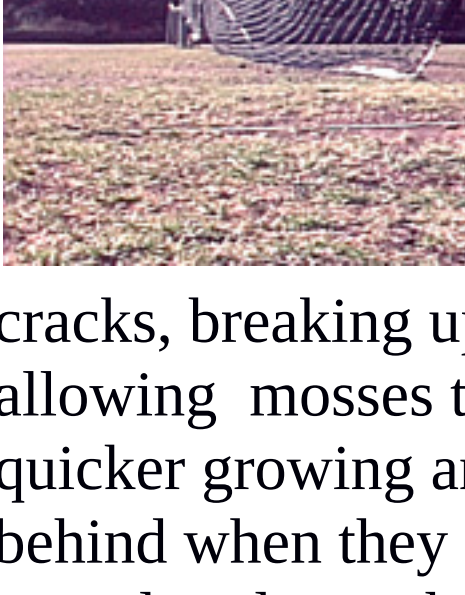


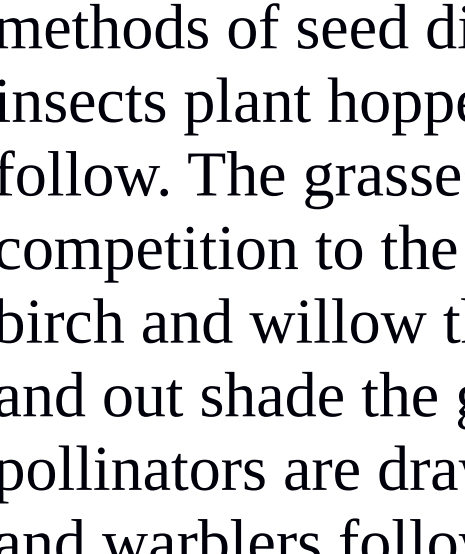
SUCCESSION



Succession is the process of evolution from a simple to a more complex habitat over time. Bare rock will be colonized by lichens with thread like rhizomes that spread over the surface and into the

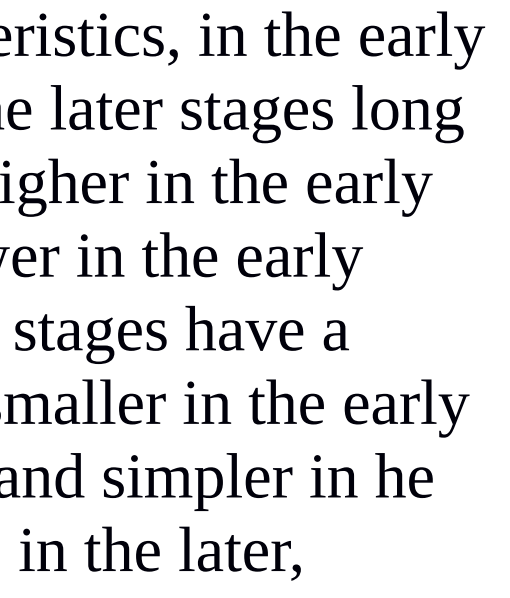
cracks, breaking up the rock surface allowing mosses to set root. Mosses are quicker growing and leave more matter behind when they rot. As the soil increases vascular plants, that can transmit water will take root, grow and wither, until the ground is eventually covered with soil. Then grasses, shrubs and eventually trees will grow.

This succession of plant habitats reaches a finishing point where the regeneration process is stable and the same plants regrow. Depending on the climate this final stage varies, in Africa it might be desert, in the high Alps bare rock. In Britain this climax succession is woodland. This final stage differs with different soils. On chalk land birch, willow and ash, and finally beech will be the dominant tree, clay soils climax with oak.



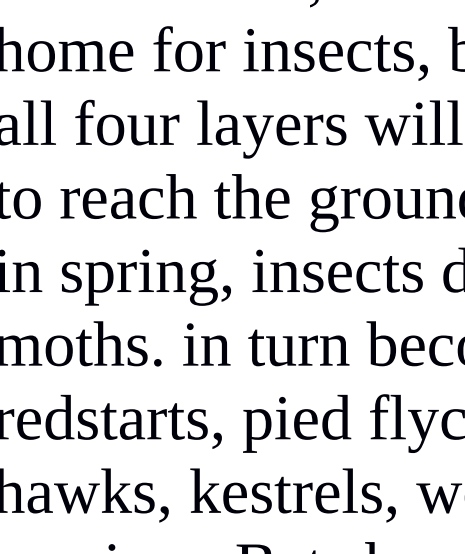
An abandoned tennis court will turn to woodland. The colonization of annual weeds will take place over a couple of years, herbs will grow over the next 2-15 years, small shrubs appear over the next 15-35 years, and trees start to take root 35 years after the first tentative weed growth.

Seed dispersal is the vital pathway for plants to invade open spaces. Animals carry seeds in their feces and wind pollinated seeds can scatter and grow. This limits the variety of colonizing plants, mostly grasses, coldfoot, creeping bent. Colonizing plants must be rapid growers, produce many seeds and have efficient methods of seed dispersal. Grass eating insects plant hoppers and grass hoppers follow. The grasses must give way without competition to the next generation of plants, dogwood, privet, birch and willow that can push their roots into available cracks and out shade the grasses. Bees, butterflies and other pollinators are drawn to the flowers and birds, wheatear, linnet and warblers follow the insects. The shrubs have to give way to taller growing trees as the woodland spreads attracting larger birds and animals, kestrels, woodpeckers and squirrels who will establish territories and food chains.



The successional climax is when a functional steady state has been established, where the plants are self perpetuating and equilibrium has been established in the physical and biological environments. The stages of succession show different characteristics, in the early stages food chains are short and linear, in the later stages long and web like, production and energy flow higher in the early stages, reduced in the later, biodiversity lower in the early stages higher in the later. Plants in the early stages have a broad niche, narrow in the later, plants are smaller in the early stages larger in the later, life cycles shorter and simpler in the early stages, long, more complex and stable in the later, populations fluctuate in the early stages are stable in the later. In the early stages nutrients are consumed more readily and wasted more often, in the later stages nutrients are consumed slowly and efficiently recycled. Quantity is the mantra of early succession, with plants multiplying quickly and the process eventually crashing, quality is the mantra of the stable late succession, producing fewer offspring and maintaining reproductive limits.

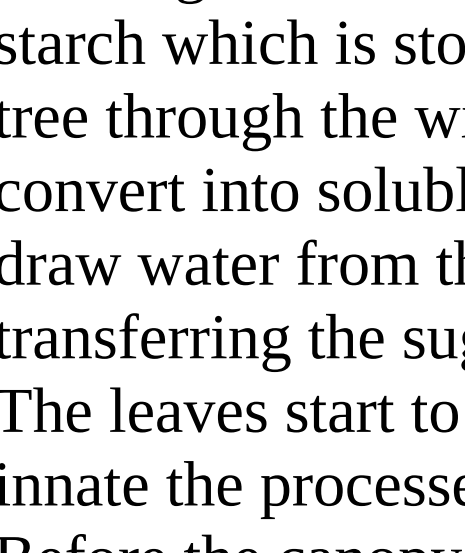
WOODLAND



Woodland differs from other habitats in that it has the extra dimension of height, with tree growing up to 30m. It has four levels of vegetation, at the lowest level the litter and soil, above that the field layer small plants

and mosses, ferns and flowers, extending up to 2 meters, the level supporting the most wildlife. Above it at the shrub layer, the under storey, with young trees, shrubs and bushes, hazel, blackthorn, buckthorn, dog rose, elder, hawthorn and spindle. High above that is the canopy layer, the branches and leaves of mature trees, the oaks, ashes and beeches. Each layer is a home for insects, birds and mammals. The wood that displays all four layers will have plenty of light penetrating the canopy to reach the ground plants. As the trees nutritious leaves unfurl in spring, insects descend in huge numbers, caterpillars and moths. In turn becoming food for tits, warblers, finches, redstarts, pied flycatchers and starlings. Crows, sparrow hawks, kestrels, woodpeckers and nuthatches nest in tree crevices. Bats hunt around the tops of the trees. Grey squirrels thrive among oaks and sweet chestnuts, leaping between branches, feeding on nuts, tree bark, shoots fungi and birds eggs, building its untidy spherical dray high in the branches. The shrub layer, entwined with ivy and honeysuckle is where the solitary nocturnal dormouse lives, preferring dense growth, with hazel, beech and sweet chestnut the dominant species. Plants that lack chlorophyll, like ferns, do not need carbon dioxide to grow, instead taking their nutrients from dead organic matter in the ground, thrive in the shade of the wood's canopy. Among the ferns the live hedgehogs, shrews and wood mice. Speckled wood, green veined and white butterflies rest on the leaves. Mosses and fungi grow on the ground. Mosses often cover the trunks of fallen trees, fungi, sending up toadstools in autumn, grow alongside tree roots providing xx to the roots and taking xxx from the roots in a symbiotic relationship. The flowering plants looking for insect pollinators grow in clearings and along the woodland edge.

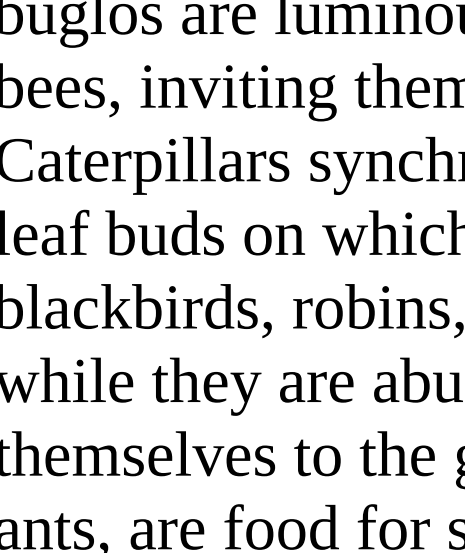
SPRING



Trees do not start to open their leaves before April, but processes to reawaken the trees start much earlier, in February. Sap starts to flow with the lengthening days, carrying nutrients to the buds.

These nutrients were produced by the tree's leaves in the previous year and stored in its roots overwinter. Growth starts when the spring temperature reaches 6 degrees centigrade. The leaves combine water with carbon dioxide to form sugars and other chemicals that are carried in the sap to nourish the tree. As water evaporates from the leaves, water is drawn from the roots causing the sap to flow. In spring the nutrients are used to fuel growth. In autumn the nutrients are converted into starch which is stored in the tree's wood and roots, to fuel the tree through the winter. With spring the insoluble starches convert into soluble sugars and the tips of the roots start to draw water from the soil. Sap slowly begins to flow transferring the sugars to the trees buds, leaves and flowers. The leaves start to breathe, increasing the flow of sap and to innate the processes photosynthesis for the trees growth. Before the canopy starts to grow in earnest, the early spring flowers take advantage of the light to bloom, primroses, violets and wood anemones. These spring flowers have a cache of nutrients held in their bulbs which flow up to feed the flower as temperatures rise, the soil warms and hours of daylight increase. Butchers broom open with small clumps of male and female flowers. Many spring flowers are pollinated by moths, flies and beetles, which are in flight before other insects, who vision is sensitive to white and yellow. To be visible many spring flowers are white and yellow. Summer flowers are often red and blue, visible to the ultraviolet sensitivity of bees. Mosses produce new growth and start to fruit. The spring flowers of the wood sorrel nod forward at night and in the rain to keep their pollen dry, and fold up in strong sunlight to protect their delicate leaf surfaces. Elder and horse chestnut are among the first trees to leaf. Hazel, aspen, alder, hornbeam and willow burst into flower before their leaves unfurl, attracting insects, shedding their pollen. Brimstone and orange tip are the first butterflies on the wing, ladybirds, queen wasps and ground beetles seek out nourishment. As temperatures increase hibernating hedgehogs and dormice reemerge looking for food, toads and frogs congregate around their spawning ponds. Insect eating birds, robins, finches and tits pair and build nests, when sufficient numbers of insects are abundant enough to provide for the extra energy needed to raise a brood. Overwintering migrants, redwings and fieldfares return to their breeding ground in Scandinavia, while summer migrants arrive, warblers, chiffchaff, martins and swallows, some returning to the same nest site as the previous year. In late April the sound of the song of the cuckoo indicates the start of summer.

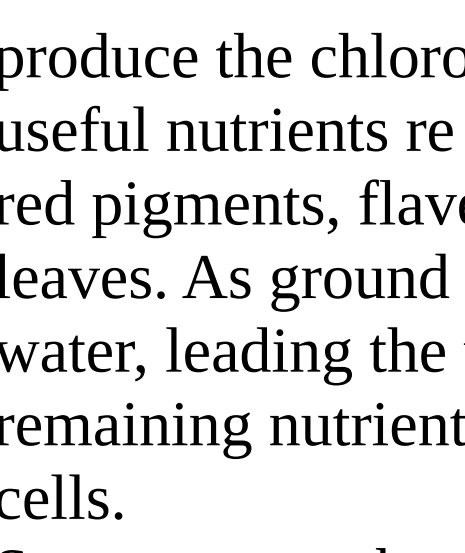
SUMMER



By April the tree canopy has thrown the wood floor onto shade. Ash is the last tree to come into leaf, the spruce adds a new whorl of branches at its crown.

Holly and red campion, dog's mercury, woundwort, bugle and bluebells grow in the shade of the canopy. The mauve and blue spikes of foxglove and vipers buglos are luminous to the ultra violet discerning vision of bees, inviting them down to feed and spread their pollen. Caterpillars synchronise their hatching with the emergence of leaf buds on which they feed. Tits, warblers, thrushes, blackbirds, robins, magpies and jays feed on the caterpillars while they are abundant. In June they build a cocoon or lower themselves to the ground on a silk thread, to pupate. Flying ants, are food for starling and gulls, heavier insects like the maybug are hunted by rooks, little owls and tawny owls. As summer advances, the frenetic activity of nesting birds calms. Fledglings emerging from their nests are vulnerable to hunting foxes seeking food for their own cubs. By the end of July birds are moulting their breeding plumage, migrant birds preparing for their flight south. The wood undergrowth is overwhelmed by bracken and nettles. The first pink flowers of the rosebay willowherb and the darting flight of dragonflies are signs of the encroachment of autumn, and with it the promise of berries on rowan and blackberry bushes for thrushes, blackbirds and squirrels. The birds use the summer months to raise their young, to benefit from the brief abundance of food. With 15 hours of daylight plants extend their branches and push out their leaves, plentiful food and long hours for birds to forage. Insects multiply providing insect eating migrant birds with food for their growing chicks. Groundfeeders like the song thrush and blackbird, taking worms, slugs and millipedes, are the first to build their nests, starting in March. The blue tit waits until late April, when winter moth caterpillars hatch in their millions. Migrant birds like the swallow who depend on flying insects delay until May. Seed eaters like the yellowhammer are the last to breeding laying their eggs in late May, so that the chicks hatching will coincide with the ripening seeds. The young of predatory birds, like the sparrow hawk, are on the nest from May to August, dependent for food on the very chicks hatching earlier in the year.

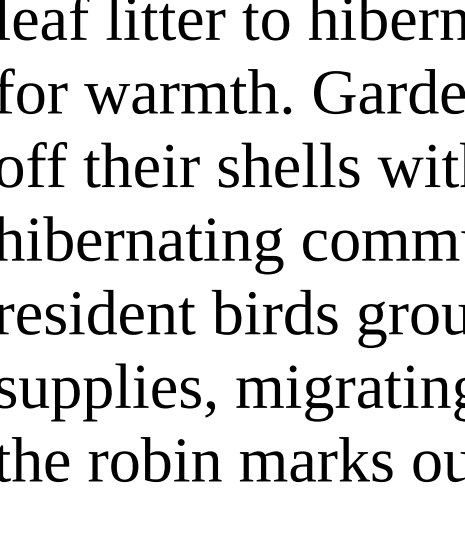
AUTUMN



Throughout the summer the trees have been drawing nutrients from the green pigment chlorophyll stimulated by the sun's rays. With shorter days and less intense sunlight the trees can longer produce the chlorophyll, the green pigment decays, with all useful nutrients reabsorbed into the tree, leaving yellow and red pigments, flavonoids and carotenoids, the colour of autumn leaves. As ground temperatures drop the trees roots extract less water, leading the tree to shed its leaves to conserve the remaining nutrients, sealing of the leaf stems with a layer of cells.

Summer growth culminates in fruits, blackberries, sloes, rose hips, and many other berries. Thrushes seek out white mistletoe berries, starlings elderberries. Trees offer beech nuts, acorns, winged seeds of the hornbeam. The woods animals, birds and insects fall on this abundance of food, hoarded by jays, squirrels, mice and voles to provide through the winter. Bees draw the last of the nectar from the late flowering ivy. Spider's webs shimmer in the light, the hammock web of the money spider. Leaves falling to the ground form leaf layers. This is home to a host of animals. The upper centimetres contain the most recent fallen leaves is the litter layer. Below is the fermenting layer, where the plants are slowly decomposing, which may be several centimetres thick. Under that is the humus layer consisting of fully rotted plant material, where bacteria and fungi spread. Wolf spiders hunt in the litter, scampering across the surface. Harvest spiders live under the litter and in the humus, feeding off small insects and animal droppings. Mites, springtails, beetles, wood lice, millipedes and centipedes eat leaves and plant debris, starting the decay process, which is completed by bacteria and fungi, the fly agaric, earth stars and puffballs. With decomposition nutrients are released into the soil, taken up by the plants, establishing the woods cycle of growth. Earwigs and ladybirds dig into the leaf litter to hibernate overwinter, ladybirds clustering together for warmth. Garden snails group together underground, sealing off their shells with mucus. Toads, frogs and snakes gather in hibernating communes. As the bounty of autumn declines, resident birds group into flocks to seek out the diminishing supplies, migrating birds prepare for their long flight south and the robin marks out its solitary winter territory.

WINTER



Annual plants die away in the autumn and rely on the distribution of their seeds to enable new growth in spring. Trees stop the flow of nutrient and enter a state of hibernation, while green algal growth takes advantage of the wet conditions to spread up the tree trunks, providing food for wood lice and millipedes. Insects such as dragonflies and grasshoppers disappear with the cold. Many insects overwinter as pupae, grasshopper eggs are buried in the soil, with dragonfly nymphs swimming in the ponds. A queen wasp will hibernate in a fallen oak. Brimstone and tortoiseshell butterflies overwinter as adults, converting their blood sugar to glycerol, which acts as an antifreeze. Winter moths and winter gnats are active, attracting mates and laying their eggs. Many birds join large overwintering flocks. Robin pairs split up to maintain a single territory, singing through the winter, as do the dunnock, song thrush and wren. Wrens and long tailed tits huddle together at night to conserve body warmth. Tawny owls lay their eggs in February and March, and so the winter months are used to establish a territory to attract mate with its hooting call. Pairs are established by December as the male offers voles and mice to the female to provide her the nutrients she will need for egg laying. Hedgehogs and dormice and bats hibernate. The food of autumn feeding feast is converted into a thick layer of brown fat, which they consume slowly through the winter. To economize on their consumption these hibernating animals reduce their heart rate to one heartbeat every 15 minutes. Squirrels feed from caches of buried acorns and beech nuts they collected in the autumn. Perennial plants wither in the autumn but their root structure remains intact underground, gathering nutrients to enable it to regrow in the spring. Rootstock, for the primrose, with a toughened stem base and root, is a basic structure able to store nutrients. The root tuber, for orchids, a swelling at the base of the root, is more efficient with nutrients stored in the tuber until it is needed. Rhizomes spread horizontally across the ground, covering a larger area and thereby drawing more nutrients. Corm grows at the end of the stem, on plants like the crocus, with the prospective flowering shoots and leaves contained underground in its round body. In bulbs, daffodils, the leaves rather than the stems of the plant are modified to store nutrients, the brown skin protecting the bulb, being composed of old leaf bases. Flowers of snowdrops and winter aconites emerge in January, elder starts to leaf and hazel produces its catkins.