

BCS 312: Land and Environments of the Circumpolar North II

Module 3: Living Terrestrial Resources

Developed by

Monique Haakensen, Contango Strategies Ltd

Overview

This module will discuss living terrestrial resources of the circumpolar north, including forestry, agriculture (and animal husbandry), reindeer herding, and terrestrial wildlife. The economic significance and environmental impacts of these activities is discussed, and future management plans are explored for these resources in various countries of the circumpolar north.

Learning Objectives

Upon completion of this module, you should be able to:

1. Identify the main forest resource in each northern country and explain its economic significance.
2. Identify different types of agriculture and explain the economic significance of each in the northern region.
3. Analyze the main environmental impacts of agriculture and forestry in the North.
4. Identify the areas and peoples involved in reindeer herding in the North, and explain its significance for these peoples.
5. Identify the major terrestrial wildlife species in the North and explain its significance for these peoples.

Required Readings (including web sites)

Day, Trevor. "Uses of the Taiga". Taiga, Biomes of the Earth. New York: Chelsea House Publishing, 2006. Science Online. Facts on File, Inc. 8 pages.
<http://www.fofweb.com/activelink2.asp?ItemID=WE40&SID=5&iPin=BOETA0007%SingleRecord=True>

Key Terms and Concepts

- Biome
- Conifer (Coniferous)
- Deciduous
- Ecotone
- Forage

- Genera
- Isotherm
- Permafrost
- Sustainable Forestry
- Silviculture
- Taiga
- Timber

Learning Material

Introduction

Natural resources are derived from the environment. Many of them are essential for our survival, while others are used to satisfy our commercial economies. Natural resources can be categorized in different ways. The first distinction that is normally made is between renewable and non-renewable resources.

Non-renewable resources are formed over long geological periods. Minerals and fossil fuels are included in this category. Because their rate of formation is extremely slow, they cannot be replenished once they are depleted. Non-renewable resources are covered in previous modules of this course.

Renewable resources are those that are easily replenished or can be reproduced. Some renewable resources, such as sunlight, air, wind and tidal flows are continuously available and their quantity is not affected by human consumption. However, many renewable resources can be depleted by human use. In order for a resource to not be depleted, a balance must be reached between our use of the resource and its ability to renew or regenerate. To varying degrees of success, humans make efforts to assist these resources in their renewal. Some resources, such as agricultural crops are quickly and effectively renewed, while others, such as forests, require a much longer renewal period, even with human assistance.

In this module, we will explore terrestrial living resources of the circumpolar north, including forest resources, agriculture, reindeer herding, and the impacts associated with these activities. We will study the northern boreal forest and its use; agriculture and animal husbandry; and, finally, terrestrial wildlife. We will also discuss the present economic, social, and cultural importance of harvesting renewable resources for indigenous peoples.

Forest Resources in the Circumpolar North

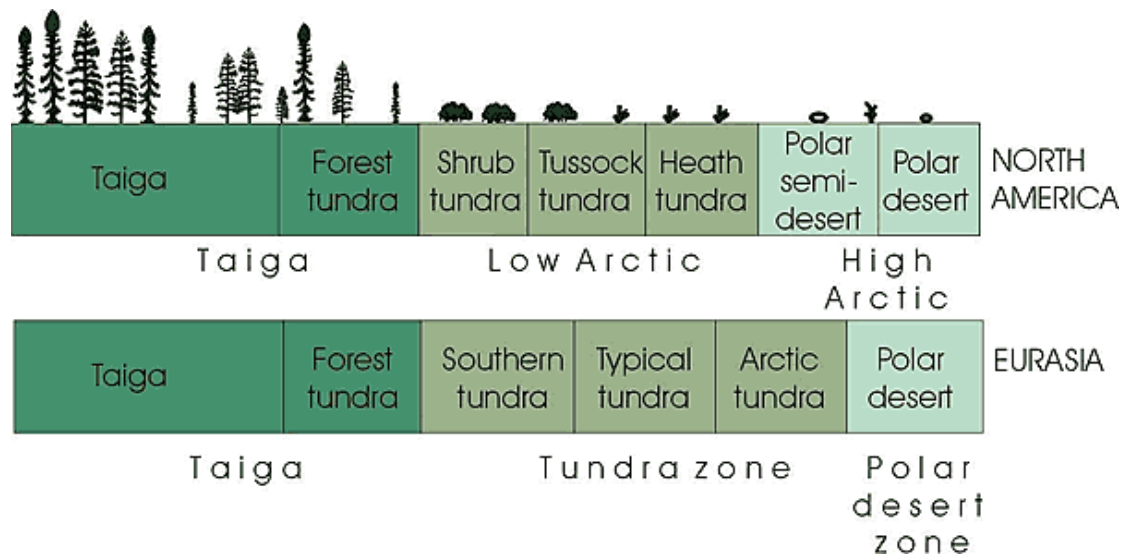
Immediately south of the Arctic tundra lies a circumpolar band of forest variously termed the northern coniferous forest biome or the boreal forest or the taiga. Taiga is generally defined as the band of **coniferous** trees lying roughly between 50 and 60 degrees of latitude north in both hemispheres and where the growing season lasts only about 130 days of the year with an annual precipitation of 40 to 100cm and an average summer temperature of about 10°C. **Conifers** or cone-bearing trees are the dominant form of tree, but there are also **deciduous** (shedding leaves annually) and herbaceous plants along with mosses, fungi, and lichens. It should be noted that the trees often extend far south of this temperature **isotherm**, but the forest extending south beyond this region is not part of the Taiga region. An isotherm is a term that refers to a line or curve on a map or diagram connecting areas that have the same temperature at a given time or on average over a given period. The region where a region of transition between two **biomes** or biological communities is reached is referred to as an **ecotone**. The tundra-taiga interface is an example of an ecotone. Here, the landscape often looks more like tundra than forest and trees are few in

number and very dispersed. Most taiga trees belong to four **genera** (a taxonomic grouping of organisms that have common characteristics distinct from other groupings). These four genera are: *Pinus* (pines), *Abies* (fir), *Picea* (spruce), and *Larix* (tamarack, larch) – all are members of the *Pinaceae* family and are all evergreen except for the deciduous larch which sheds its needles annually.

All plant forms in the world rely on sunlight, soil nutrients, and a source of water. Additionally, in the Circumpolar North, all forms of plants must be adapted to long, cold, dark winters and short summers. Additionally, these plants must be able to grow in nutrient poor soils that, in some places, may be permanently frozen just a few centimeters beneath the surface. This permanently frozen soil is referred to as **permafrost**. The extended winter season subjects plants to a continuous drought condition because despite the cold, water continues to be lost through **transpiration** (loss of water vapour from parts of plants). The water lost through transpiration cannot be replaced until the spring thaw.

In the forests of central Alaska and Northern Canada (Yukon and North-West Territories), the rains of summer combined with snowmelt yield an annual precipitation of less than 250-500mm. Such a modest rainfall amount would produce near-desert conditions if it were not for the mosses that can occur in abundance on the floor of the taiga. These mosses accumulate and retain water. Additionally, where permafrost does occur, the rain that does fall cannot sink far into the subsurface, therefore making the rain water more available to the root systems of the plants.

The interior forests of Alaska, and most forests in Canada and Siberia are generally characterized by very cold winters and only modest annual precipitation. The Pacific forest of Northwestern North America and the boreal forests of Scandinavia and the Kola Peninsula of Russia are influenced by relatively warm ocean currents and even warm winds from the tropics and are therefore much more moderate in temperature with more abundant annual precipitation. Collectively, the world's forests of the circumpolar north are a vast carbon reservoir, with the forests of Russia holding an estimated 20% of the world's carbon (Encyclopedia of the Arctic).



Source: CAFF (2001)

Fig. 1 Classification of northern vegetative zones (ecozones or biomes) according to North American and European usage

The taiga spans all continents of the circumpolar north and extends further south, for example, including the once-forested highlands of Scotland. When including the southern extent of its reach, the taiga is the largest biome on Earth, making up one third of the world's forested land and covering approximately 15 million square kilometers. About 60% of this area is in Russia, 30% in Canada, and the remaining 10% shared between the remaining countries of the circumpolar north. The taiga is the primary habitat of a diverse range of animal and plant species that will be covered in the following sections of this module. It is the home to many people and communities, including more than one million indigenous peoples.

Economic Importance

Forestry plays an economic role in all countries of the circumpolar north. Growth rates of trees near the transition from forest to tundra are extremely slow, which makes management and harvesting of the trees in these far northern forests uneconomical. Therefore, forestry has been pursued to a greater extent in coastal regions and in the more southerly bounds of the taiga, both which are warmer and offer quicker regeneration of the forest resources.

Alaska

From the 1950's through the 1990's the forest products industry of Alaska was centered on the large pulp mills in the Southeastern communities of Sitka and Ketchikan. However, by the year 2000, the mills had closed for a variety of reasons, including more stringent environmental standards, increasing competition in growing world markets, and aging mill facilities. Over that span of 50 years, commercial timber harvesting occurred primarily on federal, state and Native corporation lands in the Southeastern portion of the US state. However, recent trends in Alaska's wood products industry have favoured the establishment of smaller facilities, typically processing less than 25 thousand board feet and operating kiln-dry facilities. Since 2000, over a dozen such facilities have begun operation not only in the Southeast, but also in South Central and Interior Alaska. These facilities are of great benefit to the economies of the local communities as they create jobs and retain dollars in the region. Alaska's South Central forests contain mostly paper birch and spruce trees. Historically, these had little economic value due to a high defect rate in the wood. However, recent interest in woodchips for biomass energy and hardwood timbers

may provide wider opportunities for forestry in this region. Also in the South central region, there has been deterioration of the forests due to infestation of a beetle that kills the spruce trees. This has forced some mills in the area to move or close. In contrast, the Interior forests of Alaska have supplied lumber, logs, and firewood for use in the region since the days of the gold rush. The state is the major owner of forested lands. In recent years, there has been an expansion in the number of small mills in the interior forests which is being fuelled even more by the interest in wood energy from biomass. These extensive hardwood forests offer potential for a variety of manufactured products including lumber, logs, and firewood, but also artisanal products such as birch syrup and wooden bowls and artistic goods.

Alaska is home to the Tongass forest, the US's largest national forest, containing over 9.4million acres of old-growth forest and 5 million acres of which are commercially used and about half a million acres of young growth forest that are a result of timber management activities initiated since the 1950's. The management of the Tongass forest is transitioning from a focus on old growth timber to a more balanced, long term program emphasizing young growth management. While the old-growth timber will continue to be managed, the focus over time is to provide higher value and specialty wood products. New grade stamps have been issued for softwood species including Alaska spruce, hemlock, and yellow-cedar lumber. These advances allow Alaskan softwood species to gain recognition and increased market value.

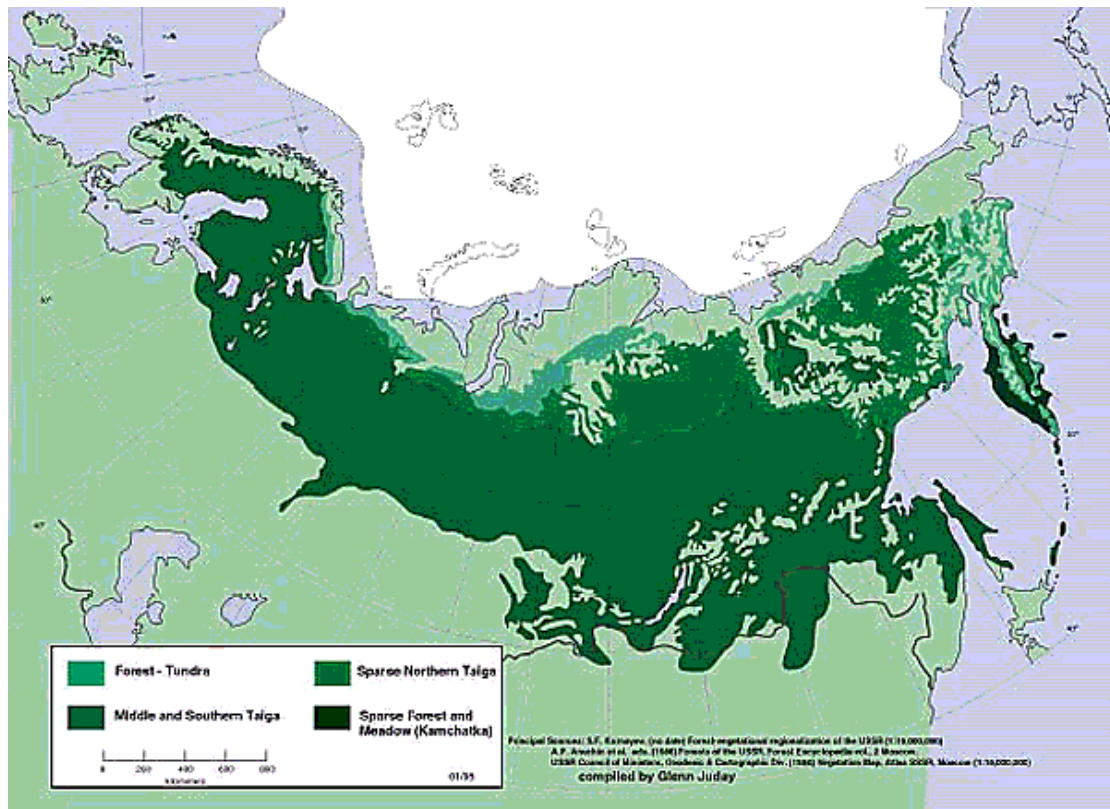
Canada

Approximately 42% of Canada is forested (418 million hectares) and in all of Canada, the predominant tree species on forest land are spruce (53.2%), poplar (11.6%) and pine (9.3%). 94% of these forested lands are under public control, with the management of these forests being shared between provincial (or territorial) and federal governments. Annually, only a small fraction of Canada's forests are harvested, corresponding to about 0.6 million hectares (ha) in 2009 and more than 0.4 million ha were replanted or reseeded. In contrast, in the same year, over 15 million ha were affected by insect defoliation and 3.2 million ha were lost to forest fires. Canada is the second largest producer of forest products in the world, and in 2010 forestry contributed over \$16.6 billion to the Canadian economy. Exports of wood products contribute about 14% to the value of all Canadian exports. (www.nrcan.gc.ca/statistics-facts/forests/897 accessed July 19, 2012). Specifically in Northern regions of Canada, both the Northwest and Yukon Territories are 57-58% covered by forests. In the NWT, 61.4 million ha are forested, but only approximately 14.3 million ha of this land is useful for tree harvesting. The territorial government owns 83% of the forests and the federal government controls the remaining 17%. In the Yukon, all of the forested lands are owned by the federal government. Efforts have been made to promote the forest industry to reduce reliance on mining, tourism and government support. The total In contrast, Nunavut lies entirely north of the treeline and as such there is no forestry in Nunavut and even firewood is in short supply.

Russia

Russia contains nearly 22% of the world's forest area as defined by the FAO (Food and Agriculture Organization of the United Nations), this is the most of any country in the world. The next largest forest countries are: Brazil with 16%, Canada 10% and US 6% of the world's forest cover. Russia's approximated forested area is 851.4 million ha. Figure XX contains a map depicting the forested area of Russia. It is known that the majority of this forest region is found in the Taiga ecozone; however, only about half of this area is commercially accessible and only 7-10% is currently exploited. The forest stock in Russia is similar to that in Canada, with 80% of the trees being coniferous in subarctic areas and deciduous trees growing further south.

Since the dissolution of the USSR in 1992, the forestry industry has undergone massive changes due to de-regulation and widespread privatization occurred. The forestry industry in Russia remains in a state of flux.



Source: <http://www.borealforest.org/>

Scandinavia

Forests occupy approximately 55% of the land in Sweden, and this number has been fairly constant since the first National Forest Inventory performed in 1923. Nearly all of Sweden's forests are regrowth forests, with less than 3.5% of current forests being virgin forests. The virgin forests are almost exclusively found in national parks and nature reserves. Important species include spruce, pine, birch, and to a lesser extent, oak, beech, alder, and aspen. About half of the total forest area is privately owned and 40% is owned by private corporations or rural communes. Only 10% of the forest is owned by the government, and these areas are generally further to the north where conditions slow the trees growth. Forestry is the second biggest economic contributor in Sweden, with competition coming from Canada from the world leadership in the export of wood pulp. In the early 1990's Sweden's government eliminated subsidies to commercial forestry because they were deemed to be counterproductive in a strongly competitive international market.

The management and ownership of Norway's forests is similar to that of Sweden, with over 80% privately owned. Norway's government subsidizes both **silviculture** (the growing and culture of trees) and the building of forest roads.

In Finland, about 70% of the total land area is forested, and 70% of the forests are privately owned. There are about 10 major sawmills in Finland and numerous smaller operations. Over 80% of the forest products generated in Finland are exported with Finland supplying about 10% of Europe's demand for forestry products.

In 1805 a law was made in Denmark that “where there is now high forest there must always be high forest”. As a result, forests which only occupied about 5% of Denmark’s land area and were in danger of being wiped out at the beginning of the 19th century now have rebounded and make up about 10% of the land. The government is making efforts to continue this growth to increase forest area to approximately 20% of total land area by the 2100’s. As a result, in contrast to other countries discussed, Denmark does not have a large forestry sector. Instead, they are a large importer of softwood lumber, especially from other Scandinavian countries.

Agriculture in the Circumpolar North

Agriculture refers to the production of goods through the growing of plants or animals (or less commonly, other life forms such as fungi). The population our world relies on two basic agricultural systems for its food supply. The first type of agriculture is known as subsistence agriculture production. This system can be characterized as regional and largely self-reliant. It does not rely on a complex infrastructure to move raw or finished products to a consumer. Products are generally characteristic of the production region but may be obtained as a mixture of a variety of annual activities. These regions are categorized as having low population density or a low economic profile. This subsistence agricultural system is used in many communities around the globe and also serves the majority of the area of the circumpolar north, but only a minority of its population. Generally, regions in which subsistence agriculture predominates have either limited or no physical and/or economic access to the global food supply network we will discuss next.

The second type of agriculture is a more recent phenomenon in our history but is perhaps more familiar to most people. This is the large-scale commercial production and trade of commodities. These commodities are agricultural products such as livestock (cattle, sheep, hogs, etc) for their products such as meat, wool and dairy products, grains for animal feed or direct human consumption, and oil seeds. These products are traded and transported through complex networks and various amounts of processing before reaching their final consumer. Comparatively smaller volumes of products that are also important for human dietary variety also move through this network, including fruits and vegetables, and other raw products such as spices. As a result, a diverse choice of foods is available to those consumers who have both physical and economic access to the network. Within the circumpolar north, this agricultural and trading system serves the major population centres, which are served by regular surface transportation, and to a lesser extent, remote communities.

Alaska

Alaska has several climatically distinct agricultural regions, including interior valleys and lowlands with warm and dry summer climates, coastal regions with cooler summers and moderate to high precipitation, and a broad transition region in the major population zone of south-central Alaska. Most of the volume and value of agricultural production takes place in the transition and interior locations. In the dry interior valleys, heat sums necessary to mature grains such as barley are generally achieved, and recent warming trends have increased the probability of achieving this critical factor to a very high level. In interior valleys and the south-central transition region, there is a correlation between years of excellent crop production and adequate and (especially) well-timed precipitation in the early and middle parts of the growing season. However, persistent and heavy precipitation in the late summer can delay, reduce, or even ruin crop harvest and recovery. In 2001, Alaska had about 580 farms and ranches (sales greater than US\$ 1000) covering 370 000 ha, of which the great majority was unimproved pasture. Alaskan crop production in the same year included 10 500 t of potatoes (including high-value, certified virus-free seed

potatoes), 27000 t of hay, 800 t of carrots, and over 8800 m³ of oats and barley. Alaska produced 11500 cattle, 1200 sheep, 1000 hogs and 15000 domestic reindeer in 2001. A few farm and ranch operations are producing species such as elk (wapiti), bison, yak, and musk oxen. Some Alaskan crops and pastures are already moisture-limited, especially in the warmer summer climate of recent years.

Canada

In the northern Canadian territories (Nunavut, Northwest, and Yukon), agriculture is a relatively small industry in high-latitude regions due to short, cool growing seasons. It generally consists of cool-season forage crops, cool-season vegetables, and small grains; traditional livestock such as cattle, sheep, goats, pigs, and poultry; and herding reindeer (which will be covered elsewhere in this module). By North American standards, farming is expensive in northern areas and farms are smaller than those in the southern provinces, averaging under 150 acres. In the territory of Nunavut in Canada, production of crops is very limited, with seasonal berries produced for home consumption being the most prominent. As of 2001, Nunavut had no farms on record, the NWT had 30m and Yukon had 170. Of the field crops in the Yukon, three quarters are estimated to be hay crops used to feed reindeer, musk-oven and horses that are commonly found on farms in the territories.

Russia

Russia possesses a large amount of the world's arable land (approximated at 8% of global arable land in the late 1990's). The arable land covers about 75% of the country's land area, but the northerly regions are more heavily forested and not as agriculturally inclined. In contrast to other regions of the circumpolar north, agricultural production has been dropping steadily over the last few decades and Russia currently holds a very large agricultural trade deficit (fourth highest in the world). Harvests generally include potatoes, sugar beets, barley, vegetables, and a variety of other grains in lesser amounts. About 5% of the total land area in Russia is used as pastureland for livestock. The main livestock are cattle, sheep, pigs, horses and poultry. Between 1990 and 1999, Russia saw a 50% decline in its livestock production, and meat is now frequently imported in large amounts.

Scandinavia

Denmark

Denmark is highly regarded around the world as an example of intensive animal husbandry. It has developed methods to maintain uniformly high standards and cooperative systems guarantee the quality of the products of all its members. Meat, dairy and eggs contribute a very important share of Danish exports. Livestock is mostly composed of (in order of numbers), chickens, hogs, cattle, sheep, horses. Denmark also has farms for mink, pox, polecat, finnracoon, and chinchilla raised for pellets. The value of exported meat and animal produces was over \$10 billion in 2001. Organic products are considered a strongly growing market.

Although not of great significance for the Danish economy, over half the land in Denmark is cultivated, mostly for feed and root crops. Agriculture engages less than 5% of the labour force. The majority of farms are small, with most being smaller than 125 acres. Grain growing and root-crop production are traditional pursuits, but in recent decades diversification has been seen into the production of forage, flower, and industrial seeds and apple growing. The soil is not particularly fertile, but widespread use of fertilizers have resulted in high yields and good quality of produce. Agricultural exports accounted for over 15% of the value of Danish exports in 2001.

Finland

Farming in Finland is characterized by the relatively small proportion of arable land (compared to the large percentage of forested land), and generally adverse climatic

and soil conditions. Most agricultural operations are concentrated in the southwestern part of the country, and elsewhere it is set in the frame of the forest. The average farm is only about 75 acres of land and in 2000 agricultural activities contributed 4% to the GDP. Of this total agricultural income, 70% is accounted for by livestock production. Livestock of importance to the Finnish agriculture industry (in order of numbers of animals) include: poultry, cattle, hogs, reindeer, sheep, and horses. Surpluses of dairy, eggs, and meat are exported.

Norway

Only about 3% of Norway's total land is subjected to agricultural activities. As is seen in many other countries, farming families often pursue additional occupations (such as forestry, fishing, or handicrafts). The main crops are grains and potatoes. With steep slopes and heavy rains, Norway's agricultural crops require heavy fertilization to counteract soil leaching. Norwegian grain production is currently a government-subsidized endeavour (since 1928). Similarly to Iceland, sheep are the most common livestock animal. However, in contrast to Iceland, cattle, hogs, horses and poultry are also common. The breeding of furbearing animals is also widely undertaken, with foxes being the most common, followed by mink. Reindeer are also raised in the north and mountain regions.

Sweden

The importance of agriculture to the Swedish economy has been steadily declining over the past century. At the beginning of the 20th century, more than 50% of the workforce was employed by agricultural activities, by 1950 this number was down to 20% and current estimates are at about 2% of the workforce. Only about 7% of Sweden's land mass is cultivated. Despite this, agricultural production greatly exceed domestic production, yet a considerable amount of food is imported that cannot be grown in within the country itself. Like Finland, fertilizers are used heavily to increase yields. Grains, potatoes and other root crops are the main agricultural products, with fruits and vegetables also being grown. Sweden is currently implementing plans to convert 10% of the country's arable land to ecological or organic agriculture. At the same time, taxes are being imposed on energy use, fertilizers and biocides.

Dairy farming is of particular importance to the Swedish agricultural economy, contributing about 80% of farm income. Reindeer, sheep, pigs and poultry are also of importance. Fur farms are on the increase, with fur farm breeders raising large numbers of mink and a declining number of fox.

Iceland

A little less than 80% of Iceland is considered agriculturally unproductive, and only about 1% of the total land area is actually used for cultivation. Of the 1% that is used for cultivating crops, 99% is used to grow hay and other fodder crops to feed local sheep herds. The remaining 1% is used to grow potatoes. Sheep raising is extensive in Iceland, sheep are generally allowed to find their own grazing pasture during warmer months and are rounded up for winter. Cattle are also raised (mainly for dairy production), and numbers are steadily increasing, however beef production remains negligible. Icelandic animals are mostly descended from the animals that were brought by 10th century Scandinavian settlers.

Environmental Impacts of Agriculture and Forestry in the Circumpolar North

As is the theme with all anthropogenic activities, agriculture and forestry generate environmental impacts wherever they are implemented. This effect is amplified in the circumpolar north where growing seasons are short and species may be fragile. Despite this, the concerns associated with both activities in the circumpolar north are

not unique to this region, but are a global concern in many regions. Both agriculture and forestry result in the fragmentation of natural habitat, and result in increased erosion, pollution, and decrease the overall fertility and diversity of the land. Environmental impacts are covered extensively in other sections of this module. Here, we explore the management systems implemented by various countries to counteract the impacts of agriculture and forestry in the circumpolar north.

There are a variety of forest management systems that are used in the taiga region. The range of these is a clear illustration of the influence of each country's socio-economic and historical characteristics. A general model of development of forestry resources can be used to describe **timber** extraction as it has changed over time in the taiga. Timber is a word used to describe trees that are grown or harvested to be used as wood. The development of timber extraction over time has evolved through the phases of local use, timber mining, tree planting, rotation forestry and progression to the eventual end goal of sustainable forestry. Until about the end of the 1800's, forests were largely considered to be an inexhaustible resource. Trees were felled freely and without any real form of restraint to provide raw materials for lumber, paper, fuelwood, and other wood-derived products. Only within the past century as demands have increased substantially has much thought been given to reforestation. Previously, natural regeneration of the forest was mostly relied upon. In addition to production of wood-products, large areas of forested land have been cleared for farming and livestock grazing.

In Scandinavian countries, large-scale exploitation of forest resources began in the 1800's. Today, almost all of the forestland in Scandinavia has been transformed into intensively managed secondary (or tertiary) forests, with only 5% or less of the original forest remaining. Scandinavia is emerging as a leader in forest management, evolving its management practices from rotation forestry towards the development of more sustainable forest practices. **Sustainable forestry** attempts to mimic natural processes that thereby restore system complexity and biodiversity through reduced amounts of harvesting, improved forest protection, increased natural regeneration strategies, and forestry practices that are less harmful to the ecosystem. However, the actual success or "sustainability" of such forestry practices is debatable and is dependent on the detail of forest policies, their implementation and monitoring.

In contrast to Scandinavia, most of the primary forest in Siberia has been retained, and most or all of the characteristics of the first phase of industrial forest exploitation can be seen in the region. The same is true in more remote parts of Canada and Alaska. The potential impacts of industrial forestry practices include profound change to the structure and dynamics of the taiga, reduced biodiversity, loss or alteration of wildlife habitat, soil modification, reduced biodiversity, reduced water quality, and forest fragmentation. The impact of such forestry practices is unlikely to subside as the timber industry expands, fuelled by technological advances and increased consumer demands.

Alaska

The Alaska Board of Forestry advises the state (Alaska Department of Natural Resources – Division of Forestry) on matters concerning forest practices and provides a forum for discussion and resolution of forest management issues on state land. The board also reviews all proposed changes to the Alaska Forest Resources and Practices Act and its regulations.

Canada

The National Forest Strategy is meant to guide Canada's efforts in sustainable forest management. It is a plan to deal with the connectedness of the ecological, economic, and socio-cultural aspects of forest use and conservation. Even more so

than European populations, this century has seen unequalled acceleration in human population and widespread industrialization. Globally, Canada participated in the advances of the globalization of markets, the advent of the information age, and the emergence of a global economy based on both material and informational resources.

In contrast to the globalization of the economy, fundamental ideological rifts occur worldwide between cultures suggesting (or perhaps, simply reminding us) of the overarching importance of reconciling our economic pursuits with nature's ability to sustain human activity. Issues that require attention through the near and distant future include:

- Aboriginal forestry
- Effective measurement of changes
- Private-land forests
- Improvement of mid-career training

Forest management objectives and the methods implemented for achieving those objectives have developed rapidly over the past century. Within a broader context, so have the societal values and technological advancements evolved.

Scandinavia

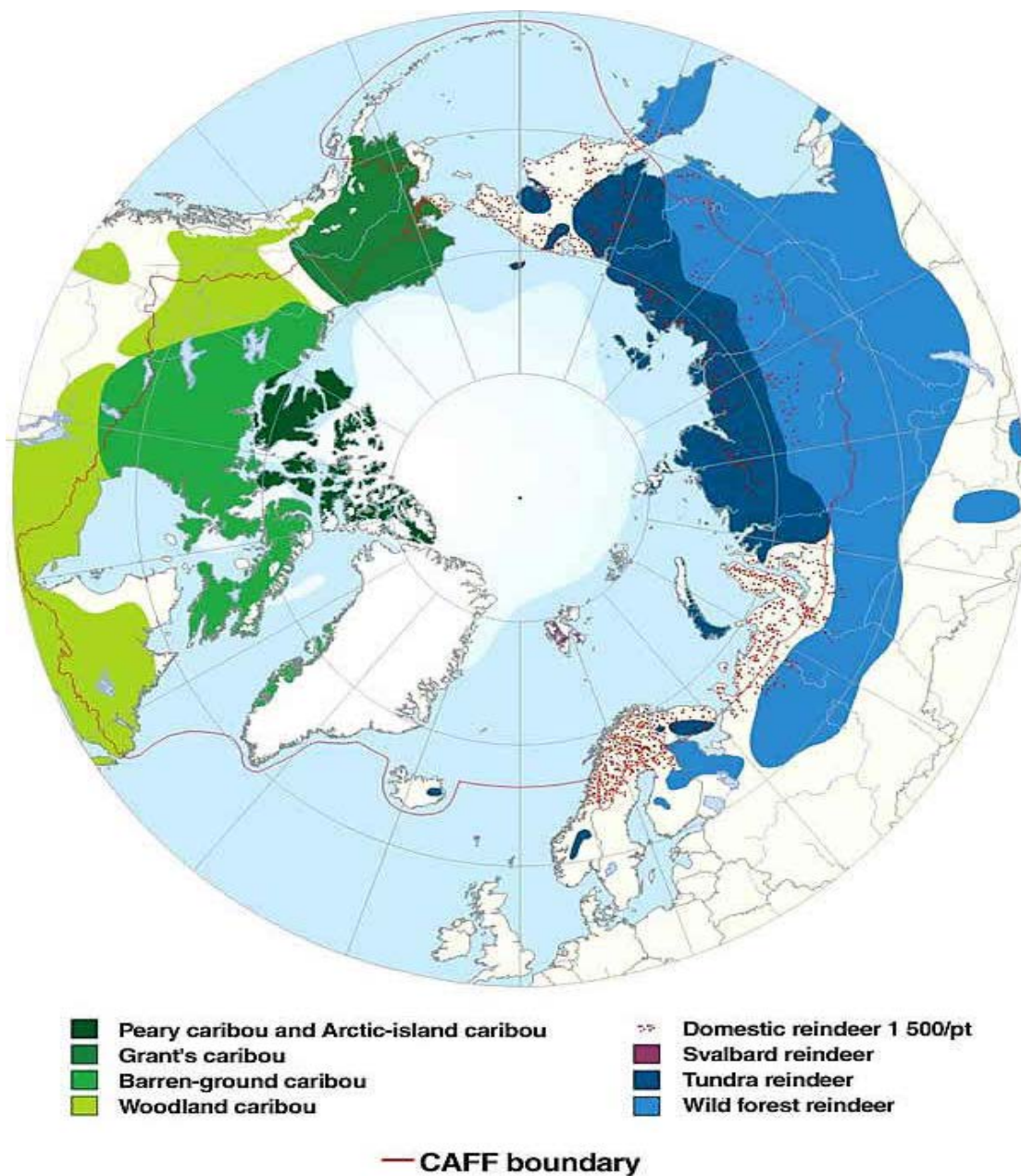
Sustainability and long-term planning have been key concepts in Scandinavian forestry practices long before these became buzzwords for environmentalists and politicians. Over more than the past century foresters in Scandinavian countries have been working towards sustainable practices, although the practices focused on timber production. However, both ecological and social considerations have played a role in Scandinavian forest management for a very long time.

Near end of the 1800's or early 1900's, Finland, Norway, Sweden, and Denmark introduced forestry legislation that limited the amount of timber that could be harvested, and imposed an obligation on woodlot owners to carry out regeneration after felling trees. Since then, the forest resources in these countries have increased substantially. In contrast, reforestation has not advanced in Iceland as substantially as it has in other Scandinavian countries. This may be in part to the harsher climate and importance of sheep farming, however, recent restrictions and new regulations show a promising trend towards reclaiming previously forested land. Finland was an early leader and innovator in forest management. Governments there have been controlling forest resources since the 1600's. By 1928, the government had introduced a policy of sustainable yields, with production and harvesting being reflective of timber growth.

In general, the forests of the circumpolar north naturally do not contain the same amount of diversity of species as compared to more southerly and tropical climates. The main reason for this is the northerly location, which results in a combination of colder climate and extreme variance in daylight hours throughout the year. In addition to this, after the most recent glacial period, many species had to migrate and evolve northwards to their current ecozone. Moreover, present day forests in some regions of the circumpolar north, such as Scandinavia have experienced massive deforestation over the past century which has had an adverse effect on the diversity of species. In 1980 a forest policy was introduced that better coordinated forestry measures with industrial needs, placing emphasis of more complete use of the forest biomass. The government enforces pest control and prevention of premature cutting, and the use of proper methods for preserving permanent forest cover.

Reindeer Herding in the Circumpolar North

Reindeer husbandry has a long history in the north in eastern countries. There are multiple indigenous peoples in the European arctic that are reindeer herders. Caribou and reindeer look somewhat different, but belong to the same species, *Rangifer tarandus*. Reindeer are slightly smaller than caribou and are found in the European and Eurasian arctic. Reindeer were domesticated in northeastern Eurasia about 2,000 years ago and today are herded by many Arctic peoples including the Sami, in Fennoscandia and Russia and the Nenets, Dolgans, Chukchi, Even and others in Russia. In North America, it is not reindeer that exist, but cousins of the reindeer known as caribou. In these areas (Canadian territories and the US state of Alaska), caribou have not been domesticated; but rather, the herds have been followed by nomadic peoples and hunted. This is addressed in the following part of this module in the section pertaining to terrestrial wildlife.



It is estimated that approximately 2.5 million semi-domesticated reindeer graze about 4 million square kilometers in Eurasia. Reindeer herders have managed these vast areas in the Arctic over thousands of years, serving as an example of sustainable

management of barren circumpolar areas. Reindeer herders have developed unique management strategies for the protection of pastures and management of changes and rational and sustainable use of natural resources that should be recognized, supported, and can serve as a model for future efforts towards sustainability in the circumpolar north (and elsewhere in the world). The economic impact of reindeer herding is very difficult to quantify due to its far-reaching impacts into land management and sustainability. However, the value of the reindeer meat “harvested” in a year alone has been placed in the tens of millions of dollars.

Today, reindeer herders face new challenges as industrial interests increase in their traditional herding areas. Many reindeer herders are actively developing their own monitoring programs and are tracking the changes that are occurring in their herds as habitat is encroached upon and/or fractured by urbanization and industrialization. Aspects of environmental impacts on reindeer herding are covered in other modules of this course.

Terrestrial Wildlife in the Circumpolar North

The harvest of wild animals (wildlife) is common in all areas and peoples of the world and is shared by the people of the circumpolar north. In modern times, wildlife harvesting can be for subsistence, cash income, sport, or a combination of reasons. The hunting of wild reindeer and caribou provides an important source of food and income for many parts of the circumpolar north. Other species that are frequently hunted include birds, small fur-bearing mammals, and a variety of larger mammals. Traditionally, this has played a central role to life in the circumpolar north for millennia. In modern day times, wildlife still plays a role of great importance to many communities in the circumpolar north, especially so in Russia and North America. It is though that the remoteness of these communities likely contributes to their continued reliance on local terrestrial wildlife for both food and other resources.

Much as the reindeer have been central to life in northern Eurasia, caribou have played a central role to subsistence living in Arctic North America. Subsistence caribou hunting was (and in some instances, still is) practiced by many indigenous peoples including (but not exclusive to) the Dogrib, Koyukon, Gwich'in, Dene, Cree, Chipewyan, Inni, Naskapi, Yupiit, Inupiat, Inuialuit and Inuit. In some parts of the Canadian territory of Nunavut, subsistence living was maintained through fishing and hunting until the mid-1960's. In North America, it is not reindeer that exist, but cousins of the reindeer known as caribou. Caribou and reindeer look somewhat different, but belong to the same species, *Rangifer tarandus*. Wild caribou are distributed across the North American Arctic and parts of Greenland. Caribou have been important to the northern peoples of North America for Millennia and hold an important spiritual and social value in addition to their sheer (and large) economic value as a source of food, hides, and other materials.

Conclusion

The terrestrial environment of the circumpolar north provides many economically valuable and culturally significant resources. As we have learned in this module, these include forestry, agriculture, animal husbandry, and wildlife. These resources have been used for many years, even millennia in some cases. In modern times, practices are evolving and becoming more intensified. This is amplified in more heavily populated areas. With the use of these resources also comes the potential for environmental pollution. The countries of the circumpolar north are all working towards establishing or increasing environmental regulations associated with these activities in order to protect these resources for many years to come.

Discussion Questions

1. What forestry activities take place in your area (or an area of the circumpolar north of your choice). How does this compare with the activities in the countries that were discussed in this module?
2. What agricultural activities take place in your area (or an area of the circumpolar north of your choice). How does this compare with the activities in the countries that were discussed in this module?
3. What wildlife-based subsistence activities take place in your area (or an area of the circumpolar north of your choice). How does this compare with the activities in the countries that were discussed in this module?

Study Questions and Answers

1. Identify different types of agriculture and explain the economic significance of each in the northern region.

The main types of agriculture are subsistence agriculture and large-scale commercial production. Agriculture includes the growing and harvesting of crops, as well as animal husbandry. Large-scale commercial agriculture is most important in more populated areas of the circumpolar North, such as Scandinavia. Farms are usually much smaller than counterparts to the south in each of the countries of the circumpolar North.

2. List the main environmental impacts of agriculture and forestry in the North.

The main environmental impacts of agriculture and forestry in the North include: Habitat fragmentation, erosion, introduction of new species, deforestation, loss of habitat, and pollution (from equipment and also from fertilizers, etc.).

3. Identify the areas and peoples involved in reindeer herding in the North, and explain its significance for these peoples.

Reindeer is practiced only in the north in Eastern countries and is not practiced in Canada or the US. There are an estimated 2.5 million domesticated reindeer currently herded. Reindeer herding contributes significantly to the economies of these countries not only through the value of the reindeer, but through the environmental stewardship practiced by the communities practicing reindeer husbandry.

4. Identify the major terrestrial wildlife species in the North and explain its significance for these peoples.

Terrestrial wildlife have played a significant role for people in the circumpolar North over centuries and millennia as they enables subsistence living. Caribou (and their cousins the reindeer) have been one of the most important land animals in the circumpolar North.

Glossary of Terms

Biome: A large, naturally occurring community of flora or fauna occupying a major habitat.

Conifer (Coniferous): A tree that bears cones and evergreen needle-like or scale-like leaves.

Deciduous: A tree or shrub that sheds its leaves annually.

Ecotone: A region of transition between two biological communities.

Fodder: Food, especially dried hay or feed for livestock.

Forage: Bulky food such as grass or hay for livestock; fodder.

Genera: A grouping of organisms having common characteristics distinct from those of other such groupings. The genus (singular of genera) is a principal taxonomic unit.

Isotherm: A line on a map connecting points that have the same temperature at a given time or on average over a given period/

Permafrost: A thick subsurface layer of soil that remains frozen throughout the year occurring chiefly in polar regions.

Sustainable Development: A pattern of economic growth in which resource use aims to meet human needs while preserving the environment so that these needs can be met not only in the present but also for generations to come.

Sustainable Forestry: The management of forests according to the principals of sustainable development.

Silviculture: The growing and cultivation of trees.

Taiga: Also known as the boreal forest, is a biome characterized by coniferous forests in high northern latitudes.

Timber: Wood prepared for use in building and carpentry, or trees grown for such wood.

References

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