

“The greatest service which can be rendered any country is to add a useful plant to its culture”
Thomas Jefferson



PROJECT BLAEBERRY

by

Fiona Sinclair

a Millennium Award project

funded by

The Millennium Forest for Scotland Trust



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INTRODUCTION

Forest fruits – the roots of my research

It has been a long and winding path over many years that has led to this research. I have always had a particular interest in the environment – although I may not always have expressed it as such. I have loved trees since my childhood. But I suppose that the most direct route has been since I became interested in semi-natural and ancient woodlands and their ecology. I discovered that a key way to determine this type of woodland was to take a look at the herb and shrub layer – because the plant relationships that constitute these layers are impossible to replicate in any other type of woodland.

There is a great aesthetic pleasure in walking in such woodlands, in contrast to the often sterile environment of a plantation woodland. As a keen amateur photographer, I have found much to photograph. My interest in Scottish history and folklore has naturally added another strand to my interest in woodland ecology. From this I have learnt that there are many plants that were formerly used in everyday life. The former uses of these plants can yield clues as to their possible future uses. Although most plant-based folk medicines, for instance, will have been the result of generations of empirical observation of the effects of various substances on differing ailments, those observations contributed to a cultural tradition, and were not recorded for the benefit of posterity. Only latterly did the men of science begin to take an interest in the uses of these plants, without the benefit of any real understanding of the cultural tradition from which they came.

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Today, we are much more familiar with the proverbial search for 'a cure for cancer' in tropical rainforests than we are with some of the medical discoveries on our own doorstep. One of the most important drugs of the 20th century, and, it is predicted, of the 21st century, was discovered in the bark of the willow – aspirin*. We appreciate the need for biodiversity in tropical rain forests, because they host so many of the total number of species on this planet, and yet we pay little attention to biodiversity within our own part of the planet, over which we have more control. There may not be another drug of the importance of aspirin still waiting to be discovered within our own biological resources, but we could help to take the pressure off biological resources in these 'hot spots' by making better use of ours. Moreover, we would do well to learn that humankind has always had a more active role in managing biodiversity for the good, as well as the bad. Ethno-ecologists are revealing that the biodiversity of apparently pristine and unexploited natural forests is due in part to the stewardship of their indigenous populations.¹

Most of us are no doubt familiar with the practice of intercropping, which is practised in the tropics by subsistence farmers. Crops such as coffee grow and ripen in the shade of trees and it is known that this practice produces far more food per acre than monoculture, for a variety of reasons. Furthermore, some of the people living on the margins of tropical rainforests have refined intercropping to the point where they are now cultivating medicinal and other 'useful plants' from the forests in their own 'forest gardens', outwith the forest boundaries - conserving time, effort and biological resources.

So what, you may ask, do tropical forest gardens have to do with a dwarf, ericaceous shrub such as blaeberry, which is mainly known in the British Isles as a moorland or heathland plant, from which it is hardly worth the effort to collect the berries? It is precisely because most of us are only aware of this unnatural ecological situation. Most people do not know that blaeberry only reaches its full ecological potential within a woodland environment. And hardly anybody in these islands is aware of the factors that limit that potential, still less those that would increase it. It is the intention of my report to begin to address those factors, and set forth a case for the management of blaeberry, to be cultivated by intercropping as a true 'forest fruit' that may be set within the larger context of development of Non-Timber Forest Products (NTFP).

I am all too aware that I am writing this report at a time when the agricultural industry is in crisis, because of the foot and mouth epidemic, and that this follows a period of severe decline in farming in general. Newspaper headlines have varied between speculating that the government intends to encourage the closure of 25% of farms by 2005, with 50,000 jobs to go, and reform of the CAP to allow more environmentally friendly farming, with more government encouragement of organic farming.

It is obvious that livestock farming is the mainstay of farming in the uplands, and it is this branch of farming that has been suffering the most, even before the foot and mouth outbreak. It is clear to everyone that things have to change. Perhaps, as the head of the Countryside Agency has suggested, a solution could be found through a huge expansion of alternative energy, particularly wind energy. This could give the fastest real boost to farming incomes, and then other reforms, such as reform or

* New uses for aspirin are still being found. It is currently used to prevent miscarriage, and also to prevent heart attacks.

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abolition of the CAP could be implemented. But when redirection of farming support is being suggested towards biodiversity for the benefit of wildlife, and for associated recreational use, I would hope that this report may form part of an argument for the consideration of alternative food crops as a natural consequence of increased biodiversity. Farming across the world is facing massive problems – and it is not in the interests of any nation's food security, whether at war or not, to be as heavily reliant on food imports as was the U.K. in 1939. It makes no sense to abandon arable land, nor to continue to abuse our uplands as monocultures for plantation forestry, field sports playparks, or the ubiquitous sheep.

My study tour of North America, to learn at first hand about lowbush blueberry cultivation and to study the extensive industry that has built up around it, was initiated because I found the idea of growing a native species as an arable crop on non-arable land very exciting. The lowbush blueberry grows on acid soil, as does our native blaeberry – albeit the soil types differ greatly in other respects. Scotland does not retain the extensive forests that are found in Scandinavia, where wild berries are a natural benefit to rural communities and their local economies. Paradoxically, because of the loss of biodiversity, it may be worth the while of individuals and communities in Scotland, and elsewhere in the British Isles, to cultivate blaeberry, where it has not been worth the trouble to do so in either Finland, Norway or Germany.

BLAEBERRY IN SCOTTISH CULTURE AND HISTORY

Although blaeberry is fairly extensively distributed throughout Scotland, I have not been able to find the wealth of cultural references one might have expected. It seems clear to me that it is precisely because of its ubiquitous nature that blaeberry has pretty much been taken for granted, and that these few cultural references are indicative of the fact that it was a widely known and utilised plant.

'The Fairy Lullaby' is an old Gaelic song, which I came across many years ago in its English translation. It mentions blaeberrys in the context of a woman leaving her baby (presumably wrapped up on the ground) to gather blaeberrys, and then returning to find that the child has been abducted by the fairies. The song has a lovely melody, and I am assured by Morag MacLeod, the Gaelic song specialist with the School of Scottish Studies of Edinburgh University, that the English words, for once, are a reasonably accurate translation from the Gaelic. There are several Gaelic versions of the song, only one of which mentions blaeberry – in D.C. MacPherson's 'An Duanaire', published in 1868. The Gaelic titles are 'Mo chùbhrachan' (My fragrant one) and 'An cóineachan' (a child stolen by the fairies).

The library of the University of Glasgow has a collection of chapbooks within its Special Collection section. There is a 'humorous' song by the name of 'The Blaeberry Courtship' within a chapbook that was printed in Falkirk in 1813. Another undated chapbook contains 'The blaeberrys; or Allan's love'. It is appropriate that blaeberry, as a common wild fruit, should have been referred to within popular culture.

A Highland writer, albeit one who wrote solely in English, is responsible for possibly the only piece of prose to explore the erotic potential of eating blaeberrys! 'Blaeberrys' is part of Neil Gunn's collection of short stories entitled 'The White Hour'. Read and enjoy!

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One of the `Scottish Chaucerians`, the poet Robert Henryson, makes mention of blaeberry in `The Tail of the Paddock and the Mous`. The paddok (toad) makes an analogy between his own appearance and that of blaeberries, which `thocht thay be sad of hew are gadderit up quhen primeros is forsakin`. One can at least deduce from this that blaeberry was widely known and picked in the 15th century, even in the area around Dunfermline in Fife, where Henryson lived.

Hugh MacDiarmid wrote in `Lucky Poet`: `Many a great basket of blaeberries I gathered on the hills around Langholm`. MacDiarmid makes considerable mention of nature, and native plants in his poems. He mentions blaeberries again in his poem `Water Music`. In the same poem, MacDiarmid's reference to `brae-hags`, being the wooded overhanging banks of a stream, is a particularly evocative one [see Photo 1]. Another writer who hailed from the south-west, John Buchan, gives blaeberry an honourable mention in his famous novel `The Thirty-Nine Steps`.

In view of these last two writers' connections with the south-west, it is interesting to note that there are two placenames associated with blaeberry in the Langholm area – both called Blaeberry Hill - in Eskdalemuir Forest. Other blaeberry placenames are also in the south-west: Blaeberry Burn in the North Lowther Hills, near Coalburn in South Lanarkshire, and two in or at the edge of the Galloway Forest Park - Blaeberry Isle on Loch Macaterick and Blaeberry Island on Loch Skerrow.

Outwith Scotland, there are also place names associated with blaeberry. Blaeberry is not just the Scots word for *Vaccinium myrtillus*, but also the northern English word for it as well (the standard English being `bilberry`). There is a Blaeberry Burn in Teesdale. More surprisingly, there is also a Blaeberry Crag, by Lough Belshade, in Donegal in Ireland. Although it is the northernmost county in Ireland, Donegal is in the Republic. However, the county is part of the old province of Ulster, and has had close links with Argyll and the Isles over the centuries, so this is perhaps why the Ulster Scots word has taken precedence over the English equivalent. In the Rocky Mountains in British Columbia, Canada, there is a river, and a valley and a settlement called Blaeberry. There are numerous placenames with Scottish associations in the wider area. North American botanists maintain that there are two areas in the Rockies where *Vaccinium myrtillus* grows, although this is disputed by British botanists such as Ritchie. First Nation peoples such as the Kootenay and the Shuswap have made use of this species over the centuries, and they belong to the area around Blaeberry!

Blaeberry is the clan badge of Clan Shaw, the Scotts and MacLaine of Lochbuie. Clan badges are a far more ancient symbol of clan than tartan, as only four of the original tartans remain. The rest were invented for the Edinburgh visit of King George IV, which was promoted by Sir Walter Scott. Many of the original tartans were very similar to each other in their patterns, hence the clan badges were devised to differentiate between clans – rather important in the heat of battle.

A number of `tours` were made of Scotland, particularly of the Highlands, in the 18th century. It is widely assumed that these were, in part, information-gathering exercises for the emergent medical and scientific establishment in Edinburgh and beyond. One account of such a tour, the `Journal of James Robertson` (published 1767) refers to blaeberry as `Common Bil-berry`, `Blea-berry` and `Black Whorts`. John Lightfoot, in his `Flora Scotica` (published 1777) wrote of blaeberry: `The berries have an

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Photo 1



Photo 2



Photo 3



Photo 4



Photo 5



Photo 6



Photo 1 – ‘Braehags’, containing blaeberry, heather, hazel, etc. along the Dalmellington – Carsphairn stretch of the A713 in Ayrshire.

Photo 2 – ‘Wild’ lowbush blueberry being handraked on Gramp’s Farm in Maine

Photo 3 – Lowbush blueberry in its blue (*Vaccinium augustifolium*) and black (*Vaccinium augustifolium* f. *nigrum*) forms

Photos 4 & 5 – Lowbush blueberry

Photo 6 – Blueberry fields in the Nova Scotian landscape (with the *nigrum* variety in the foreground)

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astrigent quality. In Arran and the Western Isles they are given in diarrheas and dysenteries with good effect. The Highlanders frequently eat them in milk, which is cooling and agreeable food, and sometimes they make them into tarts and jellies, which last they mix with whisky to give it relish to give to a stranger.' In Martin Martin's 'A Description of the Western Islands of Scotland', which was written in 1690, he notes that 'Fluxes are cur'd by taking now and then a spoonful of the Syrup of blue Berries that grow on the Mertillus'.*

Mary Beith's book 'Healing Threads' draws on several sources for information about the healing properties of blaeberry. 'Pennant lists meadowsweet among treatments for flux which included 'jelly of bilberry'. She mentions the Revd Angus MacFarlane, who contributed a paper on plant lore to the Transactions of the Gaelic Society of Inverness in 1924, and who said that an infusion was used for soothing pain. 'In the Reay Country Gaelic of north-west Sutherland, the blaeberry is known as *fiagag*, and was once highly rated in that area for dissolving kidney stones. In the islands blaeberry tea was once a common drink'.

As for archaeological evidence of ancient use of blaeberry, and other useful plants, there is now available 'Plants and People in Ancient Scotland', by C. and J.H. Dickson, which gives evidence of consumption of blaeberry from the Neolithic period onwards. The chambered cairn at Embo, in Sutherland, 'is noteworthy archaeobotanically for two reasons. Firstly, two carbonised berries of Bilberry, or an allied species, were found. This is a very rare discovery in Scottish archaeology; seeds of such species are often found but not carbonised fruits.' The Romans made use of local wild fruits and nuts, including blaeberry. Archaeological digs from the Mediaeval period have also indicated that blaeberry and other forest fruits were extensively eaten, even in comparatively urban settings such as Perth, Aberdeen and Elgin. The monks of Paisley Abbey, for all their cosmopolitan connections, still consumed wild fruits, including blaeberry.

HEALTHY BLAEBERRY

There are a number of claims made for the health benefits of eating blueberries, which until comparatively recently were largely based on research conducted on the blaeberry. There has been a lot of health research carried out in Italy, and the Japanese are particularly interested in the benefits that are offered to optical health.

The various American blueberry marketing organisations claim that blueberries can:- help reverse short term memory loss; inhibit the bacteria which cause urinary tract infections from attaching to the bladder wall; promote optical health; and prevent heart disease and cancer. Some caution should be applied when considering these claims, because there are not only genetic factors to be taken into account in any examination of human health, but also the various environmental factors, including environmental pollution (which can itself impact upon our diet) and the entirety of our diet.

Nevertheless, it is interesting to note that blaeberrys are extremely high in anthocyanins - 300mg per 100g, compared to 128mg per 100g for blueberries, which are themselves higher in the content of these substances than any other commercially grown fruit or vegetable. Anthocyanins are linked to the prevention of cancer and

* 'the flux' was diarrhoea and dysentery

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heart disease, and are also beneficial to blood circulation. Blaeberry is used in the treatment of circulatory disorders for this reason.

Various universities and research institutions in Finland are actively engaged in ongoing research into the health benefits offered by wild berries. Consumption of wild berries is very high in Finland and they are known to have many healthy properties:- Antioxidant, Anti-carcinogenic, antiviral, antibacterial, anti-inflammatory, antiallergenic

Blaeberries `are extremely rich in potassium and phosphates. They contain a good quantity of magnesium, calcium, manganese and iron compounds, too. Vitamins found were: carotene, vitamin B1, vitamin B2, nicotene-amid and vitamin C.`

`It was reported that the sugar-content, which dropped enormously in cold and wet seasons, reached more than 10% in sunny weather.`²

Dried blaeberries are used in Sweden to treat childhood diarrhoea. This use is attributed to the anthocyanoside content, which is a substance found in blaeberries believed to be effective against E Coli bacteria.

Essential oils of wild berry seeds contain healthy fatty acids, and wild berries are also rich in soluble and insoluble fibre. Blaeberries contain some of the highest levels of these fatty acids. Soluble fibres such as pectin and lignan have a positive balancing effect on the level of cholesterol and sugar metabolism. Lignans also appear to play a role in the prevention of cancer and osteoporosis.³

`Every autumn, Finnish children get a day off lessons to pick wild berries and take them into school, where they are emptied into enormous deep freeze rooms. The schools stock up with berries for the long winter months ahead when the children then benefit from regular healthy desserts.` The Finns, as a whole, consume a lot of wild berries. Cancer rates in Finland have dropped by more than 60% in the last 25 years.⁴ From having one of the worst health records in Europe – as bad as the Scots – they now have one of the best. It is more than probable that their imaginative approach to health promotion has enabled the Finns to improve their health so dramatically.

EUROPEAN COMPARISONS

Germany used to import a considerable quantity of blaeberries from **Poland**. Blaeberries, of course, grow in Germany, too, but Poland had developed an industry out of exporting blaeberries, probably because of lower labour costs and greater forest cover, particularly in old-growth forests, of which there are more in Poland. Borówka is commonly used in Poland as a place name, or as part of one, and means blaeberry – so it is perhaps little wonder that Poland used to be a major exporter of blaeberries. Today there is a small domestic market for Germany's own blaeberries in Germany, but the import of Polish blaeberries has suffered from the burgeoning export of blueberries from North America, and from European cultivation of blueberries. Poland itself has been cultivating highbush blueberries since the 1970s – trials were first conducted on land that had previously grown blaeberry! The import and cultivation of blueberries has adversely affected the market for blaeberry, although the latter is still the prime source for use in the pharmaceutical industry, because of its much higher levels of desired active ingredients.

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Dr. W. Heermann was the first researcher in Germany to scientifically investigate fruit production in a species of the genus *Vaccinium*. At the end of the 1920s he selectively bred blueberry 'to increase the quantity and quality of the yield'. 'In the course of his efforts, he became acquainted with the American large-fruit and high growing *V.* species as well as the results of the selection and breeding work being carried out on these species there. Realising that he could never achieve such success with the *V.* species available in Germany, he halted his experiments. Heermann was supplied with a large number of *V.* species from all over the world and carried on his breeding work with them.' However, cultivation of blueberries did not really take off until after the war, when highbush blueberry gradually became more popular.

The main problem in cultivating the American highbush blueberry in Germany, as in other European countries, has been the fungus *Godronia cassandrae* Shear, or *Fusicoccum putrefaciens* Peck, which causes the shoots to die, to the extent that plant growth is severely inhibited. Quantities of fungicides are used to try to mitigate this problem.* In addition, there is a 'problem warding off birds' from blueberry.⁵

A 'lack of pickers' was the universally cited reason for under-exploitation of wild berries in Germany.⁶

Poland

Polish tenure legislation allows free access to the state owned forests with the exception of protected areas. Local communities are allowed to collect forest fruits for their own consumption and for small-scale commercial benefit. The state forests represent 80% of forested areas. State forests were excluded from the reprivatisation of 1999. While Poland possesses fragments of original primeval forests, it also has some of the most degraded land in Europe – with forest areas which have been chemically poisoned by atmospheric deposition of industrial pollutants. Through high resolution satellite imaging, it has recently emerged that vast areas of land within forests have been devastated by the huge military complexes located within them. 'For many years this terrain was counted as forest in official statistics, although there were no trees left.'

The only shop-bought blueberries that I have been able to find were bottled blueberries from Poland, in a supermarket in the north of Scotland! I contacted a wholesaler of country wine ingredients, who informed me that they had ceased to import dried blueberries, because they regarded them as too expensive. They were previously retailed at £8 per pound, and were sourced from Poland.

There is considerable exploitation of blueberry in **the Scandinavian countries**, where wild berries play a highly important role in the rural economies. The main yield of Sweden's foremost household berries (cowberry, bilberry, cloudberry) has been calculated to be 485 million kg. The corresponding figure for Finland for an average year is 450 million kg but it can be 730 million kg in a good year. The value of edible wild berries amounts to about 450 million Finnish marks (100 million U.S. dollars).

* With Scotland's wet climate, this canker has been even more of a problem. Even 50 years after the first trials of highbush blueberry were conducted in Scotland, there are still only a handful of commercial growers, most of whom grow blueberries in polytunnels.

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In Sweden and Finland, there is a right of access to the outdoors, where people can pick wild foods – there are more restrictions in Denmark, Norway and Iceland. Income from the sales of these wild foods is tax-free in Finland, which is not the case in Sweden, but it is possible to sell up to 5000 Swedish kronor (670 U.S. dollars) per person without paying tax in Sweden.⁷

Blueberries are cultivated in Scandinavia, with varying degrees of success.

Norway does not have a large trade in wild berries, but there is considerable domestic use of wild berries, although the most popular of these are cowberries and cloudberry. This may not seem to have any economic importance, until one considers the costs of importing food into rural communities. There was some experimental work undertaken some years ago on the cultivation of blaeberry, but this was not a success.⁸

Norway has 125,000 forest holdings, averaging 50 ha in size, of which about 120,000 are family owned (80%). Municipalities own 4%, 12% of forest holdings are state owned, and 4% are owned in common. Almost 50% of farm forest holdings in Norway receive more than 50% of their total income from farming and forestry. The forest owner associations provide forest management plans for their members. The Nature Protection Act legislated for public access to all forested and non-cultivated land in Norway. The public may `pick berries, wild mushrooms, walk, put up tents, and participate in other outdoor activities.`

Blaeberry is an important complementary income for those living in the sparsely populated northern parts of **Sweden**. Boreal coniferous forest, in which blaeberry forms the field layer, is the most common forest type in northern Sweden, covering approximately 27% of the forested area. About 250 million kilos of blaeberries are produced each year in Swedish forests, about 7% of which is picked for human consumption. Roughly 6-8,000 tonnes of blaeberries are gathered for sale each year in Sweden. People come from Russia, Poland and other countries to pick berries in Sweden in autumn to augment their income.⁹

A growers' organisation `is in the process of being set up` in Sweden¹⁰

Finland has by far and away the most organised system of exploitation of wild berries. There are over 440,000 forest owners in Finland, out of a total Finnish population of about 5 million – roughly the same as Scotland, but in an area larger than that of the U.K.. Most Finns live in the south of the country. In terms of latitude, Finland begins where Scotland ends, so it is not surprising that `there is frost even in the middle of the summer in all parts of the country`. Blueberries are grown in the south of the country – researchers have tried various means of improving their hardiness, including crossing with bog bilberry, which is native to Finland. It is impossible to cross blueberry with blaeberry because they possess different numbers of chromosomes. Attempts to cultivate blaeberry have been abandoned because it is just not worth the trouble when it grows so well in the forests!

In practical terms, Finnish wild berries are organic: more than 95% of Finnish forests are not fertilised and use of pesticides is illegal, although certification is a problem, because of the sheer numbers of forest owners. About 50 million kilos are picked

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annually, of which 35 million are for domestic use, and the rest are sold commercially. Nearly 4 million kilos are exported. The most important wild berry is the cowberry (or lingonberry, as it is frequently called) – 25 million kilos are picked each year, of which 9-10 million kilos are sold commercially. Blaeberry is the next most important berry – 15 million kilos are picked, of which 3-5 million are sold commercially.

67% of Finnish adults pick wild berries, and, as can be seen by the figures above, they consume a lot of them too. Under Finland's Everyman Rights, anyone can pick berries on anybody else's land. 'Natural forest products, including edible mushrooms and berries, are made use of by almost every Finnish family, especially in Lapland and Kainuu, where the gathering of such produce has a significant economic impact'. The most important part of the market is Individually Quick Frozen (IQF) berries for the jam industry, but other products, such as berry juice concentrates, are produced. However, the marketing power of the North American blueberry industry has had its effect even here and 'both exports and imports have increased and domestic berries have lost their market share to imports in domestic use.'¹¹

It has to be remembered that, even with Nokia, Finland still has higher per capita earnings from forestry products than anywhere else in the world and is Europe's most forested country. Forest is an integral part of a Finnish farm. The Worldwide Fund for Nature has placed Finland second only to Switzerland in a ranking of best practice amongst European nations for care of their forests. Forest ownership in Finland is highly dispersed. Of the total area of forest, private families own 62%. Of this 62%, only 18% is owned by farmers, with 17% belonging to wage earners and 21% to pensioners.

NORTH AMERICAN 'COUSINS'

There are 26 species of the genus *vaccinium* that grow in North America. Four of these species are cultivated:- cranberry (*vaccinium macrocarpon*), highbush blueberry (*vaccinium corymbosum*), lowbush blueberry (*vaccinium augustifolium*) and rabbiteye blueberry (*vaccinium ashei*).

North America has nearly 90% of the global production of blueberries. The blueberry (*Vaccinium* sect. *Cyanococcus*) is the most recent major fruit crop to be cultivated; improvement through selective breeding did not begin until 1909. As Vander Kloet made clear, blueberries have filled both an agricultural and economic niche:- 'The North American blueberry industry currently makes use of more than 10,000 hectares of acid, badly drained soils that had been previously classed as agriculturally worthless.'¹² The optimum pH for lowbush blueberry soils is 4.5.

The highbush blueberry grows to about 10 feet high. The berries are larger than the lowbush berries. 'Highbush blueberries typically begin commercial production in the third season, with yields increasing annually for the next four years. At full capacity, blueberries yield as much as seven tons per acre, though three to five tons per acre is more realistic. As blueberries are expensive to establish and maintain, growers seldom realise a return on capital investment until the seventh year.'¹³ Those blueberries that are sold fresh in U.K. supermarkets are mainly highbush.

The southernmost of the cultivated blueberries is the rabbiteye blueberry, which is native to the southern states of the U.S.A.. It is a shrub, growing up to 15 feet high.

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Rabbiteye blueberry accounts for a very small, but growing, proportion of the overall blueberry crop.

The `wild`, or lowbush blueberry is cultivated from wild stands, hence its name. Before the first European settlers arrived, the indigenous peoples maintained blueberry `barrens`, or fields, by burning, to encourage the blueberries to spread and to keep the forest at bay. Lowbush blueberry has been commercially exploited for more than 100 years. Lowbush blueberry is pruned by mowing or burning on a two-year cycle, in either the spring or the autumn. The first year after pruning produces vegetative growth, but no fruit. There is more fruit produced in the second year after burning or mowing than if left alone. It is usual to prune half of the field area in any one year, to obtain a crop on a yearly basis. Today, mowing is the recommended way to maintain blueberry fields, because of the deleterious effect that burning has on the organic matter, or humus layer, which blueberry is so dependent on for its good health. If burning is carefully carried out, however, it can help control pests and eliminate some of the competition from invading trees and wild flowers. It is still recommended to burn blueberry fields at least every 6 years or so, for this reason. Lowbush blueberry grows to about 4-15 inches under this maintenance regime, and the berries are either harvested by hand, or by hand rake, or by harvester [see [Photo 2](#)]. The harvesters need a reasonably level field, free of large stones, in which to harvest the berries. `Mechanical harvesters ...are used on less than ten percent of the fields in Maine.` - because of the stoniness of the ground, including huge boulders left by glaciation¹⁴. Mechanical harvesting is, of course, very much cheaper for a large operation, although it means that unripe berries are also harvested, as well as considerable quantities of leaves and twigs, which then have to be winnowed out. It also tends to squash a bigger proportion of the berries. Abandoned farmland is considered the best land for potential blueberry production, because it has been cleared of tree stumps and stones, which are time-consuming and expensive to remove - even though blueberry likes growing on or around tree stumps. It can take up to 10 years to establish a field of lowbush blueberry. The soil in lowbush blueberry growing areas like Nova Scotia is extremely poor.

Today, most lowbush blueberries receive doses of chemical fertilisers, herbicide sprays, to try to eliminated competition from `weeds` and therefore help the spread of the rhizomes over the whole field, and pesticides to deal with pests such as maggot. Because of decreasing numbers of wild bees, it is now necessary to place hives of honeybees in the fields, to ensure adequate pollination of the crop. It is mainly the smaller growers who are continuing the traditional techniques that are fully compatible with organic husbandry.

However, even the organic growers are affected by the fall in the numbers of pollinators. Jamy Lasell's beehives were knocked over by a moose, which didn't do too much damage, but the family of bears that tore the beehives apart later did! Thankfully, because he is an organic grower, there were enough of the other insect pollinators to finish the job of pollinating the blueberries.

[Blueberry Economics](#)

Because of the nature of their soils, all of the lowbush blueberry growing areas are poor, relative to the countries to which they belong. Atlantic Canada (Nova Scotia, Newfoundland, Prince Edward Island & New Brunswick) is Canada's poorest region.

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“Very large parts of Atlantic Canada are still working at almost subsistence level.” according to David Cameron, Head of Political Science at Dalhousie University, Halifax. Indeed, while I was over in Nova Scotia for my study tour, it was impressed upon me that the rural economy of Nova Scotia would collapse without the blueberry industry. Washington County, the main blueberry growing area in Maine, is the poorest county in Maine, and is almost entirely dependent on blueberry.

However, it is very clear that there are some who benefit much more than others. Blueberry farming reflects ownership patterns in U.S. farming. Even in Nova Scotia, 80% of the crop is produced by 10% of the growers. In 1967 52% of the crop was produced by 10% of the growers. Given that some of the growers have very low acreages, this trend is perhaps less surprising. However, there is a definite concentration of ownership in the hands of a relatively small number of individuals and companies, some of whom own processing plant as well. The chief example of this is the Bragg Lumber Company, who have diversified into blueberry growing, processing (they have IQF plants in both Nova Scotia and Maine), and also manufacturing of harvesting machinery.

Smaller growers in Maine have formed a co-operative to process and market their produce at the quality end of the market. They have taken the decision to convert to organic as much for economic as for environmental reasons. It has been the practice for the processors to mow the blueberries for some of the smaller growers, and to apply fertiliser, the subsequent herbicides and pesticides, and even harvest the crop. The fee for these services is then deducted from the sale of the crop. One grower told me of their decision to convert, the year that they received only 23 cents profit from their 16 acres of blueberry field - from which they now make around \$5,000 profit.

According to the smaller growers, there is a crisis in North American farming. As in the U.K., it has to do with the prices being paid for crops. Unfortunately, blueberry is a commodity crop, because it can easily be processed by freezing and shipped in bulk. Those who control the market through their sheer buying power have the capability to conduct a price war and drive mass market prices down to the level where they fail to cover costs of production. They are then in a position to buy out those smaller producers who can no longer make ends meet.

Those smaller growers who survive do so by selling in a niche market. Bill Nicholson in Cape Breton markets his blueberries through an organic marketing company which is based in the Halifax conurbation. He set up his own company, with himself as the majority shareholder, which enabled him to apply for grants and low-interest loans for processing machinery. Bill is the kind of imaginative entrepreneur we all love to read about. He showed me a digger that he had found abandoned and had `recycled` to clear forest for blueberries. In his pre-retirement career, he had obtained the Canadian licence for a U.S. innovation in maple syrup production, because he readily appreciated that a system of collection tubes for maple syrup production was a lot more efficient than buckets! In the year prior to my visit, Bill's company had put \$10,000 into the local economy – from 30 acres of blueberries, half of which yields a crop in any year. This was achieved, by Bill's own admission, with less than perfect management of the crop.

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It is astonishing to consider that Jamy Lasell, who markets direct to the consumer, charged only \$2 per pound last year for his organic blueberries. Compare this with U.K. supermarket prices of £7 (c. \$10) per pound for fresh, non-organic blueberries. However, on 7 ½ acres, he produced 112,000 pounds of berries – admittedly, a good harvest year. Revealing a mastery of understatement, he said, “It’s a lot of berries to move without a packing plant.”

Gramp’s Farm harvest blueberries from early July through to late September. Tom and Holly Taylor-Lash use mowing (Holly uses a lawn mower!), as opposed to burning, and they use an acidic mulch, and ‘not much else’. The Taylor-Lash’s market direct to the consumer, and through ‘the MOB’ (Maine Organic Blueberry Cooperative). Apart from selling hand picked (top quality), as well as handraked, blueberries, they produce a value-added product known as blueberry ‘leather’, which is just strips of dried blueberry – very tasty, and the perfect food for posting.

Lowbush Blueberry Facts

- Over 95% of the crop in Nova Scotia goes for processing. 99% of the crop in Maine is processed by freezing – which adds about \$70 million annually to its value.
- Maine has 60,000 acres given over to cultivation of lowbush blueberry. Maine is the largest producer of lowbush blueberries in the world, producing 98% of the U.S.A. crop, and half of the North American crop. Lowbush blueberries now represent over half of all North American blueberry production.
- The ‘wild’ lowbush blueberry is both the official Provincial Berry of Nova Scotia and Maine’s Official State Berry.
- Nova Scotia, Newfoundland, New Brunswick, Prince Edward Island, Quebec and Maine are the major centres of lowbush production, but there are also extensive stands in Michigan, Minnesota, Wisconsin, New Hampshire and West Virginia.
- ‘Lowbush blueberries are produced on 42,000 ha of native stands in Maine and in the Maritime Provinces and Quebec.’
- ‘More than 2 million kg of blueberry fruit is harvested annually in New Brunswick, of which 30 percent is velvetleaf blueberry.’, a completely different species.
- Organic lowbush blueberries are primarily supplied from wild stands of the berry that are hand picked in Quebec.

Blueberry Ecology

Vander Kloet could not have put it better when he wrote: ‘A major problem confronting a student of *Vaccinium* is the delimitation of species.’ Lowbush has ‘extreme plant to plant variability’ such that it is ‘extremely difficult to establish valid field experiments.’ In addition, there is at least one distinct variety of lowbush blueberry which is black! *Vaccinium augustifolium* f. *nigrum* has ‘blue-green leaves and black, shiny berries. In range and habitat it tends to increase more rapidly with repeated burnings. It has the same characteristics as common lowbush, except fruit is black with no grey casting.’¹⁵ [see Photo 3]. In terms of taste, it is reckoned by some (including myself) to be superior to the ‘normal’ blueberry.

‘The original plant, with its spreading rhizome system, is referred to as a clone. Each clone is genetically different from neighboring plants. Clones will vary in size, but the area they cover is related to their age; the younger clones cover less area. An average

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clone will cover from 75 to 250 square feet. An acre of wild blueberries may contain 200 to 500 clones. [see Photos 4, 5 & 6]. Some clones are much more productive than others. There are now 'select clones' of lowbush blueberry, which have been developed in both Nova Scotia and Maine.¹⁶

Lowbush blueberries form a substantial part of the diet of the black bear, chipmunk and other species. Robins are considered a pest on the blueberry barrens of New Brunswick, because of their fondness for the berries, and Deer, elk, hares and rabbits browse on the twigs and leaves.¹⁷

In wild populations, yield is a function of pollinator density and self-incompatibility. According to Hepler and Yarborough, Lowbush blueberries can set up to 100% of their blossoms, but set in the field seldom exceeds 40% with native pollinators and 70% when supplemented with honeybees.¹⁸ However, it should be taken into account that in many parts of the eastern U.S.A., widespread use of insecticides has decimated populations of wild bees which formerly pollinated blueberry fields. In some locations, it is now necessary to supplement natural pollinators with honey bees to ensure adequate fruit set in commercially managed fields. The Forest Ecology Network of Maine, is campaigning, amongst other things, for an end to pesticide use in Maine's forests. Vermont has legislated for the end of pesticide use in forests. Clearly, there are other industries that need to look carefully at their use of biocides.

Velvetleaf blueberry is diploid (24 chromosomes). Lowbush is tetraploid (48 chromosomes). Where velvetleaf grows in a field of lowbush blueberry, it will reduce the yield, because pollinators do not make a distinction between them. Wild plants of the highbush blueberry, *Vaccinium corymbosum*, are also found along lakes or ponds adjacent to managed wild blueberry fields and occasionally will cross with the lowbush plants to produce a hybrid that has characteristics of each plant. Indeed, I photographed such an apparent hybrid on Bill Nicholson's land in Cape Breton. Bill also grew half-high blueberries, which are a cultivated hybrid of highbush and lowbush blueberry.

ECOLOGY OF BLAEBERRY

Geographical Distribution and Habitat

Blaeberry (*Vaccinium myrtillus*) is one of 450 species belonging to the genus *vaccinium*. According to British botanists such as Ritchie, it grows only in Europe and North Asia, although North American sources (Vander Kloet, Camp, etc.) maintain that it also grows in Greenland and North America. Vander Kloet states that there are 2 disjunct populations of *myrtillus* in the Rocky Mountains – one in south east British Columbia to central Oregon, the other in central Colorado, adjacent Utah, north-central New Mexico, and southern Arizona. It is reckoned that blaeberry migrated to Greenland from Europe as an ancient European introduction.

Blaeberry is more common in the west of its European range. Ritchie describes it as being of local occurrence in the heaths of the southern Uplands of Scotland, becoming very common in the moors and woodlands of the Highlands. He also stated that it was not common in Caithness, Orkney & Shetland, which is contrary to what I have been told by the BSBI Vc Recorder for Orkney and Shetland.* It is found at all levels from sea-level to 1300m, although the stems are unable to carry more than one

* the person who collects local records of plant occurrences for the Botanical Society of the British Isles

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berry at altitudes of over 1100m,¹⁹ which is unsurprising given that few flowers are formed in exposed habitats above 1000m.

Ritchie states that blaeberry 'shows its maximum vegetative and reproductive performance in woodlands, generally open pinewoods of the natural and semi-natural forest areas of Highland Scotland, such as in the upper Dee and Spey valleys. ... In woodlands dominated by the sessile oak (*Quercus petraea*) it is an important associate of the vegetation'.²⁰ Nothing illustrates the true ecological niche of blaeberry better, than the height to which it grows in different habitats: in the field layer of pinewoods and oakwoods it grows to a height of 60-90 cm; in lowland heaths and drained bogs the average height is 25 cm, and on montane summits and exposed cliffs it is rarely taller than 5 cm. Because blaeberry will tolerate open conditions, there is frequently an assumption that moorland is its 'natural' environment.

The most important factor determining distribution and relative abundance is the soil in which blaeberry grows. According to Ritchie, 'It is found on all major soil types of acid reaction with the exception of those developed over sand dunes'. Occurrence and abundance of the plant 'are closely controlled by the drainage and proportion of organic matter in the soil.'

Plant Biology

Blaeberry has been known to cross with cowberry, which is also diploid (chromosome number $2n=24$).

Blaeberry is a clonal plant. Seedlings do not develop rhizomes and shoots do not produce berries until the third year at the earliest. Buds and flower buds overwinter. Seed setting and berry formation follow pollination by 2-4 weeks. Development of root systems occurs in spring & autumn – rhizome growth and branching is most vigorous at these times. Ritchie notes that new leafy shoots sprout in March – April, although I have observed this happening well into June, after a particularly late start to spring.

'Flower-Ellis (1971) found that bilberry colonies expanded radially at a rate of about 7cm per annum (the rate of rhizome growth may be greater) that aerial shoots had a maximum age of 15 years, and that the maximum age attained by rhizomes was 23-28 years.'²¹ The rooting system in the blaeberry is almost entirely adventitious, with a working depth of between 2-13 cm and a maximum depth of 17 cm. Root, and therefore nutrient, competition is also clearly a factor in the success, or otherwise, of blaeberry. The roots of heaths and cowberry compete below ground level with blaeberry, because they are of the same ecological type – that is, relatively shallow systems with a considerable lateral spread.²²

Ritchie has demonstrated that 'the flowers are both insect and self-pollinated, and that the former is the more common method.' Due to the nature of its clonal distribution, the way that it is pollinated by insects and the fact of self-pollination by gravity and the wind, blaeberry has been described as 'an habitual inbreeder.'

There is conflicting information on whether heat or cold improve the germination prospects of blaeberry. In the Scandinavian research, a moderate amount of heat was

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found to improve germination, but in the British research, the results were inconclusive. Danish research has found that blaeberry's chances of germination are improved after passing through the gut of certain birds.

Ritchie could give no information on diseases, although there are many and varied animal feeders or parasites & plant parasites on blaeberry. Common and Wood Cow Wheat are partially parasitic on the roots of blaeberry, as well as other plants. It is an important food source for herbivores such as red deer, especially in the winter, because of the nutrients it contains. Blaeberry is also an important food source for ptarmigan, red and black grouse and capercaillie, as well as small rodents, such as voles and mice. Of course, blaeberry also provides pollen for bees and other insects.

Grazing & Regeneration

Yalden and Anderson concluded that the 36% loss of heather and blaeberry moorland in the English Peak District between 1930 and 1976 was the 'cause and effect' of a trebling of sheep numbers over that period. They also noted that grouse numbers had fallen to roughly a third of their 1930s level, although effects on wildlife in general were undocumented. Most interestingly, they observed that qualitative changes in vegetation 'are less apparent with heather, which either thrives, under light grazing, or is suppressed, by heavy grazing.' whereas blaeberry 'can survive as a short, tightly grazed 'turf'.' Photographs of the area from 1913 'suggest that bilberry formerly existed as luxuriant tussocks, a growth form nowadays most evident on ungrazed roadsides' [see Photo 7].

Anecdotal evidence supplied to me, particularly by those who were children in the pre-war years, confirms that there were more blaeberries to be picked on moorlands at that time, the numbers of sheep on heather moorland having increased overall since then. Yalden and Anderson's conclusions fit neatly with these memories, that blaeberry 'withstands moderate sheep grazing better than heather; although grazing reduces it to a tight sward which is barely able to flower or fruit.'²³

It is not merely grazing per se that affects blaeberry's fruitfulness. Tall heather will shade out blaeberry.²⁴ There is some recent interest in blaeberry because of its ability to survive the kind of grazing pressures that heather cannot and consequently to provide some sustenance for game birds, some of which are declining sharply in number. These grass and blaeberry moorlands are a particularly prominent feature in the south-west of Scotland, where they are known as 'white moorland'.

In two other studies by Rawes and Pigott, it had been assumed before the research commenced, that climate, altitude and soil had been the main factors controlling the poverty of vegetation in, respectively, blanket bog and oak woodland. (These studies began in 1966 and 1955 respectively, so it is clear that some scientific opinion, and the decision-making it influences, has only comparatively recently 'seen the light', in spite of the efforts of Fraser Darling and others.) Both studies demonstrated beyond doubt that sheep grazing was the only limiting factor. The usual stocking rate for sheep in upland Britain is one sheep per 1.5 hectares, and yet the rate at which heather maintains its status is one sheep per 2.5 hectares. This is most probably why there has been an ongoing shrinkage of heather moorland in the U.K..

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Photo 7



Photo 8



Photo 9



Photo 10



Photo 11



Photo 12



Photo 7 Blaeberry and heather along roadside fence, A713 Dalmellington to Carsphairn.

Photo 8 A classic illustration of the effects of sheep grazing over a period of time. Behind the fence extensive marsh grass and other coarse grasses, in front of the fence blaeberry and heather.

Photo 9 Woodland regeneration without stump treatment – blaeberry growing on a rotten tree stump, South Ayrshire.

Photo 10 Pine needles – another favourite growing medium for blaeberry - Carrick Forest, Ayrshire.

Photo 11 Residual blaeberry growing along field boundary fence, Auchinleck Estate, Ayrshire.

Photo 12 Blaeberry growing in woodchips, Black Wood of Rannoch.

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In Rawes' study, it was noted that coverage of cloudberry, which is notably rare in Britain, 'increased spectacularly' when sheep were fenced out. Pigott's research revealed that birch leaves, which collected in the tall swards of grass, both smothered it and provided blaeberry with the humus-rich conditions in which it thrives. The grass, of course, was no longer being cropped by sheep. Where blaeberry and cowberry had shared equal prominence, in a fenced, sheep-free environment, blaeberry was able to completely dominate its shorter relative. In four years, blaeberry shoots increased in height from 1-2 cm to 25-40 cm. The percentage cover of blaeberry increased yet more spectacularly from less than 1% to over 50% in nine years. Pigott's study also noted a change in soil structure, with fine tree roots developing in the fenced woodland. This would undoubtedly assist in the spread of blaeberry because of the increase in soil aeration, as against the soil compaction caused by sheep trampling and the absence of tree roots outwith the enclosure.²⁵

Hester, Miles and Gimingham noted that clipping reduced the growth of blaeberry, and point out, moreover, 'it is well known that ...different grazing animals can have different effects on plants, e.g. due to different selectivity or different pulling or cutting of the plant material.' It is widely accepted that sheep are more selective feeders than cattle, and so can destroy all but the coarser grasses.²⁶ [see Photo 8] Hobbs and Gimingham discovered that both the severity of a muirburn, the age of heather stands and the immediate vegetational composition after a fire are the determining factors as to what the future vegetation will be. Blaeberry, as with its American 'cousin', the lowbush blueberry, is capable of regenerating from its seeds or underground rhizomes, provided the burn is neither too hot nor too prolonged.²⁷

Forestry practices

Blaeberry does not do very well after clearcutting. It can maintain a margin around trees, but it will quite quickly disappear elsewhere. Although there is some dispute amongst British ecologists as to whether or not blaeberry forms seed banks in forests, the work of Granstrom and others in Sweden have shown that it does. The apparently conflicting results would seem to lie with some of the assumptions made by British scientists, some of whom have not taken account of the absence of fruiting blaeberry on hill pasture, or the different ecological structure within semi-natural forests (especially soil structure), which Granstrom asserts is not fully understood. It is certainly the case that blaeberry relies more on vegetative spread than on sexual reproduction, but its seed has no problem in germinating and growing into seedlings, given the right conditions. Granstrom found that blaeberry regenerated 'sparingly' on scarified ground on clear-felled areas. It does not appear to form seedlings on burned ground, nor are seedlings found in mature, closed forest, although seedlings may be found in mature forest after local disturbance by small rodents. In many clonal species, disturbance, in the form of fires or removal of the field layer, is required before seedlings will establish themselves. Darkness and low temperatures are believed to prevent germination of seeds in the forest, and lack of light has been reported as the main factor controlling germination of both blaeberry and heather (*Calluna vulgaris*). It has also to be remembered that blaeberry is an important food plant for many species, and predation of berries will undoubtedly be of importance in nature. Blaeberry is popular with the members of the grouse family, especially the capercaillie, which is in serious decline in Scotland. Experiments conducted in Denmark have shown that voles are major predators of blaeberries (as well as eating the rest of the plant), and excrete few viable seeds. Blaeberry seeds germinated more

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rapidly when passed through the gut of black grouse, and the `total germination rate was highest for seeds passed through fieldfares` - a member of the thrush family. The time at which the berries were gathered also influenced the germination rate.²⁸

Tree stand density is closely correlated with closure of the crown canopy, which influences illumination of the forest floor. Stand density is more easily calculated, and is therefore the means used to estimate light levels within the forest.²⁹ The Russians recommend regular and intensive thinning of pine stands for encouraging plants such as blaeberry.³⁰

Population Ecology

Some research in Finland has focused on the question of whether or not blaeberry utilises phenolic compounds as a defence mechanism against herbivores, such as voles, which have highly cyclic population fluctuations. The conclusion of this research was that the population fluctuations are correlated with availability of food supply, and that the level of phenolic compounds is determined, in the main, by summer temperatures. Periodic grazing may be responsible for compensatory growth, utilising nutrients stored in the rhizomes.³¹

Factors affecting yields

According to research in Russia, the main meteorological factors affecting yields of blaeberry are `late springs, night frosts and cold rainy weather or dry soil during the ripening of the berries.`³² Frost during flowering seems to be the single most important factor governing yields. Cold weather at this crucial time is also a key factor, as it decreases the activity of insect pollinators. Indeed, blaeberry does not begin to flower until the mean daily temperature is roughly 10 degrees C. Blaeberry yield is more stable in pine stands, and moist stands of pine and birch produced the largest berries. Transition areas between drier and wetter forest types were observed to give higher yields.

Blaeberry is more frost resistant in January and February than at other periods, and at that time it is more frost resistant in southern, as opposed to northern, Finland. This is most probably because of the protecting effect of snow cover, which would be consistently greater in northern Finland. Other research has found that blaeberry buds are destroyed completely at temperatures of -32 to -34 degrees C.³³

Fortunately for Scotland, heavy rain does not appear to affect flowering, or indeed yield, of blaeberry. Wallenius reckoned that the individual meteorological variables explained about 25% of the yield variations of both blaeberry and cloudberry. Further, that these results `demonstrate the complexity of the phenomena influencing the yield of berries` which is `influenced by several factors and their mutual effects.` For wild berries as a whole, it was thought that `Scanty yields could also be caused by changes in forestry methods`. The sharp decrease in yields of cloudberry in Finland was attributed to the draining of 5.2 million hectares of peatland in Finland, subsequent to the Second World War.³⁴

Plant Nutrition and Resource Allocation

Berry production reduces the amount of growth in those shoots that produce berries. Growth declines with the age of a branch, with the newer ones allocating more of their resources to this function. Fertile branches seem to branch from those that grow

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more vigorously in the previous summer than the sterile ones. Shoots must be three years old before they start to produce berries. Deciduous shrubs, such as blaeberry, transfer nutrients into their rhizomes and roots in autumn and mobilise them again when their leaves open in the spring. Grazing will prevent such back-translocation of nutrients and affect the reserves available for the following year.³⁵ The way that amino acids are stored helps the overwintering of blaeberry.

Research on the role of mycorrhiza* in the nutrition of heather and American cranberry has indicated that they play an indispensable role in the supply of nutrients to their host plants. Blaeberry also has mycorrhiza, upon which it is equally dependent. In the family to which all of these species belong, the Ericaceae, 'mycorrhizal infection is consistently present'.³⁶

Blaeberry has much variety within the species, although no sub-species have been identified. It tends to have shorter stems, which are more flexible, at higher altitudes. Even when transplanted to laboratory conditions, the higher altitude blaeberry retained these features.³⁷

From my own observations, I have noted that blaeberry will often grow on old, decaying tree stumps [see Photo 9]. It has been noted that cowberry will grow on both tree stumps and ant hills. Wood ants (which are increasingly scarce) build nests made of mounds of dead leaves, pine needles and twigs. Although I have not observed any blaeberry growing on ant nests, I have observed that both cowberry and blaeberry grow extremely well in thick pine needle and leaf litter [see Photo 10]. Blaeberry grows in clumps, on hummocks. It has also been known to grow on top of sphagnum hummocks.

Blaeberry requires both ammonium and nitrate as sources of nitrogen, in about the same concentration as for birch seedlings, although it is more sensitive to high salt concentrations and has a lower requirement for potassium. Forest fertilisation seems to have at best a small, and at worst a negative effect. As forest fertilisation involves relatively large applications of fertiliser, this would explain its 'discouraging effects' on blaeberry. Any fertilisation would have to involve small, frequent applications with plenty of water, to avoid too high a concentration of salts in the soil water. As I know that the Swedes do use fertiliser in their forests, while the Finns do not, this may be an additional explanation for the greater relative importance of wild berries in Finland as compared to Sweden. This also explains why it sometimes can be seen growing outside of arable field boundaries, but fails to spread within the fields [see Photo 11]. Furthermore, other researchers have found that blaeberry faces a double disadvantage, because fertilisation promotes the growth of those plants that compete with it. Blaeberry is noted for its ability to withstand drought, and so therefore has less need of potassium. Ingstad inferred from his experiments on blaeberry that, if it were to grow in soils with too high an availability of calcium, this would affect its drought resistance.³⁸

Apart from deforestation, there is one considerable difference between the ecology of blaeberry in Scandinavia and in the British Isles. The latter has an oceanic, as opposed to a continental, climate. In the more oceanic parts of these islands, blaeberry is capable of net photosynthetic gains during winter. 'There is some evidence to suggest (Stewart, 1971) that lowland *V. myrtillus* may show a substantial increase in

* fungi which have a symbiotic relationship with some plants, through their root system

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carbohydrate content during the winter by the photosynthesis of its stems. Moreover, Pisek et al. (1967) have shown a minimum temperature of between -3 degrees C and -5 degrees C for positive net photosynthesis in *V. vitis-idaea* and *V. myrtillus*.

Even with our oceanic climate, heath plants such as heather have been shown to suffer large water deficits during late winter and early spring. The stems of blaeberry are highly resistant to water deficits. The most vulnerable time for blaeberry is during July, when the summer temperatures can desiccate the leaves.³⁹ Again, a woodland environment offers benefits over that of a moorland environment, because of shade from the sun and the drying effects of the wind, and the more moist atmosphere of a woodland microclimate. There is also research to suggest that blaeberry stems are short in habitats with abundant light.

Phenology

Considerable differences were discovered between southern and northern eco-types of blaeberry in Finland. An experiment was set up by transferring clones from the north and the south of Finland to a central location in the country. The clones retained their inherent growth rhythm and seasonal development even after transplantation to uniform environmental conditions. It was concluded that This showed the bilberry to be an extremely plastic species which can rapidly match its rhythm of seasonal development to new environmental conditions even without genetic changes. Possible regional differences in phenology* can therefore easily be hidden behind the bilberry's sensitivity to weather. Although latitude played an important role in the drought resistance and morphology** of blaeberry, the effects of longitude were only apparent amongst the southern eco-type. This was considered to be because climate in southern Finland varies more, in terms of moisture and temperature, between east and west.⁴⁰ It may very well be that there may also be some comparable differences between blaeberry growing in the west, to that growing in the east of Scotland. Indeed, blaeberry growing at sites of similar altitude in Argyll and Aberdeenshire were noted to ripen on the 25th July and 1st August respectively.⁴¹

Biodiversity

Native pinewoods have poor species biodiversity, when compared to other woodland types. Their ecological importance resides in the interrelations between species. Blaeberry fulfills a key function as one of the main species in the field layer, and, as has been noted, The abundance of *V. myrtillus* can be used as a surrogate indicator of wider biodiversity within pinewoods.⁴²

· the impact of climate on the seasonal development of a plant – flowering, setting fruit, etc.

** the form and structure of a plant

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DISCUSSION

Commercial Exploitation of Blaeberry in Scotland

The famous and highly successful **Baxters of Speyside**, one of Scotland's most enduring family firms, once made jelly from blaeberry, amongst other wild fruits. Mrs Kay Mitchell informed me - 'The Baxter family had a number of people locally involved in picking wild fruits and berries of all kinds for their fine quality jams and meat accompaniments during the 1950's.

The blaeberrys came not only from the Fochabers area but also Deeside. Mrs Ena Baxter used to join groups of local women and children in picking these fine fruits. The berries picked locally included wild raspberries, cranberries, rowans, lingonberries* as well as the blaeberrys. The blaeberrys were made into a delicious jelly by the process of cooking, then filtering the juice, which was then used to make the jelly. The recipes for all our products over the years are carefully guarded secrets!

New trends in eating and the changing market place brought an end to the use of wild berries picked locally in this small way. New product varieties were introduced to satisfy the modern consumers of the 70's and 80's. Larger quantities of berries were required to keep up with demand and it was necessary for the Baxter family to seek additional sources from around the country.'

The fact that Scottish blaeberry was commercially exploited in the past, by probably Scotland's most important, if not largest food company, should give the lie to any claims that blaeberry in Scotland is unsuitable for commercial exploitation. It is merely the fact that there is not currently enough blaeberry to meet the commercial demands of a company like Baxters.

Moniack Castle Wineries used to make a Blaeberry Wine but have ceased to do so, mainly because 'it was difficult to gather enough blaeberrys'. However, they do make Sloe Jelly, Bramble Wine and Rowan Jelly.

Highland Wildwoods sell trees and shrubs of Scottish provenance, including blaeberry. Blaeberry has mainly been sold to private individuals. The plants have been grown either from seed, or by cell culture.

Although I contacted other Scottish companies that claim to use blaeberry in value added products, they either failed to respond or were unable to confirm that they were using blaeberrys.

'A Blaeberry By Any Other Name', or The Problem of Terminology

English – Bilberry, Whortleberry, Whinberry, herts & worts

Scots – Blaeberry, blairdie, (child's word, from Aberdeenshire) blivert (Aberdeenshire)

Gaelic – braoileag, lus nan gnàithseag

French –la myrtille

German – die Heidelbeere – now sometimes differentiated from blueberry by calling it *Waldheidelbeere*, although they also have the word *Blaubeere*

Italian – il Myrtillo nero

Swedish – blåbär

* another name for cowberries

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Finnish – Mustikka

Latin – *Vaccinium myrtillus*

American English – dwarf bilberry, whortleberry & sometimes erroneously referred to as huckleberry.

Use of American English can completely confuse matters, even amongst those `in the know`. My North American email correspondents variously thought that *Vaccinium myrtilloides* (velvetleaf blueberry) and huckleberries were blaeberry, even though I assiduously used the botanical name of *Vaccinium myrtillus*. Continental Europeans (with some honourable exceptions, mainly amongst the Finns) are prone to describing blaeberry in their English translations as blueberry.

The North Americans use differing names for berries with gay abandon:

Vaccinium vitis-idaea (cowberry) is referred to as cowberry, lingonberry, mountain cranberry, lowbush cranberry, dry ground cranberry, etc.. *Vaccinium oxycoccus* (European cranberry) is referred to as small cranberry, bog cranberry and lowbush cranberry, the latter name is presumably to distinguish it from highbush cranberry (*Viburnum edule*), which is not a cranberry at all, but related to our own guelder rose (*Viburnum opulus*). Others denote *Viburnum edule* as lowbush cranberry, and *Viburnum trilobum* as highbush cranberry! Confused? Yes, I was!

Biodiversity, NTFP (Non-Timber Forest Products) and Agroforestry

The general consensus on Scotland's ecological history is that `the most significant factor` for the expansion of blanket peat had little directly to do with climate change. Far more significant was the clearance of woodland, due to human activity, which probably started around 8200, certainly at least 5300 years ago, and which has been continuing ever since.⁴³ Given that blaeberry is originally a woodland shrub – apart from the variety that inhabits the tops of mountains – it has done pretty well to survive this long. Ecological studies would seem to indicate that blaeberry has a better chance than many native species of surviving future climate change.

`The sparsity and isolated nature of woodlands in much of Britain, for example, restricts the movement of certain woodland understorey plants into new areas of colonizing woodland.'⁴⁴ Light intensity, whether for the benefit of blaeberry or not, has a crucial part to play in any succession from moorland to woodland. It would appear that blaeberry retains a capacity to adjust to the differing light levels between open moorland and woodland. Because blaeberry has managed to survive on moorland, it is only necessary to permit natural regeneration or to plant trees to have a ready made field layer which will only become more of an asset to biodiversity. Perhaps we have viewed native woodland conservation and expansion from the wrong perspective. The understorey of a forest is not merely an added benefit to an increase in trees, but could provide the best excuse and economic justification for their regeneration or planting in the first place.

With the honourable exception of Humphrey & Coombes, all of the British research that I have been able to review covers blaeberry in moorland, or regenerating woodland. Scandinavian research covers forest growing blaeberry, but not that growing in deciduous forest, which constitutes a large portion of Scotland's remaining native woodlands. Indeed, the famed Caledonian pine is overwhelmingly restricted to the Grampian area.

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The importance of the herb and shrub layer in woodlands has been stressed for a number of years, but little of practical benefit appears to have happened from this. The Forestry Commission, however, are experimenting with transplanting blaeberry at Millbuie, in the north of Scotland. 'In situations similar to Millbuie where *V. myrtillus* is scarce, considerable benefits to biodiversity could be gained by encouraging its spread by artificial introductions and crop thinning (Humphrey 1996).' It is heartening to know that progress is being made for blaeberry and other forest fruits. Whilst trees are obviously an indispensable part of any forest habitat, so too are its plants*. Blaeberry and other forest fruits have therefore a crucial part to play in any future plans for biodiversity of Scotland's woodlands, whether expansionist, or merely reservationist.

There appears to be little realisation in the U.K. of the potential of forest fruits within the context of non-timber forest products. Of the recent consultative documents on forestry strategy and policy, there have been no references in any of them to forest fruits as a part of NTFP development. NTFP awareness within the U.K. is not well developed, although the profile of Agroforestry has evidently increased in recent years, with the publication of a bulletin on the subject by the Forestry Commission in June 2000 and the establishment of the U.K. Agroforestry Forum. There is also the Agroforestry Research Trust (www.agroforestry.co.uk), who advise growing blueberries in an agroforestry system, but have no information about blaeberries or other forest fruits. The distinction to be made is that agroforestry at the moment concerns itself with the cultivation of (usually) non-native crop species within a wooded environment.

Scotland's oceanic summers could be more of an advantage than we think in growing blaeberry, and other forest fruits. The chances of late spring frosts damaging the flower buds are considerably less in Scotland. In the southernmost part of Finland, blaeberry starts to flower on 23rd May – from my own observations, this happens about the middle of April, at least in the south-west of Scotland. However, Finnish berries ripen, on average, around the 21st July – and one piece of Scottish research has found that this happens on the 25th July in the west, and 1st August in the east. The apparent discrepancy in the berry ripening period can be accounted for by the very long daylight hours of a Finnish summer ('only' 20 hours in central Finland, and continual daylight in the north!), the higher summer temperatures and probably also by differences in altitude, as the Scottish sites were 230-250 metres above sea level.

The size of the berries themselves is very variable in Scottish woodland, but mostly not much smaller, if at all, than lowbush blueberries. They are definitely a lot bigger than bottled Polish blaeberries. In one piece of research in Italy, it was found that cultivating blaeberries produced bigger berries than those in the wild, even within the same clones.⁴⁵

'Cultivation' of blaeberry is a matter of definition more than anything else. Mulching (with chopped untreated wood, bark, pine needles, or leaves) would produce the biggest nutrient benefit and is the main benefit to commercially grown organic blueberries. Protection from grazing, and shading, whether by trees or netting* are the other 2 key necessities. As yet, I have not been able to discover whether or not a

* After all, my project has not been funded by the Millennium *Arboretum* for Scotland Trust!

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general prune, or burning at periodic intervals, would help to maintain blaeberry yield. As berries are only produced on shoots that are at least 3 years old (as with highbush blueberry), any pruning would have to be done over a longer interval.

Those who have tried deem full domestication of blaeberry pointless and impractical, even assuming its desirability – which I do not. Domestication of cowberry in Sweden produced several diseases within a ten year timescale. Although organic cultivation of lowbush blueberry may not fall within everybody's idea of 'wild' fruit, it is certainly doing very little more than 'giving nature a hand', and is therefore a good model to follow, up to a point. The North Americans completely failed to understand that Scottish blaeberries need trees to provide the shade, shelter and nutrition for maximum fruitfulness.

Forestry practices in the U.K. will not favour blaeberry's spread or survival where fertiliser is used (see Ecology section), or where herbicide is used to control heather for the sake of Sitka Spruce (the *Vaccinium* genus is known to be intolerant of certain pesticides and herbicides). Although blaeberry will pollinate by gravity and wind, pollination is mainly by insects, particularly wild bees. If these insect pollinators are under pressure because of the use of biocides, this will be detrimental to the fruitfulness of blaeberry. If tree stumps are treated or uprooted, this deprives both blaeberry and cowberry of potential habitat and nutrition. In addition, the Scandinavians are well aware of the negative effects of timber clearance on blaeberry and other forest fruits.

Upland pasture, as described by Rawes, currently '**has a value to agriculture and wildlife limited largely to providing animals, including hill sheep, with territorial ranges rather than food**'.⁴⁶ It is time to look at other ways to farm the hills. The fact that sheep have been kept in the Southern Uplands for far longer than the rest of Scotland must explain the prevalence of 'white moorland' - grass moorland, with blaeberry – in this area. It is not just Scottish woodland which is clapped out. However, this is not the opportunity to 'manage' moorland for grouse – which is managed already in conjunction with sheep farming. It is time to greatly extend the process of natural regeneration of native woodland, in which blaeberry will form a key part of the ground layer.

Both natural regeneration and planting of trees, in many parts of Scotland, may have to rely on cleugh woodland** for a local seed source. But it will take less time to re-establish trees than to re-establish blaeberry, which seems to spread quite slowly, although the cropping timescale for blaeberries will still be considerably shorter. I can think of no better economic justification for planting an oakwood!

Health and Social Inclusion

Skye and Lochalsh have been running a local horticultural project for some years now, producing good quality fruit and vegetables for local consumption. It was set up because of the lack of such produce in the local area. The Scottish Executive has

· Following discussions with Colin Stirling (Senior Horticultural Adviser, SAC Craibstone) we both considered that use of netting would be the ideal way to give the right amount of shading in the absence of trees, and could also help to prevent crop loss from birds and grazing by herbivores. Because of the cost, this option might be restricted to small-scale commercial operations. In the longer term, planting trees may represent a better option.

** residual woodland, growing in hillside ravines, on either side of a watercourse

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proposed providing free or subsidised fruit for every nursery age child in Scotland, because of the growing concern about the health of many of the population. Only 56% of boys and 63% of girls eat fresh fruit daily. Current recommendations are that five portions of fresh fruit or vegetable should be eaten each day. As was noted in one newspaper, 'In many of Scotland's more deprived communities, access to fresh fruit and vegetables has been identified as a problem. Local shops tend not to stock it, quality can be poor and prices relatively high.'⁴⁷ Projects like that in Skye and Lochalsh could provide the model for a sustained and sustainable improvement in the health of many people in Scotland, people who want good quality fruit and vegetables but are unable, or unwilling, to seek them in a supermarket. This is also another way to look at land use, and the future of agriculture. There are other models of farming that could be developed in this country, such as the U.S.' Community Supported Agriculture, which is itself based on systems developed in Switzerland and Japan. This is an alternative farming system that directly involves consumers in the running of smaller (mainly organic) farms, allowing them to buy fresh, local produce at an agreed price, which is less than the retail cost.

Forest fruits of all kinds are easy to grow, because they are adapted to local conditions, and are thus confidence building, particularly for those who have not had a garden of their own, or who lack confidence in growing garden vegetables. Although blueberry needs acid soil in which to grow, there are many other forest fruits that could be grown in other soils and situations. It is entirely possible to grow forest fruits in an urban, as well as a rural setting, as has been shown in the United States.

Other nationalities have developed indigenous species as crops, and there is no reason why we could not do the same. The Poles have developed a thornless variety of rose, specially for the production of rosehips. The Americans and Austrians have developed cultivars of elder, and the Finns have developed cultivars of cowberry both for ornamental use in the garden and for food. This country imports 'exotic' fruits from thousands of miles away (indeed, some fresh blueberry is imported from Chile), and yet fails to exploit the best of its native exotic fruit, however good their nutritional or culinary value. The trick is to make 'Food for Free' more freely available, through community woodland management agreements with the Forestry Commission, land buy-outs, etc

Biodiversity could be radically improved without bankrupting the economy – all it takes is a radical, creative approach. Canadian lowbush blueberry producers broke into the European market in the 1970s only because of a shortage of supply in European blueberries, caused by rises in the standard of living, which produced less of an incentive for people to gather wild fruits. Almost 30 years later, and there are many people who are much less hopeful of raising their standard of living by conventional means. Much could be done through allowing people to use their time and effort as hard currency, without being penalised through the tax or benefits system. Forest fruits can be developed from local resources, they do not require to be bought in, nor do they require large consultancy fees for their development. Other countries have developed cultivars after many years of growing purely from local stock. Indeed, the cultivars are merely breeding selections of the best local plants. Economic diversity could promote biodiversity.*

* For an excellent article on 'alternative currencies' and the way they can combat poverty and promote localisation, read 'Do-It-Yourself Money and the New Alchemists', by David Boyle, in *The Ecologist*

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I already have enough indication of interest in 'Project Blaeberry' to seek further funding for preliminary field trials. From the limited amount of publicity so far given to the project, I have had a tremendous response, and hope to incorporate some of this in my website. People in Scotland have a great enthusiasm and fondness for blaeberry, partly because of the childhood memories it evokes. I also hope to conduct further research of the potential benefits to Scottish communities of other 'forest fruits'. Please visit my website, www.forestfruits.org, which will be online in the summer of 2001, or contact me at blaeberry@forestfruits.org. I hope to use this website as the hub for international discussion on forest fruits, and the attendant need for forest biodiversity, but you will also be able to find some recipes and sources for recipes on it!

Any omissions or mistakes in this report are entirely my own. Any limitations in my review of the ecological literature are as a consequence of the extremely part-time nature of my study, and restricted access to the more up to date research papers, because of budgetary constraints and because (as a non-student) I cannot gain free access to the latest research. Language has also proved a barrier to research. I welcome any comments or suggestions that any of the recipients of this report may wish to make.

I again wish to express my immense appreciation for the financial support of the Millennium Forest for Scotland Trust, through the Millennium Commission's Millennium Award scheme. Without the support of these organisations, this project would not have been brought to fruition.

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There are, of course, additional measures that can be put into place to help defuse a potential timebomb of chronic ill health. A study by Greater Glasgow Health Board found primary pupils attending breakfast clubs had a better diet, took fewer sick days and had fewer discipline problems. It is certainly one way to influence healthier eating, and to provide at least some adequate nutrition for children who would otherwise do without. See 'Breakfast clubs are the healthy option', Scotsman 4th April 2001. Increases in welfare benefits, a minimum wage and local initiatives such as credit unions all contribute to improvements in the economic wellbeing of those on low incomes, which obviously has a knock-on effect on their health.

FRONTISPIECE PHOTOGRAPHS, anti-clockwise from right:-

Blaeberries, Glen Trool, Galloway Forest Park; Blaeberry flowers, Glen Trool; Blaeberry bush, Black Wood of Rannoch, Perthshire; Blaeberries, Trossachs; Pine plantation with predominantly blaeberry field layer, Central Highlands.