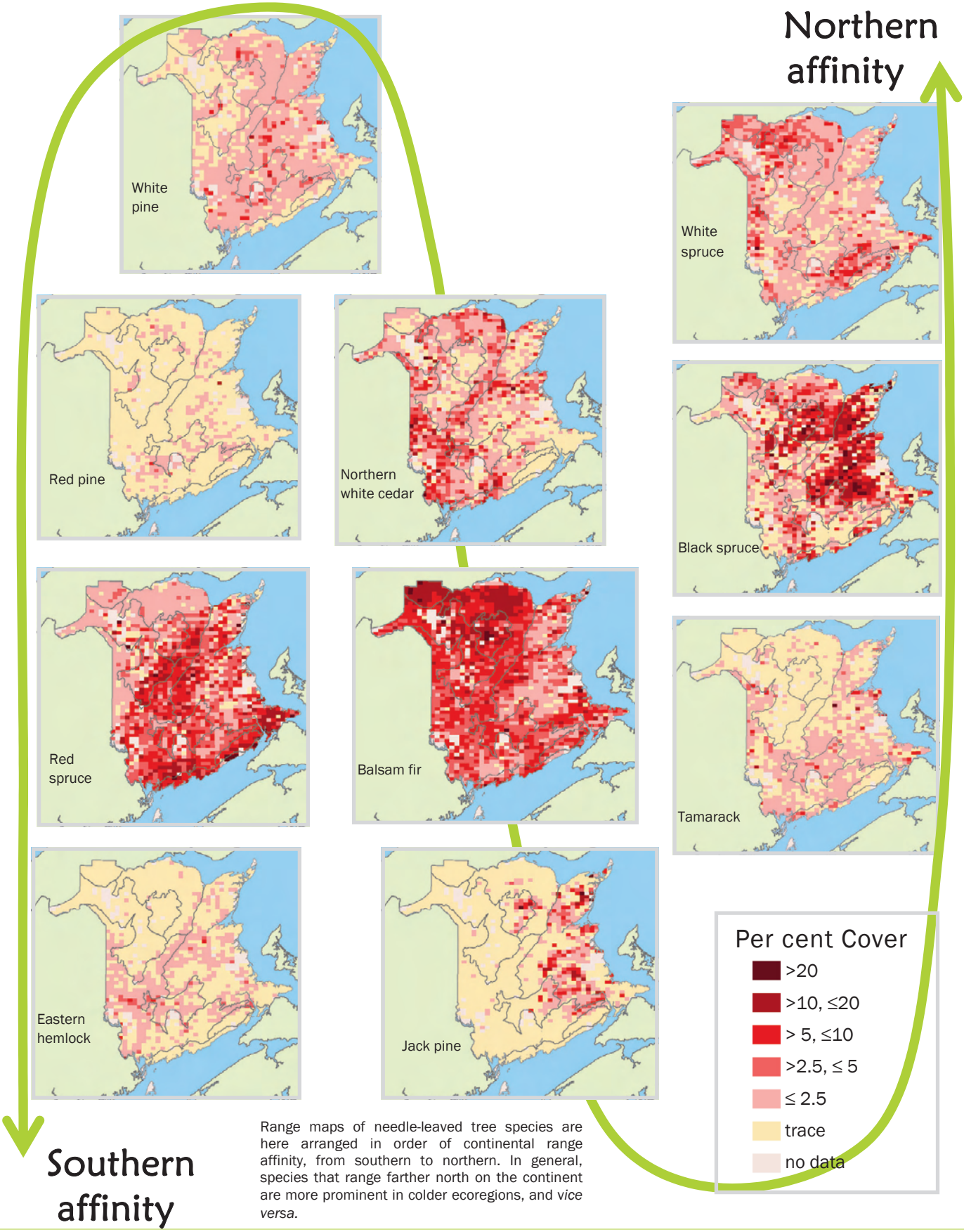
St. Lawrence River, and south through New England as far as Massachusetts. Beyond this most southerly point, only scattered populations exist as far south as the Great Smoky Mountains in North Carolina.

It is therefore not surprising that in New Brunswick, red spruce is a predominant conifer species in the climatically warmer, lower elevation areas. Soil factors may also come into play, since red spruce is more tolerant than balsam fir of the acidic soil conditions that predominate in the Eastern Lowlands Ecoregion. In contrast, the range of balsam fir stretches from southern Maine, as far north as 55° latitude in Québec and west-central Canada; it is correspondingly more prevalent in the higher-elevation, cooler areas of the province.

On a continental scale, white spruce is clearly a boreal species. It is typically found on calcareous soils throughout the north as far as the tree line, and as far west as Alaska. In New Brunswick, it is a frequent stand component in the cool Northern Uplands and Highlands ecoregions, especially on soils derived from calcareous parent materials. In southern New Brunswick, it is an important species on former fields and pastures. Only on old fields does white spruce grow naturally in pure stands in New Brunswick.

Black spruce is a species typical of the far north of Canada, dominating the boreal forest as far north as the treeline. This area of Canada is known for the high frequency and extent of forest fires, and black spruce is specially adapted to cope with wildfires. In fact, black spruce cones will open and release seed on the burned ground, in response to the heat generated by a fire. Thus, seed scattered under a burned stand can regenerate a new stand of black spruce. Jack pine employs a similar strategy, while mature individual trees of white and red pine often survive a wildfire, due to thick bark which protects the living, delicate cambium tissues underneath from otherwise lethal temperatures. Survivors then scatter seed on the burned ground, and are re-established in this way.

In New Brunswick, black spruce is common where soils are naturally wet, peaty, and acidic such as in much of the Eastern Lowlands Ecoregion, and in the areas east of the Highlands Ecoregion. In the Central Uplands Ecoregion portion of black spruce's range, however, natural occurrences are limited to sites that are unsuitable for most other tree species. These include dry, rocky sites, and very wet, peatland sites. This combination of



Range maps of needle-leaved tree species are here arranged in order of continental range affinity, from southern to northern. In general, species that range farther north on the continent are more prominent in colder ecoregions, and *vice versa*.

Table of Contents

ecological and climatic factors leads to the prevalence of black spruce and pine species in the Eastern Lowlands Ecoregion. These species also predominate in some of the fire-prone, rocky, steep-sided, or east-west-oriented river valleys of the Upsalquitch and Nepisiguit rivers, and on the low elevation, wet, acidic, flatter landscapes located south of the lower Tobique River.

A map of the distribution and abundance of pine species indicates the areas of the province that, at least in post-colonial times, have been fire-prone. The Eastern Lowlands and Grand Lake ecoregions show a strong presence of pine, as does the Nepisiguit River Valley, in the Highlands Ecoregion. The steep-sided Upsalquitch River valley in the Northern Uplands Ecoregion is also a hot spot for pine. Large, pure stands of red and white pine have persisted in this area, despite heavy logging of river valleys during the last two centuries. In contrast, the prevalence of pine is low in the Central Uplands Ecoregion and along the Fundy Coast Ecoregion. Three portions of the Valley Lowlands Ecoregion are still important for pine: parts of the lower Tobique valley; the areas south and west of Fredericton on acidic glaciofluvial deposits and on similarly dry stony or rocky soils; and on the Anagance ridges, east of Sussex.

Eastern hemlock is a shade-intolerant conifer species whose continental distribution dips the farthest south of any native conifer, into northern Georgia and Alabama. In New Brunswick it is situated at the northern limit of its geographic range. Except for a few outlying populations, hemlock is restricted to the lowland ecoregions: the Valley Lowlands, the Grand Lake Ecoregion, and the Eastern Lowlands Ecoregion. It is virtually absent from the cool Fundy Coast Ecoregion.

Eastern white cedar is capable of tolerating a wide range of soil conditions, but does best on moist to wet soils that are less acidic than average. On calcareous sites, cedar regenerates prolifically on exposed mineral soil. Cedar is more prominent in New Brunswick than eastern hemlock. It is particularly abundant in the Valley Lowlands Ecoregion, especially on soils derived from calcareous soil parent materials. Its abundance is particularly noticeable in a section of the Eastern Lowlands Ecoregion near Rogersville, where glacial transport has brought diverse rock types, including calcareous fragments, from the higher ground to the west, thus enriching the soil for cedar.

Tamarack is a distinctive conifer that sheds its needles each fall. In the southern portions of its continental range, tamarack is

most abundant on very wet sites, and both on or surrounding peatlands, but is less common on better drained sites. Tamarack is widely distributed in New Brunswick. The relatively good drainage of the upland and Highlands Ecoregion may explain why tamarack is scarce there, despite an obvious affinity for high latitudes on this continent. Tamarack is also an important species on old-field sites in the Grand Lake, Valley Lowlands, and Eastern Lowlands Ecoregions.

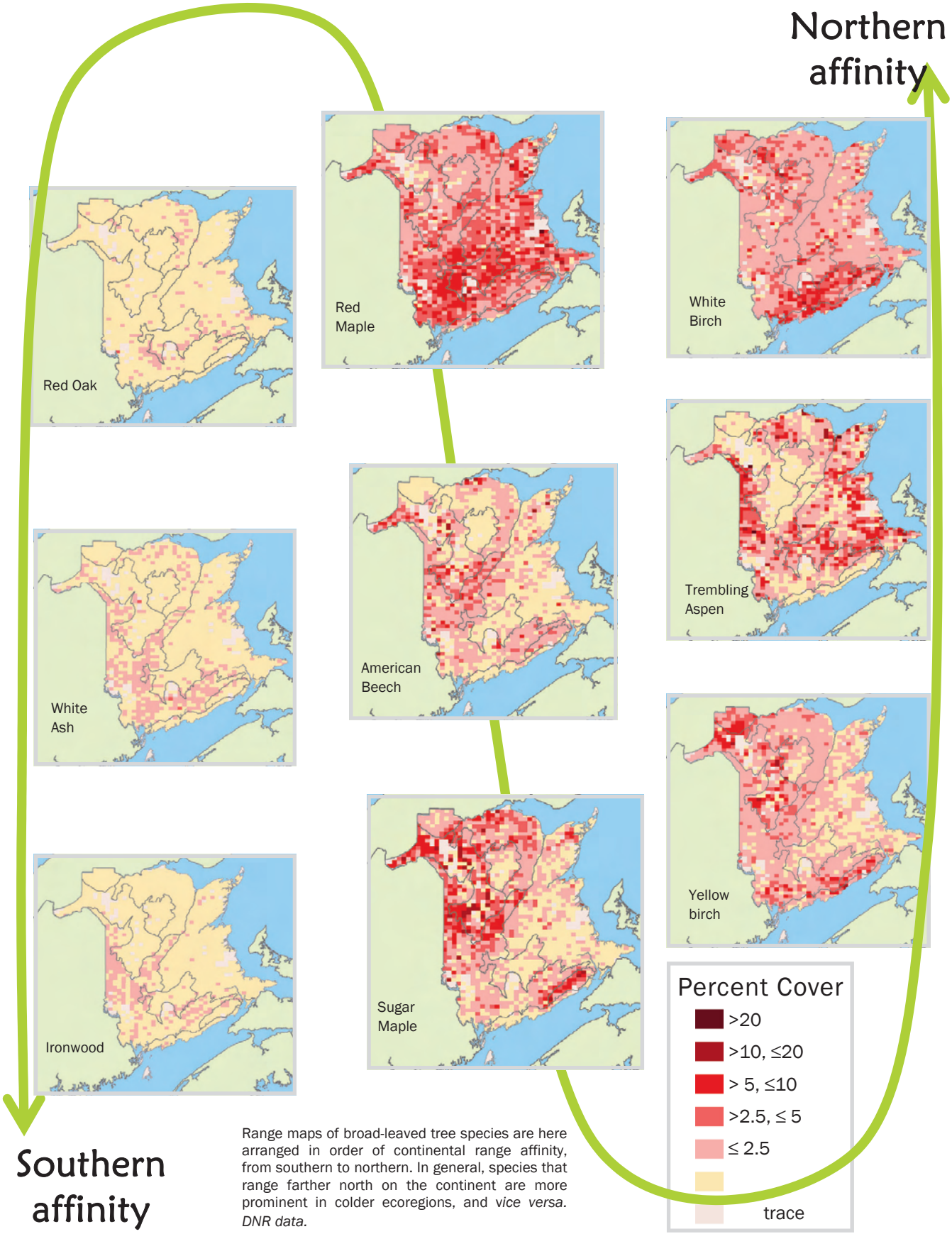
Broad-Leaved Species

The shade-tolerant hardwoods are best represented today in west-central and northwestern New Brunswick. The predominance of tolerant hardwoods in these areas is due in part to good drainage, fertile soils, and relatively infrequent fires . Historically, much of the Valley Lowlands Ecoregion supported shade-demanding hardwood and softwood species. Today, much of the low-elevation, low-relief area along the Saint John and Kennebecasis rivers now supports agriculture alongside a patchy or fragmented distribution of woodlands dominated by red maple, white spruce, and intolerant hardwood species.

Yellow birch and sugar maple are widely distributed throughout the province, but are most abundant in the Central Uplands Ecoregion. Ironwood is also common shade-tolerant hardwood species, whose range conforms quite well to the boundaries of the Valley Lowlands and Grand Lake ecoregions. Continentally, it is found as far south as mountainous areas of Central America. Ironwood and black cherry have the most southerly range extension of all New Brunswick tree species. This possibly explains why they favour the warmest ecoregions of the province.

White ash is widespread throughout the Valley Lowlands Ecoregion, in association with other tolerant hardwoods on ridges. Only rarely does it form pure stands. It is also commonly associated with well drained, coarse soils on freshwater beaches, accompanied by red oak. Red maple is a frequent associate of sugar maple, yellow birch, and beech in tolerant hardwood stands. Where the soil is too acidic to support these associated species, red maple is still found in abundance on hilltops and ridges, especially in the Grand Lake and Eastern Lowlands ecoregions. It also can regenerate prolifically from both seed and stump sprouts in clearcuts and is therefore an important component of cutovers and of shade-intolerant hardwood stands, especially in the three lowland ecoregions.

The distribution of the shade-intolerant hardwood species such as white birch and trembling aspen typically indicates where fire,



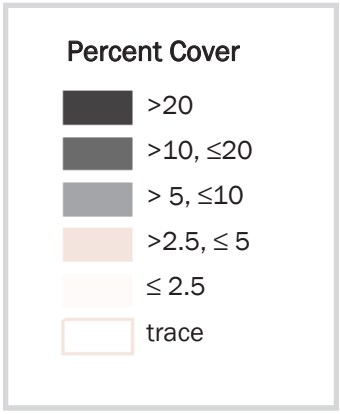
Range maps of broad-leaved tree species are here arranged in order of continental range affinity, from southern to northern. In general, species that range farther north on the continent are more prominent in colder ecoregions, and *vice versa*. *DNR data.*

logging, and farming have been a major influence on the character of the landscape. Intolerant hardwood species die out in absence of natural or human disturbances that create large forest openings. In this regard, it is interesting to note the low abundance of aspen in the Central Uplands, Fundy Coast, and Highlands ecoregions. It has been suggested that the low frequency of major fires in the Central Uplands and the Fundy Coast ecoregions has limited the opportunity for aspen to expand its range. Similarly, in the Highlands Ecoregion, aspen is common only near the relatively low-elevation and frequently burned Nepisiguit River Valley.

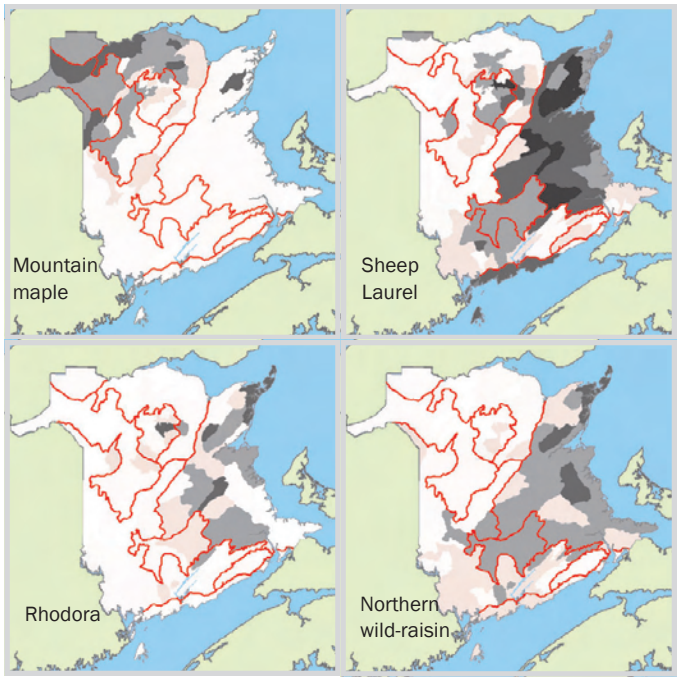
Forest Understorey Species

The range and attributes of some forest species both reflects and defines the ecological character of the province's ecoregions.

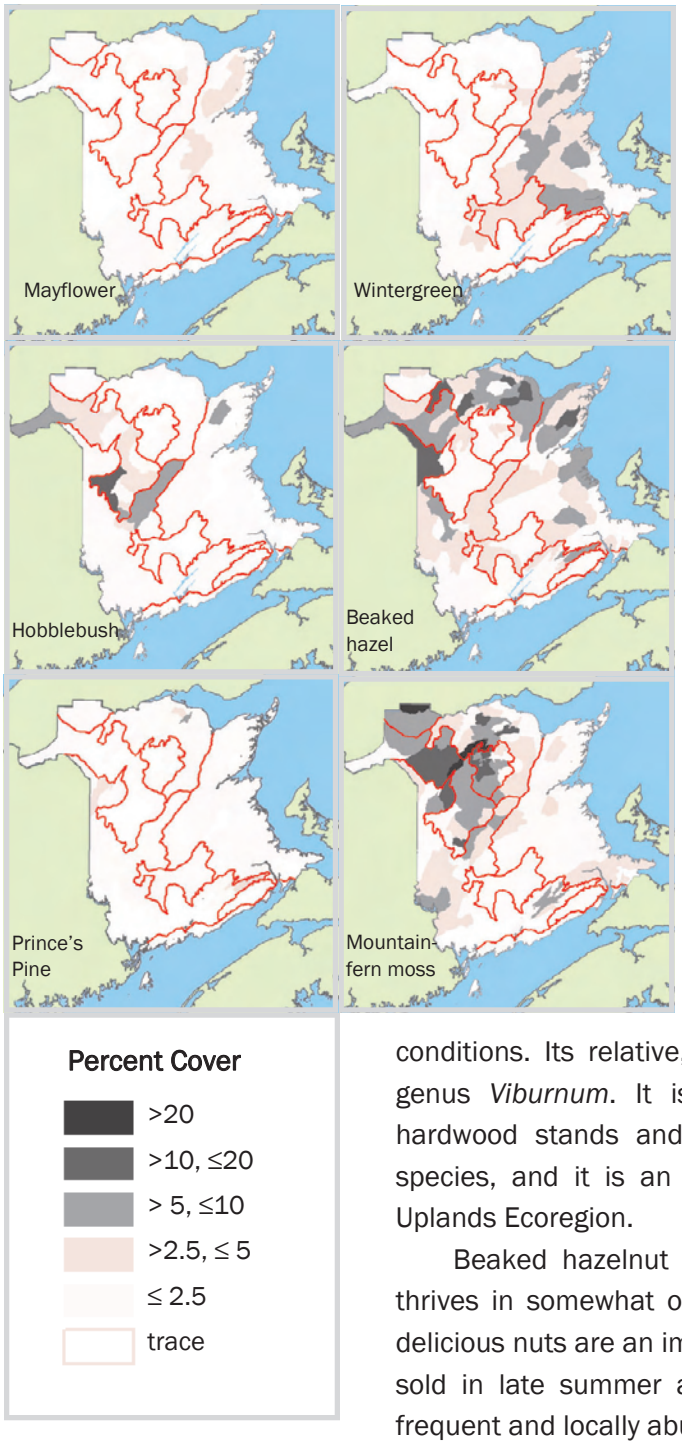
The distribution of understorey plants is not as well understood or documented as commercial tree species. Data used to compile the maps used in this report were recorded on sample plots from approximately 5000 stands province-wide. Technicians recorded understorey plant species and abundance on the sample plots. Two hundred forest plant species or species groups were identified in these surveys.



The species range maps shown here were selected from those that best conformed to ecoregion boundaries and contributed toward their distinctive stand-level "look" or ecological character of the region. In this regard, the species whose ranges are depicted may be considered representative of an ecoregion or of the predominant ecosite conditions that exist there.



Mountain maple is a shrubby tree, the smallest of our five native maple species. It is an important stand component in mixed stands of the Highlands Ecoregion and the two upland ecoregions. Creation of large forest canopy gaps in these ecoregions has resulted in a proliferation of mountain maple and an associated reduction in the abundance of more valuable timber species such as yellow birch or sugar maple. However, mountain maple is a preferred browse species for moose and deer.



Sheep-laurel is a shrubby evergreen species with colourful pink flowers that bloom in summer. The range of sheep-laurel is indicative of the occurrence of acidic and frequently burned sites. It is common in most of the Eastern Lowlands Ecoregion. Rhodora is a related member of the family *Ericaceae* that includes such familiar plants as blueberry and some acid-loving horticultural varieties of exotic rhododendron and azalea. Rhodora's distribution further demonstrates the acidic nature of soils in the Eastern Lowlands Ecoregion and in some of the areas of the province underlain by granite rock.

Mayflower, the fragrant early bloomer often sold at farmers' markets, and wintergreen, a plant from which wintergreen-flavoured candy gets its name, are somewhat similarly distributed.

Another widespread understorey species in New Brunswick is the northern wild raisin, so named because it bears dark blue or black fruit that become slightly withered with the arrival of winter. It is another acid-loving, deciduous shrub species, although it is more widespread and tolerant of moderately acidic conditions. Its relative, the hobblebush, is also a member of the genus *Viburnum*. It is an understorey shrub found in tolerant hardwood stands and mixedwood stands of shade-tolerant tree species, and it is an important stand component in the Central Uplands Ecoregion.

Beaked hazelnut is a widespread, tall deciduous shrub that thrives in somewhat open areas on dry and less acidic soils. The delicious nuts are an important food source for wildlife and are often sold in late summer at roadsides. Beaked hazelnut is especially frequent and locally abundant in the Northern Uplands Ecoregion.

Prince's pine is a low shrubby forest species known for its affinity to dry sites. It is rare in the Highlands, Fundy Coast, and the Central Uplands ecoregions, but is more frequent in the relatively dry Northern Uplands Ecoregion, and is also relatively abundant in the

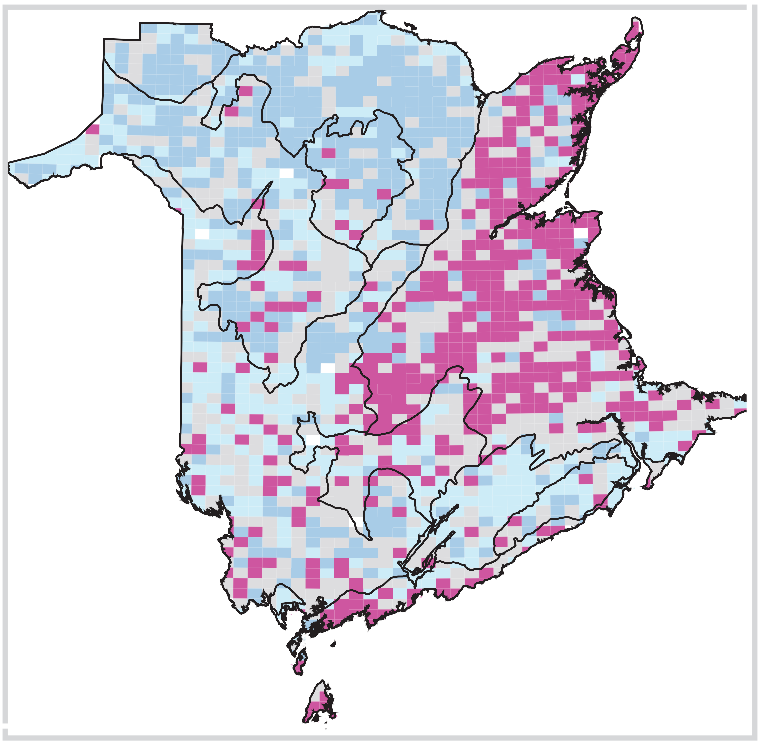
Eastern Lowlands, Valley Lowlands, and Grand Lake ecoregions.

Mountain-fern moss avoids dry areas but abundant on well-drained sites with abundant precipitation. It is common throughout the province in coniferous woods, but is particularly abundant in the understorey of spruce-fir stands in the Highlands and Central Uplands ecoregions.

Distribution of Wetlands

The unique landscape and species diversity of each New Brunswick ecoregion may also be defined in terms of its non-forested components. The most significant of these are wetland ecosystems.

As mentioned earlier, the ecoregions of the province reflect the combined effects of elevation, climate, and topography. Not surprisingly, some of these biophysical factors also affect both the distribution and composition of wetlands. At one end of the gradient is the more rugged terrain and cool, wet climate of the Highlands Ecoregion. Wetlands in this ecoregion constitute a very small percentage of the landscape, tend to be limited in size, and are typically streamside shrub swamps. The controlling factors are (1) the rapid drainage of the steep slopes, and (2) the comparatively short duration of flood events on small headwater streams and swift, steep-banked rivers, which tend to create localized, disturbance-induced riparian wetlands.

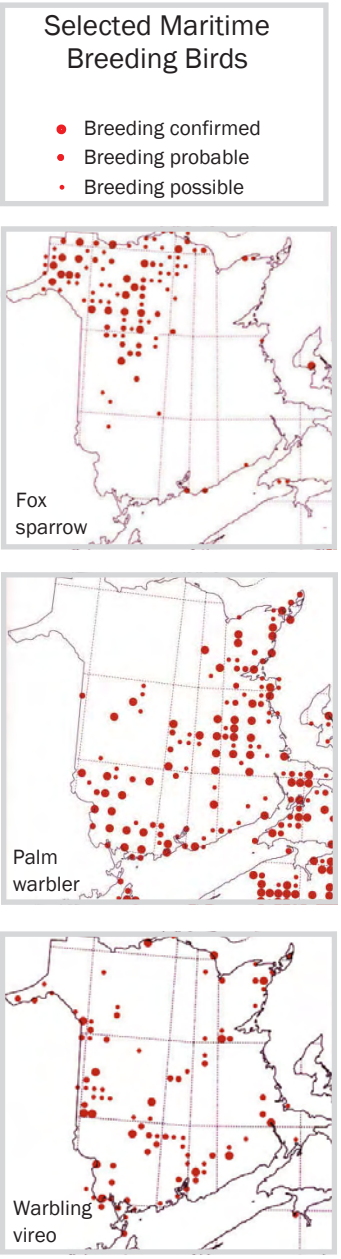


Within the lowland ecoregions are extensive areas of low elevation and/or low relief; wetlands comprise a greater share of the area of these ecoregions. Nearly half of the province's wetlands, consisting principally of large peatlands that formed in shallow basins, are found in the Eastern Lowlands Ecoregion.

The Valley Lowlands and Grand Lake ecoregions share the dramatic influence of major watercourses and large lakes, which create the required conditions for an impressive diversity of wetland types. Most significant is the large volume of

water moving through the lower St. John River and Grand Lake systems which results in prolonged flood periods over the extensive floodplains and shorelines. The interaction of these flood events with the varied topography of these ecoregions creates a wide spectrum of flood and substrate conditions, with a corresponding diversity of wetland types including silver maple swamps.

The Fundy Coast Ecoregion also presents a provincially unique situation with regard to wetlands. Despite the rugged terrain, the cool maritime climate has promoted development of impressive coastal bogs described and illustrated in Chapter 7. Coastal marshes have developed in low, protected sites behind dunes, or where rivers and streams drain across low, flat terrain into the sea. These conditions are found most noticeably along the Northumberland Strait, which shapes the shores of the southern portion of the Eastern Lowlands Ecoregion, and along Shepody Bay and the Isthmus of Chignecto in the Fundy Coast Ecoregion.



Source: Erskine 1992.

Distribution of Animal Species

For many New Brunswickers, the word “wildlife” evokes images of moose, deer, or bear, charismatic species, that are large and often conspicuous. Yet, they represent only a fraction of the roughly fifty mammal species found in the province, and a vastly smaller proportion of the total number of animal species when include other vertebrate groups (fishes, amphibians, reptiles, birds) and the large number of invertebrate groups (insects, molluscs, and others). The distributions of species in this large and diverse group range from well known to nearly unknown. However, the current document considers only very few of the animal species among those whose distribution and abundance would indicate ecoregion-scale differences.

Climate and topography combine to create a north-south gradient in animal distributions, contrasting the cool Highlands and Uplands Ecoregions with the warmer and drier Lowlands Ecoregions. We might expect these trends to be most obvious in species that have minimum control over body temperature, such as fishes and amphibians. In fact, the abundance and species richness of amphibians is higher in the warm Grand Lake Ecoregion than in other ecoregions. Moreover, there are species that are found exclusively, or are more abundant, in either the northern or the southern part of the province. These species are generally at the southern or northern limit of their range, respectively, in New

Brunswick. The mink frog, for example, is relatively abundant in northern New Brunswick, reflecting its northern continental distribution; it is found from Labrador and the Maritimes to Manitoba, but does not occur farther south than the Great Lakes states. On the other hand, the bullfrog is largely absent from northern New Brunswick, but is common in the south. Continentally, it occurs throughout eastern North America from Québec and the Maritimes, as far south as Florida and Texas.

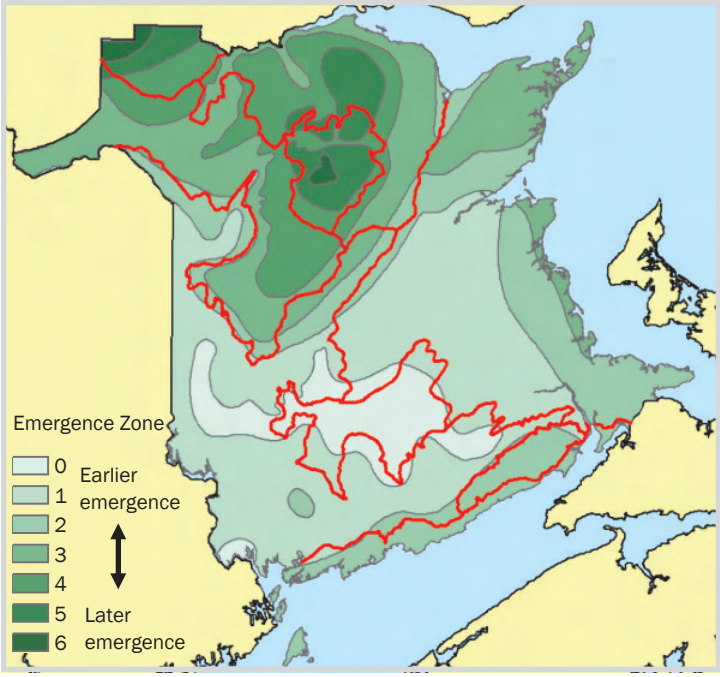
Fox sparrow is found in New Brunswick at the southern limit of its range , and breeds primarily in the Highlands and Uplands ecoregions. Palm warbler breeding conforms with the distribution of large peatlands (Lowlands ecoregions). Warbling vireo, associated with the broad-leafed forest, is restricted to warm inland valleys in our region.

Insect Phenology and the Spruce Budworm

Biological processes also vary significantly from one ecoregion to the other, including the group of processes related to species phenology. Species phenology describes the intricately controlled steps that govern the timing of plant and animal development, and that proceed similarly in all individuals of a given species. The timing of phonological processes can be affected by factors such as light or temperature, but the processes relevant to our discussion here are those influenced by climate.

One obvious example of a climate-influenced phonological process is the colour change of maple leaves in autumn. Although each leaf undergoes the same biochemical changes, trees in northern parts of the province generally are affected earlier than are those farther south.

The onset of spruce budworm feeding is another well documented example of a climatically timed process. The budworm occurs throughout much of Canada and the northern United States. It feeds on softwood species, including balsam fir. The budworm population fluctuates from year to year, periodically undergoing major increases



Spruce budworm spring emergence zones. Ecoregion boundaries are shown as red lines. The was refined using a variety of additional data. An aerial survey of selected seasonal events determined the dates when ice disappeared from lakes, snow melted from forests, hardwoods leafed out, pin cherries flowered, and balsam fir shoots flushed. At the same time, baseline field data on shoot phenology were gathered at several sites and compared with shoots at research centres in Green River in northwestern New Brunswick and at Fredericton. These various data then were extrapolated across the province using climatic and topographic information, applying the rationale that topography and related factors interact with climate to trigger the aforementioned spring events

such as took place in the Maritimes and eastern Québec during the 1970s and 1980s. The reduced tree growth and increased tree mortality caused by budworm infestations is considered a threat to wood supplies. Thus, much effort has gone into developing tools to monitor the budworm.

A spruce budworm larva feeds on a spruce shoot. *Photograph courtesy of Kees van Frankenhuyzen, Canadian Forest Service.*

The springtime growth spurt of spruce and fir trees is affected by temperature, topography, aspect, day length, and moisture availability; the spring emergence of the budworm is also driven by temperature. Although the budworm's appetite for new foliage is not fully synchronized in each locale with the flushing of young evergreen shoots, both shoot flushing and larval emergence react to similar environmental cues. Data collected over many years were used to generate a spruce budworm emergence map, pictured here. The map helps scientists to coordinate actions such as application of aerial pesticides used to reduce the budworm population.

The average difference between phenological zones with regard to shoot extension and budworm emergence was about two to three days. The difference between the Grand Lake Ecoregion and Highlands Ecoregion averages 2 to 3 weeks.

Conclusion

This overview of the seven New Brunswick ecoregions has considered ecoregions at their broadest, continental scale, outlining the distribution of their tree and understorey species, wetland types, and some animal species. In so doing, it has set the stage for a more detailed look at ecoregions. The next seven chapters describe each ecoregion in detail, offering a closer view of the complex interactions between geology, climate, flora and fauna, wetlands, and human history across the ever-changing landscape we call New Brunswick.