

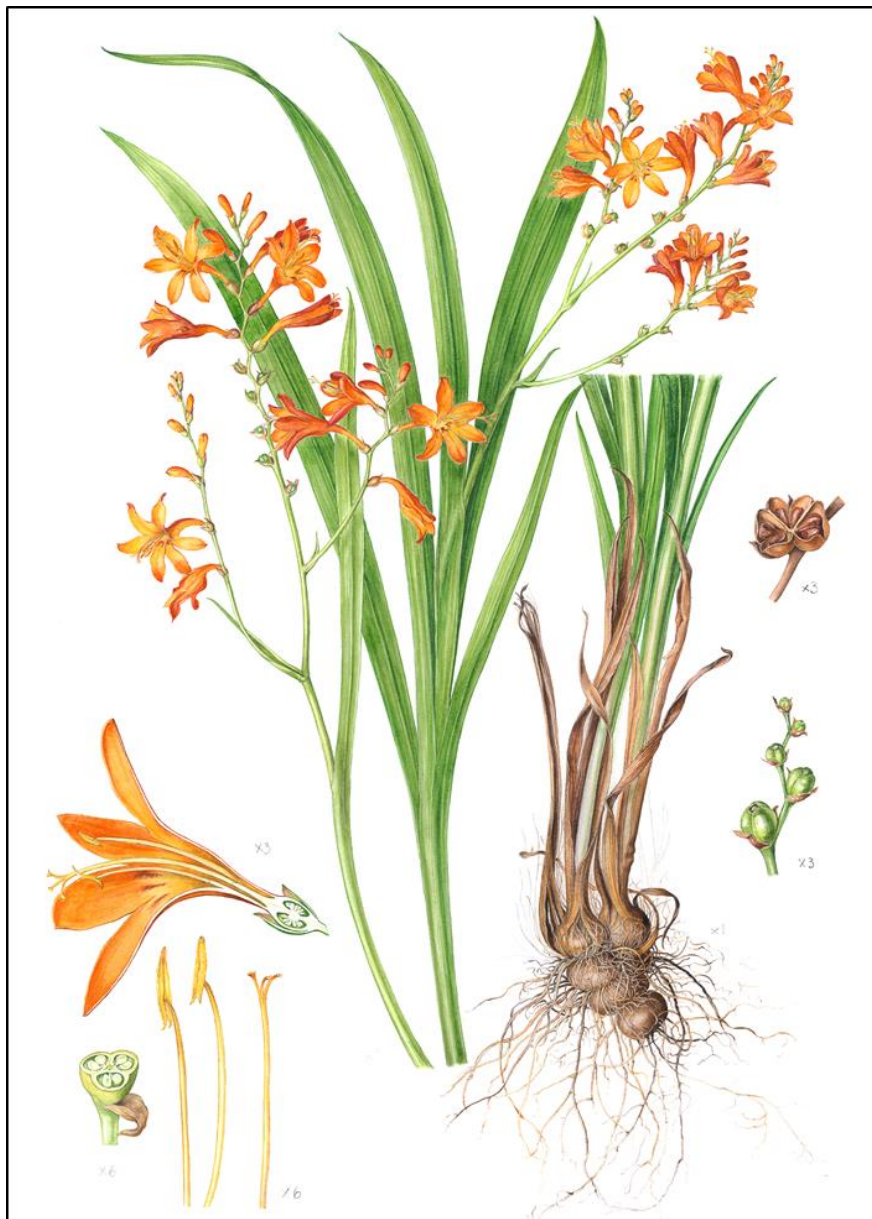


BSS News

The Newsletter of the
Botanical Society of Scotland

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The Botanical Society of Scotland is a Scottish Charitable Incorporated Organisation (SCIO) (No. SC016283)

Front cover pictures

Outside: *Crocoshmia x crocosmiifolia*, illustration by Janet Dyer. See article *Illustrations of Non-Native Invaders* on p.53

Inside:

Top: All plants and their percentage covers recorded in 4x4m quadrats at giant hogweed (*Heracleum mantegazzianum*) infested sites along the Water of Leith. Photo by Charlotte Neary. See article on p.19.

Bottom: Participants in the Moss Workshop meeting. Photograph by Brian Ballinger. See article on p.12

BOTANICAL SOCIETY OF SCOTLAND

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Website: <http://www.botanical-society-scotland.org.uk>

You can follow the BSS on Facebook and Twitter.

Founded in 1836 as the Botanical Society of Edinburgh, the Society became the Botanical Society of Scotland in 1991. Meetings are held in Edinburgh, Glasgow, Aberdeen, Dundee, St. Andrews and Inverness. The Society encourages the study of flowering and non-flowering plants. Activities of the Society include lectures, field meetings, symposia, surveys, and an annual exhibition meeting for the exchange of information on all aspects of Scottish botany. All botanical enthusiasts are welcome to be members of the Society, including gardeners, professional plant scientists, amateur field botanists and students. All members receive information about the events of the Society, including programmes of lectures and field meetings, as well as a twice-yearly newsletter, *BSS News*. Standard membership also includes the scientific journal: *Plant Ecology & Diversity*, published by Taylor & Francis on behalf of the Botanical Society of Scotland. Standard members can also go online and download all the Society's journals, from papers which have just been accepted for publication in *Plant Ecology & Diversity*, all the way back to the first issue of *Transactions of the Botanical Society of Edinburgh* published in 1844 (instructions can be found on our website).

Applications for membership of the Botanical Society of Scotland should be made to the Hon. General Secretary at the address at the top of this page. Subscriptions can be paid by cash, cheque (payable to the Botanical Society of Scotland), or Banker's Order. Please ask for a Banker's Order form if required. Or you can join online and pay by PayPal via the BSS website at <http://www.botanical-society-scotland.org.uk/content/bss-membership>. Subscriptions fall due on 1st October each year:

Standard rate (with the Journal <i>Plant Ecology and Diversity</i>)	£40.00
Standard rate for undergraduate students (with the journal)	£30.00
Basic rate (without the journal)	£20.00
Basic post graduate/undergrad student rate (without journal)	£5.00

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EDITORIAL

As we go to press, the Coul Links hearings are about to start (expected 26 February 2019), with Scottish Government appointed Reporters. See the main article on p.6. Along with many other groups, we are playing a part in a broad campaign to protect this internationally important SSSI and RAMSAR site against the proposed development, and we greatly appreciate the input of our co-campaigners. We draw your attention to the crowd funding appeal by 'Not Coul' to support their costs of participating in the inquiry (see p.9).

In this News, we report on last year's Student Field Support and Dissertation awards. Please note that the final date for submission of applications for 2019 field support is **30th April** and for the Dissertation Prize is **1st July**. See p.13.

Our Field Programme (enclosed with this News) has twenty activities this year, which we believe is a record. There is something here to suit all tastes, so we are hoping for many participants. Many of the excursions, near Edinburgh and across Scotland, are organised jointly by BSS and other associated organisations. This is a developing trend, and, we hope, helpful to all Scottish naturalists. Please contact the field leaders for further details as indicated in the programme. It is essential that you come dressed and equipped appropriately for outdoor fieldwork, as advised at the bottom of the Programme.

Three of the field work excursions are walks along the Edinburgh tramway. This is part of the Urban Flora Project. One of your newsletter editors hoped that we could record the gradual colonisation of the ballast by vascular plants. However, the ballast is sprayed annually with herbicide, and is a desert for vascular plants. The verges and hedges along the tramway route are subject to little human interference or footfall, so we are hoping for some interesting botanical records.

The Scottish Botanists' Conference, held jointly with the BSBI in November 2018 was very successful. The PowerPoints of lectures are available on the BSBI website at <https://bsbi.org/scottish-annual-meeting>.

Thank you to all who sent us articles for this edition of the BSS newsletter. We accept a wide range of types of subjects. Instructions for submission of articles can be found at the end of this News.

Roger West and Jill Thompson

ANNUAL GENERAL MEETING 2019

The 2019 Annual General Meeting of BSS SCIO will take place on Thursday 16th May immediately following Charles Quest-Ritson's lecture "Double flowered plants: why they matter" in the RBGE lecture theatre. We will report on our activities over the last 12 months, present our financial accounts, elect members to our governing body (the BSS Council) and answer your questions about the BSS.

The Provisional Agenda for the AGM is as follows

1. Apologies for absence
2. Draft Minutes of AGM 2018 for approval. These are available on the Members' Area of our website and printed copies will be available at the AGM.
3. Election/re-election of Council members
4. President's Report
5. Treasurer's Report and determination of subscription rates
7. Any Other Business

We need help to run the BSS

The BSS is run in accordance with the rules of the Office of the Scottish Charity Regulator, through the BSS Council. Council members are the Trustees of the BSS and are unpaid volunteers. We arrange the lecture and field programmes, keep the accounts and a register of members, publish the BSS News and our journal *Plant Ecology & Diversity*, liaise with other Societies, provide refreshments at meetings, run the website, publicize events, get involved in projects (e.g. the Urban Flora project), award student prizes and grants, and sometimes comment on relevant national strategy and similar issues.

We have some vacancies and would like to bring new people and their skills and ideas onto Council, while retaining sufficient existing members to ensure continuity in the running of the BSS. We hold about 4-5 formal Council meetings a year at the RBGE (starting at 17.30 or 18.00h) and use email a lot. There is no need to be a 'qualified botanist': an interest in plants and some experience relevant to the BSS activities is all that is needed.

Applicants should be nominated by two members of the BSS (a proposer and seconder) and provide a brief (2 sentence) résumé of their interests and experience. Please come and talk to us at one of the lectures or send us an email if you are interested. Nominations should be sent to the General Secretary of the Society (address below), by email or post, to be received no later than 18th April. The list of candidates for Council will be published by email and on the BSS web site during the following week.

Note to all members

Please check that your contact details are up to date in our records. This can either be done by logging into your BSS account (<http://www.botanical-society-scotland.org.uk/user>), or by contacting the Membership Secretary.

Julia Wilson

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General Secretary, Botanical Society of Scotland,
Royal Botanic Garden Edinburgh, 20A Inverleith Row, Edinburgh EH3 5LR

COUL LINKS DEVELOPMENT UPDATE

Setting up the Public Inquiry and a Crowd-Funding Appeal

In previous editions of the News, we have reported on the BSS's objection to a planning application¹ to construct a golf course at Coul Links, near Embo, Sutherland. Coul Links is an important sand-dune system, supporting much rare and diverse wild-life, of such environmental importance that it is protected by national (Site of Special Scientific Interest), European (Special Protection Area) and International (Ramsar) designations.

Highland Council's Planning Manager recommended refusal of the application but was over-ruled by their Planning Committee, composed of local councillors, who overwhelmingly approved the application. In this situation, Scottish Ministers must be informed, which has resulted in the 'call in' of the application for review by Scottish Ministers for their own

determination 'as the proposal raises issues of national importance in relation to natural heritage issues and its compliance with Scottish Planning Policy, which require further scrutiny at a national level.'

This 'call in' started the process for a public inquiry, which is managed by the Scottish Government's Planning and Environmental Appeals Division (DPEA). All correspondence in connection with the inquiry is recorded on their website² and available to the public, 1324 documents had been lodged on the site by early February 2019.

We represented the BSS and attended the pre-examination meeting, which was held at the Carnegie Hall, Clashmore, Dornoch on 31 October 2018, led by the two Reporters David Liddell and Timothy Brian, who have been appointed by the Scottish Government. This meeting was held to discuss the arrangements and procedures for the Inquiry – dates, venue, proceedings, arrangements for the prior exchange of documents, and what enquiry sessions should be held.

At the pre-examination meeting, organizations in support of the planning application were represented by Coul Links Ltd, Embo Trust, Dornoch Community Council, Scottish Crofting Federation, and some Councillors. Organizations against the application were 'Not Coul' represented by the ecologist Tom Dargie (an eminent authority on sand-dunes, and local resident) and the 'Save Coul Links Conservation Coalition' - a conservation consortium of Butterfly Conservation, Buglife, Marine Conservation Society, National Trust for Scotland, Plantlife Scotland, Scottish Wildlife Trust, Scotways/Ramblers Scotland, Royal Society for the Protection of Birds and Scottish Natural Heritage. The BSS has decided to work in support of 'Not Coul'.

Queen's Counsel have been instructed on both sides.

The outcome of the pre-examination meeting was that the inquiry will commence on 26 February 2019 and is likely to run for about four weeks. Sessions will be held Tuesday to Friday, allowing Monday for travel to Clashmore.

The following issues will be considered:

A. Impacts on natural heritage and protected species – including:

- effect on Dornoch Firth & Loch Fleet Special Protection Area (and Moray Firth proposed Special Protection Area)
- impact on Loch Fleet Site of Special Scientific Interest & Ramsar Site

- purpose and significance of above designations
- impact on the water environment
- (short term and long term) impact on sand dune-related habitats
- risk of habitat fragmentation
- effect on natural dune and coastal processes
- likely effect on breeding and other birds and other fauna and flora
- impact on existing woodland
- proposed mitigation measures, including translocation of habitat
- habitat management and control of invasive species

B. Socio-economic impacts – including:

- significance of golf tourism
- net economic impact during construction period
- net economic impact when golf course in operation – additional employment and expenditure in the area
- impact on local recreation and tourism, including public access to, and enjoyment of, the links
- other socio-economic impacts

If a topic is not earmarked for consideration at the inquiry, it does not signify that the Reporters regard it as unimportant – it means that they already have enough written material on the topic, or that it is an issue best assessed on site, rather than at an inquiry. All of the written material already lodged, including the numerous letters of support and objection, will be fully taken into account, so it is not necessary for an individual or body to take part in the inquiry to have their views considered.

Members of the public are welcome to attend the sessions to observe the proceedings and the inquiry will be webcast. After the inquiry, the two Reporters will prepare a report and recommendation to Scottish Ministers as to whether to allow or reject the proposals, and a decision as to whether planning consent will be granted or not, is likely to be released in the summer of 2019.

Not Coul has recruited a strong team of environmental consultants to appear at the inquiry. Much of their work is being done without charge, but there are considerable costs in preparing for and attending an inquiry, and a crowd-funding appeal has been set up by Not Coul to support these costs³. The outcome of this inquiry is not only important for the protection of Coul Links, but also because if the application is approved, it will set a precedent for the destruction of other protected areas in Scotland, giving developers the 'green light' that environmental protection is not to be respected.

Julia Wilson and John Grace
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References

1. Application number 17/04601/FUL to Highland Council,
<https://wam.highland.gov.uk/wam/>
2. <http://www.dpea.scotland.gov.uk/CaseDetails.aspx?ID=119883>
3. <https://www.notcoul.com/>

COMMENTS ON SCOTLAND'S FORESTRY STRATEGY 2018-19

The Scottish government released a document *Scotland's Forestry Strategy 2019-29* for consultation in September 2018 and closed this in November 2018. These notes below are based upon the response from Brian Ballinger on behalf of BSS, in answer to the questions asked in the internet consultation form.

- There appears to be a considerable reduction in the priority given to biodiversity compared with previous forestry policies.
- The proposed rapid forestry expansion in Scotland should be treated with caution in order to protect important habitats such as bogs and moorlands. We should use natural regeneration as much as possible and be cautious when introducing trees to new sites. Given the increasing danger of tree diseases, if trees have to be introduced, they should come from the local area, and local nurseries if possible. Increasing diversity of species and genetic diversity are important.

- There should be more emphasis on thorough surveys in advance of any tree planting, as there have been recent examples of planting over sites of scarce plants. There should be more specific monitoring of biodiversity and rare species should be looked for at several times of year, and identified and these sites and habitats preserved. Previous biological records should always be examined, although these will not always give a complete picture.
- Some planting has caused access problems for walkers and field naturalists – for example the mound method of tree planting may cause difficulties, and some hazards and deer fencing with few crossing places lead to access problems.
- Plantations of native tree species are really a separate category of forests from ancient little-disturbed native sites and naturally regenerating native woodland.
- Health benefits should always be looked at critically as associations between forests and human health are not always causal, although there are real difficulties in setting up rigorous double-blind trials.
- Public transport access should be encouraged and we should try to limit the use of polluting vehicles. Measures should be also undertaken to reduce pollution and collateral damage to other habitats from forest machinery.
- Habitats damaged through forestry activities should be restored.
- Forestry has many roles in Scotland but there should be more emphasis in the Scottish Forestry strategy on biodiversity

See: <https://consult.gov.scot/forestry/scotlands-forestry-strategy-2019-29/> for further details.

REPORTS OF FIELD MEETINGS AND WORKSHOPS

DOUNE MEETING 30th June 2018

The purpose of the meeting at Doune Ponds Conservation Area, was to collect botanical records as part of Atlas 2020. This area is situated on the north western side of the village of Doune in Stirlingshire and is managed by the community, who use it for dog walking, picnics and gentle exercise. It has a good network of paths but still feels untamed in some parts. The efforts of the team were concentrated on the northern part of the conservation area which had not been recorded since 2000.

One objective of the day was to look for pillwort (*Pilularia globulifera*), which had been found on the edge of the northern pond in 1985. However, when we located the pond it was very shaded by trees, and looked very dark and unpleasant. We walked round it but no sign of the pillwort was found. However, other species of note were two flowering spikes of broad-leaved helleborine (*Epipactis helleborine*), two small populations of common wintergreen (*Pyrola minor*), over 100 flowering plants of common spotted orchids and the abundance of common twayblade in the woodland areas. By the end of the morning we felt the area had been well recorded so after lunch we visited a small woodland east of Doune situated on the Ardoch Burn and found wood millet (*Milium effusum*), but the main highlight was scented mayweed (*Matricaria chamomilla*), an extremely rare species for VC87, West Perth, found growing in profusion at the edge of a nearby arable field.

A good day on one of the many warm and sunny days of this summer and another corner of the vice county recorded.

Jane Jones
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MOSS (BRYOPHYTES) WORKSHOP

1st November 2018 Dundee

Led by David Chamberlain and Liz Kungu

This workshop was organised jointly by the Botanical Society of Scotland and the Dundee Naturalists' Society and was held in the Collections Unit of the McManus Museum. David Chamberlain and Liz Kungu from the Royal Botanic Garden in Edinburgh led us through the lifecycle and identification of mosses and liverworts.

In the morning we began with a talk which was followed by exercises in identification and the use of keys in the laboratory.

After a snack lunch we walked along to Seabraes where there were areas of vacant land, some of which were old railway sidings. The first had a good covering of moss including such species as *Didymodon insulanus*, *Barbula convoluta*, *Brachythecium albicans* and many others. The sun shone so the visibility was good for the time of year.

We then passed some steps coated with a profuse growth of the liverwort *Marchantia polymorpha* and which also featured moss-covered walls, and there was a remarkable quantity of Teasel (*Dipsacus fullonum*).

In all 35 moss and liverwort species were identified. Richard Brinklow also noted 19 lichen species. All of these records will contribute to the Botanical Society of Scotland's Urban Flora Project.

We finished with a welcome cup of tea or coffee in the Queens Hotel.

We are very grateful to David and Liz for this event and also to Mike Sedekat for being our host at the collections unit. A photograph of enthusiastic bryologists may be found on the inside front cover.

Brian Ballinger

STUDENT FIELD SUPPORT AND DISSERTATION PRIZE

Support for Student Field Work

Each year, the BSS offers small grants to undergraduate students for field work projects and field work courses. In 2018 we supported Robert Engstrom (Napier University), to work on the control of *Heracleum mantegazzianum* (Giant Hogweed) (see article on p.19), and Maude Grenier de Sigley (University of Edinburgh) to attend a residential National Vegetation Classification (NVC) course at the Field Studies Council centre at Kindrogan.

We welcome requests for fieldwork support. Further details can be found at <http://www.botanical-society-scotland.org.uk/content/support-student-fieldwork-0> . The deadline is April 30th.

Student Dissertation Prize

The BSS also awards an annual student dissertation prize to the final year student of a Scottish University who submits the best dissertation on a botanical investigation carried out during their final year. The deadline is July 1st. Further details are available at: <http://www.botanical-society-scotland.org.uk/content/botanical-society-scotland-student-prize> .

This year's dissertation prize was awarded to Seth Radcliffe who studied Horticulture with Plantsmanship (Royal Botanic Garden Edinburgh/ SRUC/ University of Glasgow) for his dissertation 'Assessing epiphytic lichen diversity at a whole-tree scale in Edinburgh's urban *Acer pseudoplatanus*'.

Both Robert and Seth exhibited posters on their work at last November's Scottish Botanists' meeting. Summaries of the student dissertations are on pages 14 -17 and an article on Giant Hogweed by Robert Engstrom and Dr. Jay Mackinnon is on p. 19.

ABSTRACTS OF STUDENT DISSERTATIONS

Assessing epiphytic lichen diversity at a whole-tree scale in Edinburgh's urban *Acer pseudoplatanus*

Student: Seth Radcliffe – **Winner of BSS Student Thesis Prize.**

Horticulture with Plantsmanship RBGE / SRUC and the University of Glasgow

Supervisors: Dr Greg Kenicer and Dr Chris Ellis of Royal Botanic Gardens Edinburgh.

The UK's epiphytic lichen flora is important for biodiversity on an international level, however, since the onset of the industrial revolution many species have disappeared from the urban landscape. Epiphytic lichens underpin urban biodiversity and ecosystem function. However, they face many threats in urban habitats, such as nitrogenous pollution and modern arboricultural management. Most contemporary urban lichen studies have focused on data gathered only from tree trunks. This can lead to significant underestimations of diversity at the whole tree level and represents a fundamental gap in our understanding of urban biodiversity. This project applied the OPAL air quality lichen survey at a whole tree scale in *Acer pseudoplatanus* across Edinburgh and investigated the response of diversity metrics across pollution gradients. It has shown for the first time that the diversity of OPAL indicator taxa is highest in tree crowns, is spatially stratified across the canopy and is maintained in high pollution areas. This study has provided new baseline information in an understudied area. It highlights the importance of tree crowns for urban epiphytic lichen diversity and urban biodiversity. Finally, it raises the need for further research into the effect of arboricultural management techniques on urban epiphytic lichen diversity.

Development of a methodology of investigating siderophore gene expression and *Ramularia collo-cygni* disease severity on *Hordeum vulgare*.

Student: Greg Thornton

Abstract for Plant Science Honours Project

Supervisor: Dr Francois Dussart SRUC

Ramularia collo-cygni (Rcc), an emerging pathogen on barley crops worldwide, is asymptomatic in early stages of development and has devastating impacts on yields. Rcc has also developed resistance to traditional fungicides in recent years, increasing the need for research on Rcc in order to tackle it effectively.

One area of interest is the link between iron uptake and virulence. Rcc utilizes compounds called siderophores in order to uptake and store iron. These siderophore genes have been linked to fungal virulence. Here we sought to determine primers for gene expression analysis and observe Rcc siderophore gene expression in low or high iron conditions *in planta*.

Infected barley was grown in growth cabinets in low or high iron conditions and the disease severity was recorded by measuring infected leaf area. This yielded few statistically significant results but aided in developing a method of growing barley in nutrient deficient conditions.

Primer development and testing yielded one set of primers which worked effectively in amplifying the siderophore gene of interest. With the method and primers now shown to be effective, future work on investigation into siderophore gene activity in Rcc and their effects on barley can be explored rapidly and effectively.

An investigation into the effect of different management of *Pinus sylvestris* stands and their susceptibility to disease

Student: Tristan Williams

Environmental Ecology Environment and Countryside Department,
Scotland's Rural College

Supervisor: Barbara Harvie

The remaining fragmentations of the Caledonian pine forests are one of the most valuable cultural and biodiverse forests in Scotland. As a result, there has been significant recent efforts to restore and expand Scotland's native forests. A number of factors can affect regenerating forests; however, disease can be the most devastating. There are a host of disease epidemics that have occurred in the history of forestry. *Dothistroma* needle blight (DNB) has recently become a concern to Scottish populations of Scots pine (*Pinus sylvestris*). There is a large variation in susceptibility of stands to the disease, which is not fully understood.

The question of the study was to investigate the effect of different management of *Pinus sylvestris* stands and their susceptibility to disease. The results did not show any unusual age structures on either sites that would suggest any barrier to regeneration is occurring. It was found that around 90% of trees in all stands had low levels of damage from DNB, with infection relatively equal across all age structures. Comparatively, shoot fly was found in 33% of trees in field site 1 and only 6% in field site 2, linking management type to shoot fly infestations. It was hypothesised that this could be due to greater distance from breeding sites and reduced stand density. The level of damage was not a concern at the time, however it was recommended that monitoring the effect of these pests and diseases should continue. An ecological shift could significantly alter the effects of DNB on the trees. There is also the potential for shoot fly (*Tomicus piniperda*) to act as a vector to a harmful pathogen.

What determines the distribution and productivity of a rare plant species at the local scale? Assessing the autecology of Marsh Saxifrage (*Saxifraga hirculus*) at Munsary Peatland, Caithness.

Student: Charles Hawkins

Department of Environmental Science

Supervisor: Alistair Jump, University of Stirling

Saxifraga hirculus is one of the rarest flowering plants in Western Europe, having seen large range contraction in recent centuries. Its four population sites at Munsary Peatlands, Caithness are the latest to be discovered in the UK, and the least researched. This paper is the first to study them all in depth; it quantifies the differences between flushes where *S. hirculus* is present and absent, with sites that both appear habitable and unsuitable to it examined; it therefore helps to explain the distribution of such a restricted species. Research was conducted primarily through detailed vegetation surveys and water chemistry analysis, alongside consideration of pollinators and herbivore impact. It was found that *S. hirculus* occurs in base-rich flushes, with higher calcium concentrations found in populated flushes than flushes where it is absent. Correspondence analysis performed upon the vegetation survey results identified inundation and grazing levels as important influences on establishment of *S. hirculus*. This research substantially improves our understanding of the ecological requirements of this rare species and will enable revised management plans to improve population condition and prevent further decline, as required under national and international conservation obligations.

Editor's note: Charlie Hawkins had a longer article about *S. hirculus* in a previous edition of the newsletter. This abstract is here for completeness as the thesis was submitted for the BSS student prize.

GREATER DUCKWEED *SPIRODELA POLYRHIZA* IN EDINBURGH

On 22/9/18 I paid a casual visit to Duddingston Loch and to my surprise found the public area unusually lush after some flooding. In places the water was still quite high and *Lemnas* had been trapped in the shallows. *Spirodela polyrhiza*, the Greater Duckweed, was in one of these. It looked exactly like the cover picture on the BSS News which I had just received! Had it been lying low in the Loch for years or was it a recent arrival? For there is a history of the plant in this area.

In the 1980's I was involved with a recently-created nature reserve, Bawsinch, on the other side of Duddingston Loch, and surveyed parts of it from time to time. Four ponds had been dug close to the loch outflow and planted with commercially-supplied plants (not all of them Scottish natives), while others had arrived naturally. In 1982 and again in 1985 I recorded *Spirodela* in one of these ponds. Was it a contaminant from the commercial plants or had it arrived naturally from Duddingston Loch? *Nymphoides peltata* the Fringed Water-lily, which had appeared in one of the ponds had almost certainly come from the Loch.

Crassula helmsii New Zealand Pigmyweed on the other hand almost certainly arrived as a contaminant. I first recorded this in 1981 in a particularly shallow pond, along with *Eleocharis acicularis* Needle Spike-rush, which started to flower as the pond dried out. The pond was deepened that winter and sadly the Spike-rush disappeared, but not the Pigmyweed, which has now made its way into Duddingston Loch.

Another interesting 'foreigner' *Azolla filiculoides* Water Fern arrived in a couple of the ponds at about the same time, and also appeared on the Union Canal where it survived for several years.

By 1987 the ponds were getting overgrown and I became recorder for West Lothian and eventually resigned from Bawsinch. Other ponds have since been dug, and I do not know about the present state of the vegetation. However, in recent years *Spirodela* has appeared in a small pond in a South Edinburgh allotment. A contaminant - or brought in by ducks, which come to feed on the tadpoles?

Jackie Muscott

EXPERIMENTS ON MANAGING GIANT HOGWEED (*HERACLEUM MANTEGAZZIANUM*) NEAR A WATERCOURSE

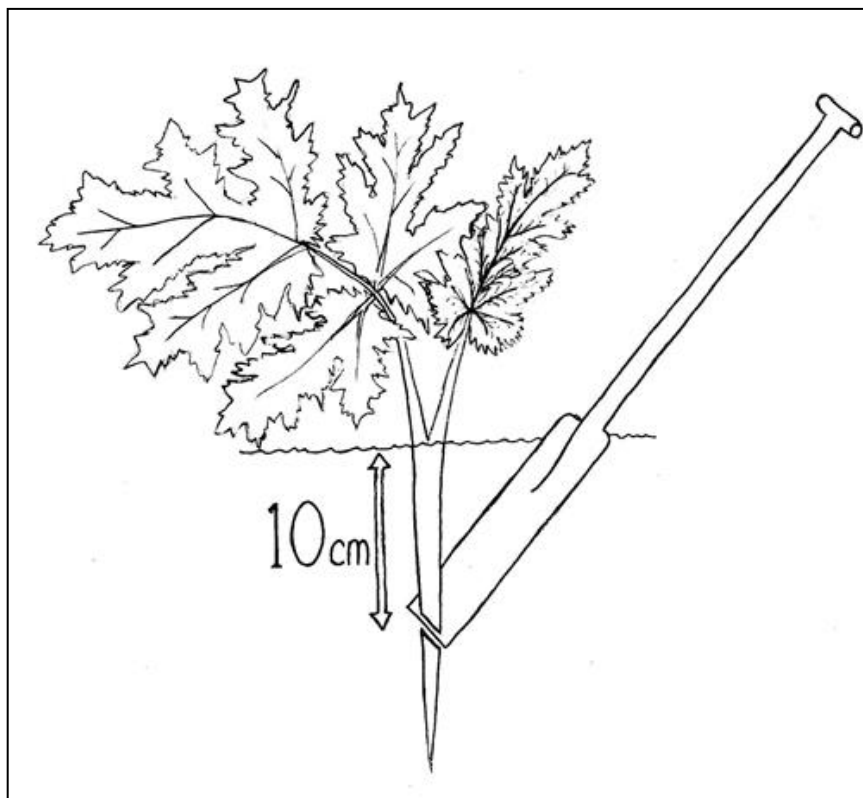
Giant hogweed (GH) is strongly competitive and can significantly reduce species richness and diversity of other plants (Pysek & Pysek, 1995). It can also have adverse effects on freshwater ecology when invaded riverbanks are bare overwinter, allowing soil erosion into the watercourse (CABI, 2017). Giant hogweed is extremely prolific, a single plant being capable of producing seeds in the tens of thousands, possibly even 100,000 (Rzeznik, 2002). With photosensitising sap, it presents a human health hazard (Rzymiski, Klimaszyk, & Poniedziałek, 2015). For these reasons, GH control is attempted in most river catchments.

Standard Management Practice

Small hard-to-reach GH stands are usually treated with glyphosate-based herbicide (GBH) using knapsack sprayers. Glyphosate is effective, and cheap (Nielsen et al., 2005), but can have adverse effects on non-target organisms in aquatic and terrestrial habitats (Rodrigues et al, 2017; van Bruggen et al, 2018). Concerns over impact on human and ecosystem health recently resulted in the European Commission being petitioned to ban glyphosate (European Citizens Initiative, 2017). The City of Edinburgh Council uses an estimated 4700 litres of GBH annually and are looking into alternatives to reduce this (Edinburgh Council, 2016); however, little information is available to compare efficacy and practicality of alternative management methods. In 2016, through volunteering with the Water of Leith Conservation Trust (WOLCT), I became aware of some of these concerns and started to look into the practicality of alternative GH control methods, with guidance from some of my lecturers at Edinburgh Napier University (ENU). Photographs of these activities appear on the inside front cover and on p.30.

Alternative Treatments and Treatment Impact

A more labour-intensive method, which appears as efficient as GBH in killing the plant, is to sever the tap root 10cm below ground and uproot it (illustrated diagrammatically on the next page; photograph on p.30). This kills most plants, although some of the oldest individuals may survive (Nielsen et al., 2005; Klima & Synowiec, 2016), but for



Root cutting technique for killing giant hogweed (*Heracleum mantegazzianum*) as recommended by Nielsen et al 2005. Includes uprooting and bagging, the bag being kept in a safe, inaccessible place until plants have decomposed and their sap is no longer toxic. Drawing by Jay Mackinnon.

logistical reasons uprooting is not in such widespread use as the herbicide spray. A study on *H. sosnowskyi* in Poland found root cutting more effective than herbicide for a single year's treatment (Klima & Synowiec, 2016), but we could find no similar experimental comparison in the UK for *H. mantegazzianum* management. We hypothesised that root cutting will cause less damage to non-target vascular plants – and this might be associated with better revegetation after treatment, perhaps reducing GH regrowth. Caffrey (2001) recorded the plants which recolonised an Irish river after treatment of GH with herbicide alone, but comparison of impacts on non-target plants between treatments is novel.

Managing Giant Hogweed on the Water of Leith

The Water of Leith Conservation Trust (WOLCT) have treated GH with GBH using knapsack sprayers upstream of their visitor centre in Slateford, southwest Edinburgh, for the past 5-6 years without seeing any decrease in GH plant density and abundance. This area

encompasses a three-mile stretch of the Water of Leith, with no GH plants being found upstream of Currie. Since 2017, collaboration with ENU has resulted in a more rigorous and considered approach to GH management along this stretch.

In April 2017 and 2018, surveys were carried out to map all GH plants within the area – around 1000 counted both years. Based on distribution density, and in order to generate statistically valid sample sizes, we decided to set up 4x4m quadrats spanning a minimum of six GH plants. Within quadrats we recorded the number of GH plants; height of the tallest GH plant; and quadrat percentage GH cover. One of three treatments was then randomly assigned to each quadrat: (1) standard GBH concentration (control group) or (2) a lower GBH concentration than commonly used (both treatments 1 and 2 were applied using knapsack sprayers), or (3) root cutting (as explained in figure 1, p.20). Results were recorded by revisiting quadrats on average 23 days after treatment, to record the same GH growth variables as before. So far, the results show that the effects of root cutting, or a lower concentration of GBH, are not significantly different from the widely used standard amount of GBH.

The first season of field experiments was in 2017, which gave us insight into the logistics and efficacy of the different treatment methods to be trialled. In 2018, after refining our methods and rallying more support – including a grant from the BSS – we set up 47 quadrats with permanent markings, and for the first time we also recorded the presence and cover of all other plants within the quadrats. Reapplying the same treatment on these quadrats over the next few years will allow for comparison between treatments of impacts on non-target plants, adding a measurement of environmental impact in addition to the currently investigated treatment efficacy and practicality for reducing GH populations.

Treatment Practicality and Attitudes to Different Management Approaches

Although much more labour-intensive – so far taking 5-8 times as long as herbicide spraying to carry out per quadrat – root cutting need not be a less practical alternative, if a volunteer labour force is at hand, as in the case of WOLCT (see photograph on p. 30). Time and workload aspects are potential problems in the short term, however a root-cutting approach is more likely to locate all the plants in the undergrowth as more time is spent on site, and so these aspects could potentially

balance out over time. Uprooting especially younger plants also verifies whether several leaves constitute more than one plant; leaf and stem morphology can also aid in determining this (Rzeznik, 2002) but it becomes clearer once uprooted – especially for people less familiar with the plant. Spraying treatment is thus more likely to underestimate the actual number of GH plants. In quadrats where GH growth and/or overall vegetation is very dense we cannot assume that our estimated GH numbers are very precise. The point of our study then is not so much to tease out the exact differences in treatment efficacy – which would be difficult in field experiments carried out by a fluctuating group of conservation volunteers and students – but is more focused on the practical aspects and environmental impacts of these alternative approaches, in comparison to the current (standard) management practice.

A practical downside with herbicide and a knapsack sprayer is that you have to be licensed to use it, with a specific licence required for use in or near a water course. Although glyphosate readily breaks down in most soils and water (but see for example Battaglin, Meyer, Kuivila, & Dietze, 2014) the resulting metabolites can contribute to phosphorus loading (Hébert, Fugère, & Gonzalez, 2018). As glyphosate spraying is also destructive to GH associated, non-target vegetation, these sites become ruderal in nature and may promote germination of any dormant GH seeds as well as providing the ideal habitat for any wind or water dispersed GH seeds.

The project has raised many questions about differences in attitudes towards invasive plants and the use of herbicides. Successful nature conservation is not only about resources and the efficacy and practicality of fieldwork methods, but also the values and perceptions of the people directing, carrying out the work, or that live nearby. Thus, in order to explore the view on and acceptability of alternative treatments the work will be extended to investigate the approach, experience and opinions of catchment managers and conservation workers.

Moving forward: An Integrated Management Strategy and Community Engagement

Alternatives to glyphosate are needed but with no widely applicable substitute, an integrated approach – such as the one currently trialled by the WOLCT – might be the only viable option. To some extent, this approach aligns with research on Integrated Pest Management (IPM) strategies used in contemporary modern agriculture,

focusing on positive interactions between plants and their associated ecology (Brooker et al., 2015) and taking some of the focus away from the superior competitive ability of *H. mantegazzianum*.

By focusing on interactions and the biotic resistance of riverbanks, pesticide use could be minimised and restricted to use on particular ground types, locations and events where less destructive treatments are unavailable. It is a trade-off between long-term sustainability and short-term practicality that will require a planned and considered approach. We hope that our study will provide conservation workers with useful evidence on the effectiveness, practicality and some of the side-effects of treatments for giant hogweed. Furthermore, community engagement – as set out in the first Earth Summit (UNCED, 1992) – is key to tackling some of the major problems facing the sustainability of our biosphere and global human society, including unprecedented loss of biodiversity, disconnection from nature and shifting baseline syndrome (Packham et al., 2018). This project involves identification of all plants present within treatment quadrats – more than 150 different plants identified so far – stimulating learning and interaction between experienced conservation volunteers and students. These records will also be shared with national recording schemes.

As seeds can remain dormant for several years (Rzeznik, 2002) eradication requires thorough management of the affected and surrounding areas for a period of at least 5 years (Nielsen et al., 2005). Now in its third year, this project is aiming to treat and revisit the permanently marked quadrats for at least another 3-4 years. Future work will also consider other alternatives to compare to current treatments, such as stem injection and above-ground cutting methods, which could work as complementary tools in difficult terrain (e.g. rocky or rooted soil, tricky slopes) or where GH plants are overhanging the river. Moving forward, the aim is to extend the work to engage other conservation bodies in the Firth of Forth catchment area. If you are engaged in GH control or belong to a volunteer group and would like to contribute your experience, please contact us (email addresses below).

Robert Engstrom

Ecology student, Edinburgh Napier University
Conservation volunteer, Water of Leith Conservation Trust
40220829@napier.ac.uk

Jay Mackinnon

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URBAN FLORA OF SCOTLAND

Newsletter Winter 2018/9

1. The Discovery Curve

In botanical recording, winter is mostly a time for analysis and reflection (although some hardy souls continue to collect data on New Year's Day). With the Urban Flora project, we still need more data before analysis can begin in earnest. An important question is: how many species might be 'out there' which we haven't yet seen? To answer this, we can look at the relation between the number of records made and the number of species found. The relationship is an example of the 'law of diminishing returns' whereby the more you search the more difficult it becomes to find new items. Scholars applied mathematics to the problem in the 1970s to estimate the number of words in Shakespeare's vocabulary. As one works one's way through the plays, new words become progressively harder to find. Just like flowers. I thought it would be interesting to apply the concept to the Urban Flora data set (before 2014 - mid 2018).

It was gratifying to see that the data do fall onto a smooth curve, ‘the discovery curve’ I call it. I fitted this curve using the Michaelis-Menten equation first encountered in my undergraduate biochemistry class, named after the German chemist Leonor Michaelis and the Canadian physician Maud Menten. The software I used provides an estimate of the asymptote i.e. the number of species that are expected after a very large (infinite) amount of searching. The answer was 1616 ± 23 . So far, we’ve found only 1,200 of them. After filtering the data to exclude cryptogams the total number of vascular plants from urban sites was 1396 ± 58 . We are thinking of testing the predictions further, using the huge data set from the BSBI database. Roger West is interested in the related question of how many towns do we need and how to sample them systematically.

In December I happened to meet Ken Thompson, a friend who has done the same thing with his survey of biodiversity of gardens in Sheffield. He tells me that there was a striking difference between the result of the analysis of native and alien species. That is something we must look at in our own data.

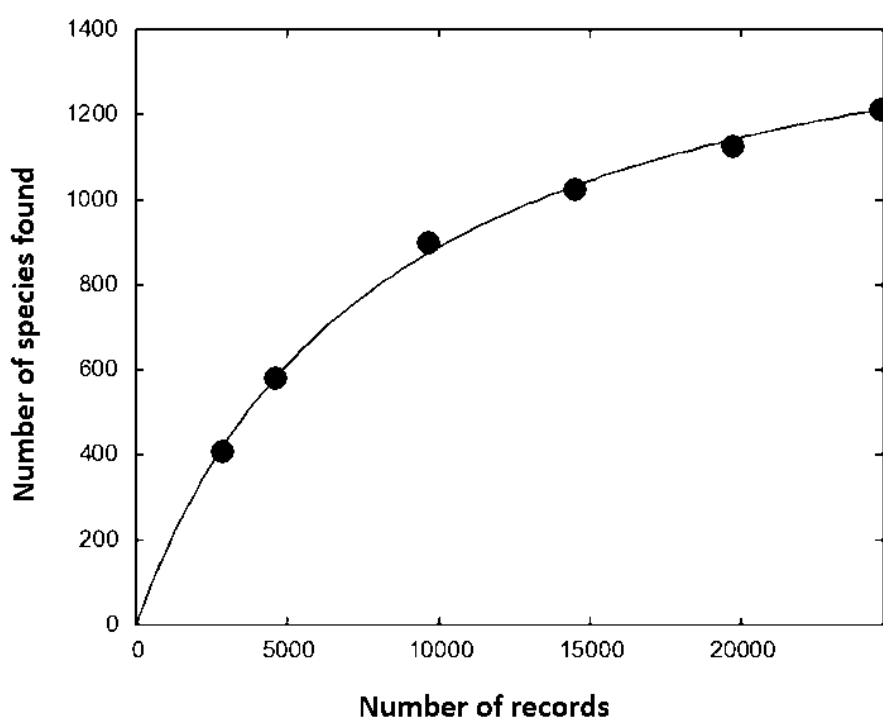


Fig. 1. The ‘discovery curve’, shown as the relation between the recording effort (number of records) and the number of species found.

2. The Piri-Piri Burr, *Acaena novae-zelandiae* (Rosaceae)

We found this little plant at Melrose, in the woods by the river Tweed. It is a prostrate perennial with a woody base, forming stolons, and well known as an alien from New Zealand and SE Australia, coming over with imported fleeces (Gynn & Richards 1985). Our initial thought was that it had escaped from a nearby garden, as we saw it there too. However, it has been pointed out that it may well be a relic of the original population of wool aliens. It certainly has increased since the report by Gynn & Richards, when there were no Scottish records at all and only a few in England, most in the NE corner of England and concentrated almost as an infestation on Lindisfarne, the Holy Island. Now there are many records (see map on p.29). The fruits have barbed spines and the species may well have been dispersed on the shaggy coats of dogs as Glynn & Richards suggested. For some time, Thompson & Morgan the seed merchants were selling it, and it can sometimes be seen at garden centres, even though it is nowadays recognised as an invasive plant, especially in coastal areas where it could threaten native species.

This raises questions about the extent to which wool aliens have persisted in our Scottish flora. Most may have died out, suffering from cold winters or dry summers. We should look into this matter, perhaps starting from the original work of Hayward and Druce (1919) and Lousley's BSBI note: *Census List of Wool Aliens found in Britain 1946-1960*.

3. Example of climatological correlations: Prickly lettuce, *Lactuca serriola*,

If we want to see climatological relationships of species we should look not at aliens, but at native species, or at least those which have been around long enough to have formed an equilibrium with the climate. I heard that the Prickly Lettuce, *Lactuca serriola*, has been cropping up in Glasgow. Dickson's *The Changing Flora of Glasgow*, published in 2000, describes it as 'very rare'. If we look at the current distribution, it is still rare in Scotland (see map on p.29). However, it shows almost exact correspondence to the mean summer temperature. As summers get warmer, we can expect to see more of it. Have you seen it?

4. Plans for the 2019 field season

The field season will soon be upon us, and the programme of field visits is being prepared. We hope to explore towns in Dumfries and Galloway,

as well as making some more local visits to allotments and a survey of Edinburgh's tramline. I do hope you will be able to join us.

John Grace

Illustrations.

The images on **p.29** illustrate the *Urban Flora of Scotland update* (p.25)

Top Left: Current distribution of *Acaena novae-zelandiae*, BSBI Atlas January 2019.

Top Right: *Acaena novae-zelandiae*, 'Piri-Piri Burr' Photograph: Swinburne Commons, Creative Commons BY-NC-ND.

Bottom Left: Current distribution of *Lactuca serriola*, Prickly lettuce, BSBI Atlas January 2019.

Bottom Right: Distribution of summer temperatures. Crown copyright but free to use under the Open Government Licence.

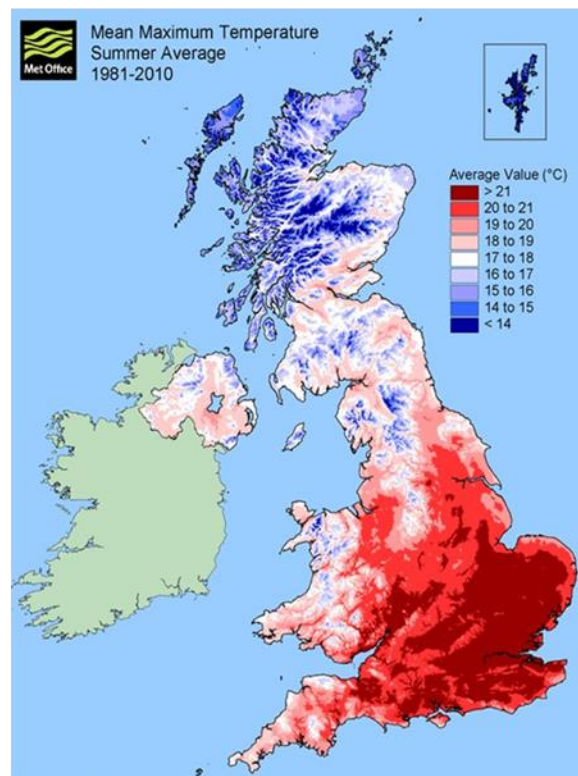
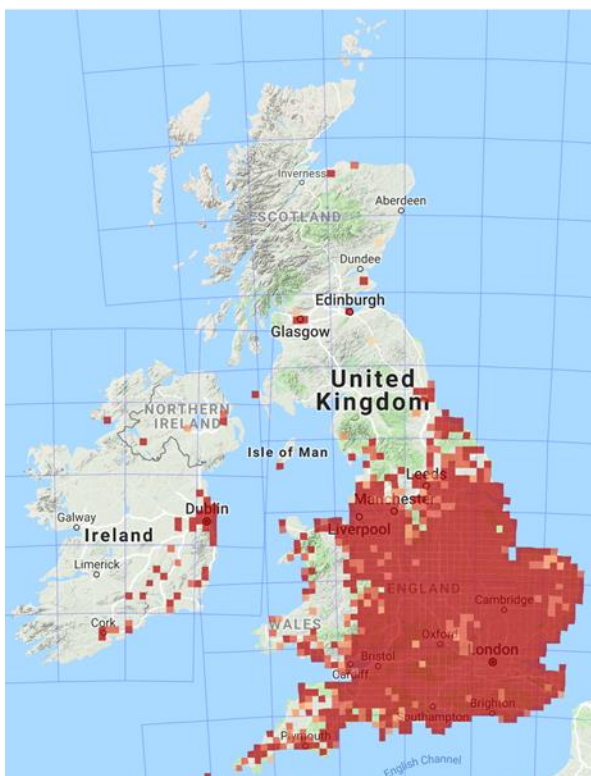
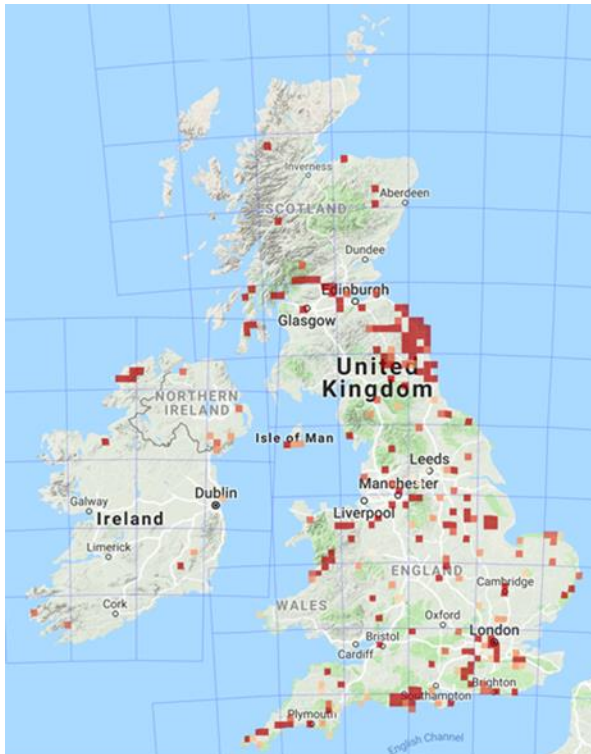
p.30:

These pictures illustrate Experiments on Managing Giant Hogweed (p.19)

Top: Giant hogweed (*Heracleum mantegazzianum*) plants overhanging the Water of Leith. A joint Edinburgh Napier University and Water of Leith Conservation Trust project is investigating the practicality and acceptability of alternatives to the use of herbicide when managing invasive plants near a watercourse. Photo by Robert Engstrom.

Bottom Left: Root-cutting and uprooting giant hogweed (*Heracleum mantegazzianum*) in full regalia near the Water of Leith. Photo by Jay Mackinnon.

Bottom Right: Conservation science fun with Water of Leith Conservation Trust and Edinburgh Napier University. Photo by Robert Engstrom.





SCIENCE SOLSTICE

THURSDAY 21ST JUNE 2018

**** BE A CITIZEN SCIENTIST FOR THE DAY! ****

Join fellow citizen scientists across the U.K. in sampling your local air for fungal spores, to monitor for resistance to azole fungicide drugs



 @jenmgshe
#ScienceSolstice

Celebrate Summer Solstice by collecting outdoor air samples from your home & workplace!
Why is this research important? To find out visit: www.fisherlab.co.uk/blog/science-solstice

A pack containing everything you need will be posted to you and a reminder text will be sent the day before.
On Summer Solstice leave the air samplers on ground floor windowsills at your two chosen locations for ~8 hours.
Return your samplers in the freepost envelope and follow a link to an online interactive map to see your data points!
(Your personal data will be kept confidential and online data points anonymised.)

To participate enter your details in the Google form: www.tinyurl.com/sciencesolstice



Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL


NERC
SCIENCE OF THE ENVIRONMENT

Tweet Activity



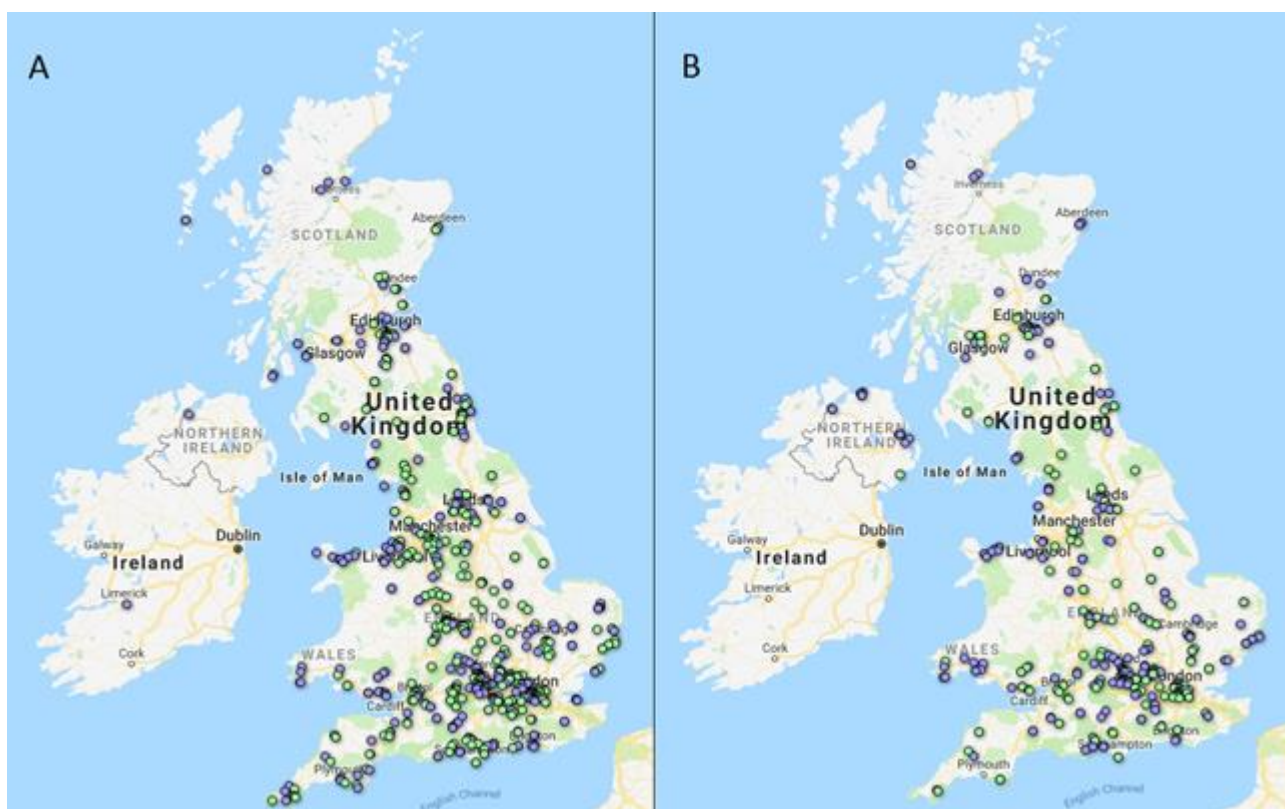
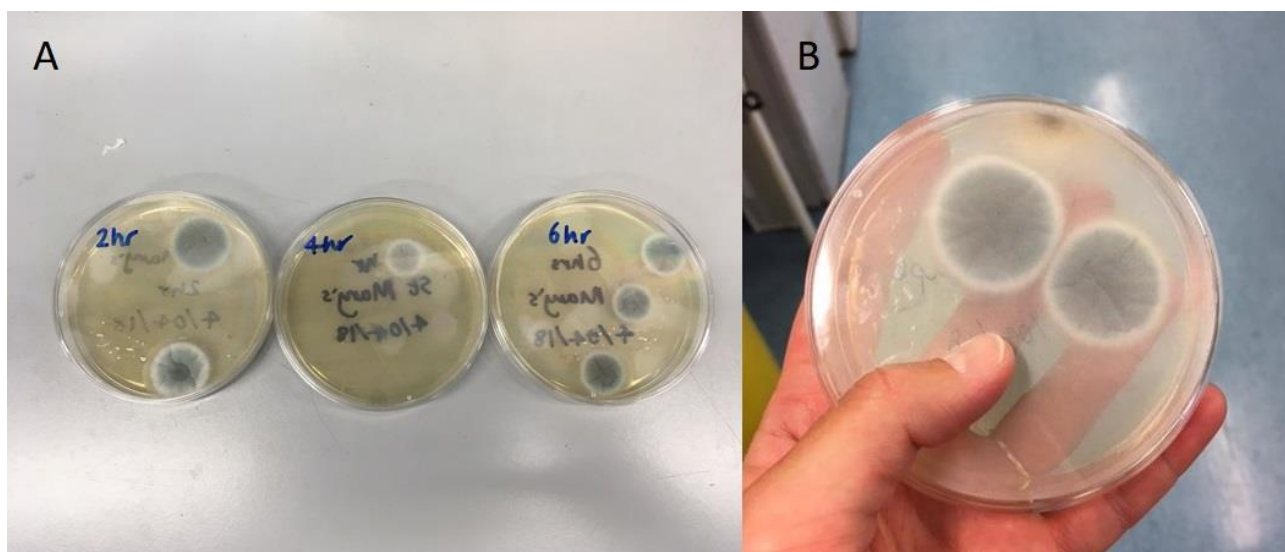
Jennifer Shelton @jenmgshe
****Volunteers needed!**** UK-wide
#microbiology #citizenscience
 project on air sampling of fungal
 spores to monitor for **#azole**
#fungicide drug resistance on
 Thurs 21st June (Summer Solstice
 '18). To participate:
<https://tinyurl.com/sciencesolstice>
@CEHScienceNews
@imperialcollege @Graham_IC
pic.twitter.com/YQcFISpEYt



Reach a bigger audience
 Get more engagements by promoting this Tweet!

Get started

Impressions	22,579
Total engagements	622
Link clicks	164
Media engagements	132
Detail expands	99
Retweets	93
Profile clicks	66
Likes	55
Replies	5
Hashtag clicks	5
Follows	3



Illustrations to #ScienceSolstice

Page 31: Top: A poster advertising for citizen scientists to take part in a UK-wide air sampling project was shared on social media platforms Twitter and Facebook in April. By mid-June the sign-up link was disabled after recruiting 500+ participants.

Bottom: Twitter sign-up for the citizen science project.

Page 32 Top: Air sampling trial run conducted at my workplaces St Mary's Hospital, London Paddington (A) and CEH Wallingford, Oxfordshire (B) to ensure the spore collection method was effective in both urban and rural locations within the timeframe of 6-10 hours.

Bottom Locations in the UK that air samples were collected from on summer solstice (A) and autumn equinox (B). Blue dots denote air samplers that did not grow *Aspergillus fumigatus* colonies, and green dots denote air samplers that did. Air samples were also collected from The Gambia, Madagascar, China, Belgium, France, Germany, Hungary, Italy, Portugal, Spain, The Netherlands, Canada, USA, Australia, New Zealand and Chile (not shown).

#SCIENCESOLSTICE: CITIZEN SCIENCE MEETS MICROBIOLOGY

Did you know that we all inhale hundreds of fungal spores every day? Many of these are produced by the mould *Aspergillus fumigatus*, which is an essential recycler of nutrients in the environment, and an opportunist lung pathogen in humans. Jennifer Shelton is a PhD student at Imperial College London and the Centre for Ecology & Hydrology who is investigating, with the help of 550 citizen scientists, the background levels of spores in the air across the UK and their resistance to antifungal drugs.

Aspergillus fumigatus is a species of fungus that is found everywhere - in air and soil, indoors and outdoors, and on nearly every continent - that plays an important role in nature as a decomposer. It prefers to grow at warm temperatures and is typically found in the centre of compost heaps where temperatures can reach up to 50-60°C and decaying organic matter abounds. It reproduces via hardy, lightweight

spores that are dispersed by air currents and it is in this way that we, as humans, inhale hundreds of these spores daily.

In the majority of us the spores cause no harm and are cleared by our immune system, but some individuals become hypersensitive to them resulting in debilitating allergic responses. The spores can also cause illness if they establish and grow within the lung, in different locations such as the cavities or airways. In immunocompromised individuals, such as those with HIV/AIDS and those receiving chemotherapy or organ transplant therapy, the growth of spores can result in a severe lung infection called invasive aspergillosis. Invasive aspergillosis has a 40-90% fatality rate and requires long-term treatment with antifungal drugs, to which infections are increasingly becoming resistant; resulting in higher fatality rates and investigations into alternative treatment regimens. Patients sometimes present with resistant infections despite no prior treatment with medical azoles, which suggests the spores they inhaled from the environment that caused the infection were already resistant.

When I started researching *A. fumigatus* for my PhD project, I found studies capturing spores and ascertaining azole-resistance levels in the air around hospitals, to assess the risk to the immune-compromised individuals; in the homes of individuals with aspergillosis, to determine the cause of infection; and around industrial composters, landfill sites and sawmills, where conditions are favourable for growth of *A. fumigatus*, to determine occupational health risks to employees. There were no studies looking at background levels of azole-resistant *A. fumigatus* spores in the air that are being inhaled by the remaining population as they go about their daily lives, which provided me the basis for my research project.

Initially I planned an intensive summer of fieldwork to collect soil and air samples from all over South England involving only myself, my car and many tubes and agar plates. Then I recalled a study conducted by a former member of my research group who used adhesive films (used in the lab to seal plates of DNA) to collect *Penicillium* spores – a different species of fungus – from the air, and an idea evolved. Why not ask individuals across the UK to collect samples of spores in the air for me? A couple of weeks later I launched my citizen science project #ScienceSolstice on social media platforms Twitter and Facebook, hopeful for 100 participants. The aim of the project was simple – to ask people to place the adhesive films sticky side up on their windowsills for

6-10 hours on summer solstice day (Thursday 21st June) and then to recover and post them back to me in the freepost envelope provided, along with details of their location. The public response was phenomenal and within 5 weeks I closed the sign-up link having recruited 485 UK participants and 66 global participants. Posters and tweets advertising for participants are illustrated on pages 31 and 32.

After making and posting out the 550 sampling packs I presented the project at a symposium on citizen science and was advised to expect 10-15% response rate, so I optimistically prepared to receive air samplers back from ~100 individuals. How wrong I was! In the fortnight following summer solstice I received envelopes back from 425 individuals (77% response rate!), which equated to 864 air samplers. These included 88 air samplers sent back by 48 individuals from across Scotland - roughly 10% of the total. I incubated the air samplers on agar plates (illustrated on p.32) and they grew an incredible 1,431 *A. fumigatus* colonies, which are now preserved and refrigerated awaiting resistance testing. Due the enormous success of the summer sampling round I contacted participants to ask if they would mind sampling from the same locations in autumn, winter and spring. The autumn sampling round on Monday 24th September (autumn equinox +1) again attracted huge support, with 306 sampling packs sent out and an impressive 254 returned (83% response rate). This equated to 490 air samplers, which grew a total of 600 *A. fumigatus* colonies.

The next step is to test these colonies for resistance to tebuconazole – the third most sprayed azole in agriculture in the UK – which will also demonstrate resistance to the medical azoles used to treat invasive aspergillosis infection. Tebuconazole is a triazole fungicide that belongs to a group of fungicides called demethylation inhibitors (DMI), which inhibit a specific enzyme involved in sterol production. This prevents treated fungi from building functional cell walls and results in abnormal growth and death of the fungi. Tebuconazole is sprayed on cereal crops including wheat, barley, oats and rye, as well as oilseed rape, to protect against fungal crop pathogens that cause mildew, septoria, rust and blight. This is important in Scotland where, in 2016 alone, 462,000 hectares of cereals and oilseeds were grown (NFU Scotland). There are other fungicides with different modes of actions to DMIs and it is recommended that these fungicides are applied in alternation or together in a mixture, to prevent fungal crop pathogens evolving resistance.

We do not know whether there will be resistant *A. fumigatus* spores in the air, but if there are, I would like to know the proportion that are resistant and whether this proportion is consistent across the UK or clustered in certain locations. If there is spatial clustering I will use land-use maps of the UK to determine whether these are agricultural areas, or particular crop types, associated with high applications of azole fungicides. This information could be used to identify 'hot spots' of resistance in the UK that individuals at highest risk of contracting invasive aspergillosis could be advised to avoid.

I would like to express my gratitude to the 550 individuals who have taken the time to participate in my citizen science project and have, as a result, provided me with a huge amount of data with a geographical spread that I could not possibly have achieved alone. As a lab scientist it is not often that I am able to interact with people whilst working, so a highlight of this project has been receiving feedback and photos from participants who have been incredibly enthusiastic about and interested in this research project. For the final sampling round in March it would be great to recruit some more citizen scientists to collect samples of their local air in Scotland, particularly anyone living north of Edinburgh!

If you would like to be involved in future sampling rounds please contact me at j.shelton@imperial.ac.uk, or if you are interested in project updates please keep an eye on www.fisherlab.co.uk/blog.

Jennifer Shelton
PhD Student at Imperial College London
and Centre for Ecology & Hydrology

1 NFU Scotland – What We Produce (<https://www.nfus.org.uk/farming-facts/what-we-produce.aspx>)

CODEWORD 4

In this codeword each number always codes for the same letter, and each letter occurs at least once. All the words are botanical genera (including some cryptogams). Solutions do not enter grey squares or cross thick lines. Further helpful hints may be found on the Members Page of the BSS website: click **Help for BSS News puzzles**

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POEMS

I saw *Dandelion Clocks* on a leaflet on Michael Braithwaite's stall at the Scottish Botanists' Conference, and he was happy for me to pass it on to you. Michael is the retired VCR for Berwickshire, a past president of BSBI, and the author of *The Botanist in Berwickshire* and *A Short Flora of Berwickshire* (both available on-line).

DANDELION CLOCKS

As spring turned into summer a line arose along the lane –
The flowering stems of dandelions elongate in synchrony,
When the flowers are all over, the flower-heads shut up tight,
Then, once the stems have straightened the heads open once again –
Open to reveal the wonder of the clock with many hands,
The seed-topped domes covering of feathery parachutes.

When I saw the long line of clocks late one sunny afternoon
A stiff breeze was gusting, so I thought I'd see them blow.
I walked onward down the lane and slowly back again.
Not a single seed detached though I intently watched.
I tried again the next day, the weather much the same.
Of the clocks I had seen before, full half had blown in the wind,
So I watched those remaining, once again no movement seen.
Then I picked a clock low down in quite a sheltered spot,
And I lifted it up slowly to the level of the hedge –
Whoosh – it all disintegrated, lifted in a gust of wind.
Seeds parachuted far and wide, just as they properly should.

One fine day in late September yet another open clock
But this time home at Clairlaw alongside my tarmac drive.
The wind was blowing near a gale, but just half the clock had gone,
So expectantly I waited, stood still and watched in vain,
Then I left impatiently and walked along the lane.
Now by the time I had come back the wind was even stronger –
Saw the stem of the dandelion bending almost to the ground,
Still no movement in the seed-clock, it was quite beyond belief.

Clocks are there to tell the time,
But with these I know not where to look,
So, their time of day for blowing
Is a mystery still not solved.

Michael Braithwaite.

DUTCH ELM DISEASE

Dutch Elm Disease. One understands
It started in the Netherlands.
Then it survived for centuries
In Europe's stately *Ulmus* trees.
But evolution's give-and-take
Ensured that there was no outbreak
Of catastrophic consequence,
until some elms were taken thence
to the New World, whose native trees
succumbed to this new-brought disease.
This stirred its slumbering genes, and hence
brought forth a virulence so dread
that U.S. elms were soon all dead.
Some logs brought back across the sea –
an act of utmost lunacy –
carried this new, lethal strain,
so that it could rampage again.

Roger West

THE SECRET WORLD OF RHODODENDRONS

Dr Richard Milne

**Joint meeting between the Dundee Naturalists' Society and
the Botanical Society of Scotland held in the University of Dundee:
28th November 2018**

Richard Milne from Edinburgh University joined us on a stormy evening to give a fascinating talk on Rhododendrons. He approached the subject from many angles, historical, cultural, botanical, horticultural and genetic.

Richard began by describing the collecting work of George Forrest in Yunnan, China. Forrest just escaped from an armed clash between Tibetans and Chinese in which many members of his party were killed.

This did not prevent him from continuing his collecting work and over the following years he brought many *Rhododendron* species to Britain.

We then heard about folktales and myths involving *Rhododendrons* and also about the survival of an ancient hieroglyphic script.

Rhododendrons feature in literature, perhaps most famously in Daphne du Maurier's *Rebecca*, where the oppressive *Rhododendrons* at Manderley are described.

The common ancestor of the *Ericaceae* plant family emerged 90 million years ago, with new interactions with fungal associates. Then 60 million years ago strings of pollen developed, facilitating pollination by insects.

Recently DNA evidence has led to an extensive reclassification of *Rhododendrons* and *Azaleas* and the realisation that these two groups are not really distinct. They are now subdivided into *Rhododendron*, *Hymenathes* and *Tsutsusi* subgenera.

Rhododendrons may contain toxins, and a few drops of nectar have been reported to cause staggering on occasion. They may also sometimes be toxic to sheep and cattle.

Ledum has now been recognised as a *Rhododendron* (*Rhododendron tomentosum*) and this species is quite widespread in Eastern Europe. There it has been used medicinally and to produce an intoxicating drink. The similar plant in Scotland is Labrador Tea (*Rhododendron groenlandicum*) and this North American species was probably introduced to produce an ale.

Rhododendron ponticum is now very frequent in the wild in Scotland, especially in the west and is seriously invasive. It occurred in Ireland before the last ice-age, but is an introduction in Scotland. It can produce dense impenetrable thickets and is difficult to control. It may have become more invasive after the introduction of genetic material from another species of *Rhododendron*. However, some people appreciate the floral displays it creates.

Richard Milne developed his interest in this topic whilst doing his PhD. work in Turkey. He has also written a book on *Rhododendrons*.

Brian Ballinger

INTRODUCING THE BRITISH ECOLOGICAL SOCIETY'S SCOTTISH POLICY GROUP

Linking Scientists and Policy Makers

After Jill Thompson attended one of the British Ecological Society Scottish Policy Group's (BES-SPG) 'Pie and a Pint' events in late November last year on "*Does a Natural Capital approach deliver for Biodiversity Conservation*" she thought BSS members would be interested in what the BES-Scottish Policy Group does, as there may be opportunities for BSS members to contribute to our work and attend our events.

The BES policy team is committed to making the best scientific evidence accessible to decision-makers - which sits well with the BES's vision of: *a world inspired, informed and influenced by ecology*. The idea of forming a Scottish Policy Group with an accompanying committee that would work alongside the long-established BES Policy Committee, was formulated eight years ago by a BES member Rob Brooker of the James Hutton Institute, in recognition of the fact that environmental policy is a devolved issue.

The aims of the BES-SPG are three-fold:

1. Supporting ecologists to understand and get involved in policy making, and to support policy makers in understanding ecology.
2. Promoting the use of ecological knowledge as part of a multidisciplinary approach to policy making.
3. Providing robust ecological evidence.

In practical terms this has meant, amongst other things, providing policy training on an annual basis to our members, usually aimed at early career researchers (with the one-day policy workshop being free to BES members) and keeping our members informed of policy matters and upcoming policy events that may be of interest to them through regular eUpdates – both activities support the first aim.

In support of the second aim we host 'Pie and a Pint' events twice a year - themes have covered topical issues such as: "The place of people in rewilding" and "What does biodiversity success in 2020 look like?" At these informal gatherings we invite external speakers to give short, PowerPoint-free presentations after which we breakout for group discussions around the chosen theme - we always write up the event into a short report, which we publish on the BES website and distribute

to interested parties. The events attract a high calibre of speakers and the contributing audience is a good mix of academics, policy makers and practitioners. Not surprisingly the networking after the talks and discussions, over a free pie and a beer, have proved very popular. There are photographs of a Pie and Pint event and of participants in a Policy Workshop on the inside back cover.

The SPG committee has found the third aim to be the most challenging to deliver, mainly because collating members views into one formal BES response to a Scottish Government consultation or inquiry is very time consuming and many of the deadlines given are very tight – neither of these obstacles are easy to overcome for our volunteer committee members whom all have full time jobs. This problem has been addressed, as the BES took on a full time Policy Officer in Scotland (i.e. me, Maggie Keegan, for three years until 2021!), and one of my roles is to help the SPG committee to carry out its activities and to help in the delivery of aim three (providing robust ecological evidence for policy).

When we provide responses/evidence on behalf of our membership, we act as the ‘honest broker’ as we do not adopt policy positions or campaign on particular issues, rather we focus on the evidence to support the statements we make. However, that does not mean that our members do not have their own views!

Between August and November last year we submitted responses on behalf of the membership to the Scottish Government’s consultation on the Forestry Strategy, the Future of Agricultural Subsidies during the Brexit transition period, Stage 1 of the Climate Change (Emissions Reduction Targets) (Scotland) Bill and the inquiry into Grouse Moor Management. (All responses are available on the BES website on the Scottish Policy Group page).

I have been greatly impressed by the support I have received from our members who have provided me with many comments/evidence/papers/advice or put me in touch with other experts. Often they have not had time to submit their own response and are happy to make their contribution through our collective BES response. They take satisfaction from knowing the research they have carried out is having an impact in policy.

The draft responses that I collate, go through a rigorous internal vetting process and are passed back and forth with comments and

changes between the SPG committee and the Policy Committee before being finally signed off by the SPG committee. Needless to say, final responses are robust and can only add to the growing reputation of the BES-SPG in Scotland. And, it certainly proves Aristotle's point that "the whole is greater than the sum of the parts."

If you would like to keep abreast of policy matters in Scotland or would like to contribute to, or provide evidence for, our future responses or come along to one of our events, you can regularly check our website or sign up to receive our eUpdates by email, which I send out about every three weeks (click on the orange button on the: Join the BES Scottish Policy Group on the Scottish Policy Group web page www.britishecologicalsociety.org). For those of you who use social media you can also follow us on Twitter (@ BES_ScotPol). Or you can simply email me if you want to find out more.

Two photographs of participants in the Policy Group meeting appear on the inside back cover.

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THE FLORAL DIVERSITY OF CENTRAL SCOTLAND – 50 YEARS OF CHANGE.

Lecture by Roy Sexton

**4th December 2018 Joint meeting between the Stirling Scottish
Wildlife Trust Members' Centre and the Botanical Society of
Scotland held in Stirling**

In 1974 Professor John Proctor, a former Botanical Society of Scotland president, published an account of the flora of what was then the Central Region of Scotland. In his talk Roy Sexton gave a description of floral changes that have taken place in the subsequent 50 years. The old Central Region did not coincide with the Vice-county boundaries usually used in botanical recording, but includes the areas around Stirling, Falkirk and Clackmannan, extending north into the Breadalbane mountains. There is a very wide spectrum of habitats and a rich flora of around 1,500 species.

Roy's illustrated account was based on his own observations together with those of many local botanical specialists. He took us through the various habitats, beginning in the mountain reserves on Ben Lui and Ben Lawers, well known for their alpine flora. Plants such as *Gentiana nivalis* (Alpine gentian), *Silene acaulis* (Moss Campion), *Minuartia sedoides* (Cyphel), *Erigeron borealis* (Alpine Fleabane) and *Veronica fruticans* (Rock Speedwell) are carefully monitored and managed by SNH and NTS staff. Changes over the 50 years have been relatively few, although sheep grazing remains a problem and visitor pressure has increased. The impact of grazing was illustrated by the luxuriant plant growth that occurred in NTS's 'exclosure' areas.

Many of the higher hills in the upland moorlands are covered in blanket bog and, where peat erosion has occurred, re-profiling is being undertaken. *Rubus chamaemorus* (cloudberry) is still present as described by Proctor (1974). Much of the original heather moor has been replaced by grassland, a process exacerbated by burning and heavy grazing. However, species such as *Genista anglica* (Petty Whin), *Trientalis europaea* (Chickweed-wintergreen) and *Neottia cordata* (Lesser Twayblade) can still be found. The reduction in grazing pressure resulting from the reform of CAP subsidies in 2005, has had a profound impact on these uplands. Grasses and Rushes have grown up and the

area of Bracken increased by 27%, smothering many of the smaller forbs. In the last five years there has also been a major increase in new Sitka Spruce plantations, encouraged by Government policy.

In the upland flushes some plants such *Hammarbya paludosa* (Bog Orchid) have been re-found, and the burns that lead from them are generally in good condition. Some major rivers like the Teith and Devon are much the same botanically as they were in the 70s. However, the banks of the Rivers Forth and Allan have been over-run by non-native invasive plants with very little bank area unaffected. The predominate species involved include *Impatiens glandulifera* (Himalayan Balsam), *Heracleum mantegazzianum* (Giant Hogweed) and *Fallopia japonica* (Japanese Knotweed). In freshwater lochs, rarities such as *Pilularia globulifera* (Pillwort) and *Nuphar pumila* (Least Water-lily) are still recorded. The fens surrounding the lochs still contain *Stellaria palustris* (Marsh Stitchwort), *Lysimachia thyrsoiflora* (Tufted Loosestrife) and *Dactylorhiza incarnata* (Early Marsh Orchid) where they were described in the 70s. The very rare *Rumex aquaticus* (Scottish Dock) grows round the Endrick, although it does tend to hybridise with more common Dock species.

The cliffs and gorges of the Ochils hold a large population of the rare and beautiful *Silene viscaria* (Sticky catchfly), still present in many of its old sites. Grazing by sheep and incursion by *Ulex europaeus* (Gorse) are threats.

With regards to the woodlands one fragment of ancient pinewood survives at Cononish near Tyndrum. Native broad-leaved woodlands have been badly affected by Dutch Elm disease and Ash Die Back, though Elm is recovering in most places. Amongst the rare woodland floor species mentioned by Proctor (1974), *Neottia nidus-avis* (Bird's-nest orchid) and *Lathraea squamaria* (Toothwort) are doing well, but *Paris quadrifolia* (Herb Paris) has been lost at all its sites. *Corallorhiza trifida* (Coralroot Orchid), which was thought to have been lost, has been re-found at two woodland sites.

The use of selective herbicides has led to a major reduction in the weeds of arable fields, and many like *Agrostemma pithago* (Corn Cockle) and *Centaurea cyanus* (Cornflower) have disappeared. The CAP set-aside policy of the 1990s led to some spectacular resurgences of those weed species with long-lived seed including *Chrysanthemum segetum* (Corn Marigold), *Papaver dubium* (Poppy) and *Galeopsis speciosa* (Large-flowered Hemp-nettle). Twenty-five wild flower rich

grasslands have been monitored by the local SWT over the last 15 years. Each site is evaluated by counting the numbers of selected axiophytes. Nine have remained stable and unchanged, 11 have been declining and five have been lost. These changes are mainly attributed to alterations in grazing regimes. In a study of the hedgerows in the Carse of Lecropt, 47% of those present in the 1850s have been uprooted, reflecting the national trend. Forty eight percent of the remaining hedgerow plants are now flailed annually, reducing hawthorn berry production by 60-fold.

The creation of new salt marshes in the Forth Estuary following the breaching of sea walls at RSPBs Skinflats reserve and the flooding of Alloa Inch has been beneficial floristically. Magnificent displays appear when *Cochlearia officinalis* {Scurvy Grass} and *Aster tripolium* (Sea Aster) flower. A new species to the area *Monotropa hypopitys* (Yellow Birds-nest) appeared in 2016 on the old oil-shale ridges at Skinflats.

Of 73 plant species thought to be lost by Proctor in 1974, 35 have subsequently been re-found and several new species such as *Pseudorchis albida* (Small White Orchid) have been discovered.

In summary, there is still an important diversity of plant species in the central Scotland area but threats remain. These include the relentless impact of the intensification of agricultural practices, the influence of subsidies to forestry and agriculture, the irresponsible introduction of non-native invasive species, short-term approaches to conservation and public ignorance of botanical matters.

Brian Ballinger (with information from Roy Sexton)

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THE FAVOURITE FLOWERS OF ROBERT BURNS

Frances Wallace Dunlop, Scottish heiress, landowner, and descendant of a brother of William Wallace, lived at Dunlop House in East Ayrshire. In the winter of 1786, despondent after a lengthy illness and the death of her husband, Mrs. Dunlop read Robert Burns' poem, "The Cotter's Saturday Night," in a friend's copy of Burns' first book of poems, "Poems, Chiefly in the Scottish Dialect" commonly known as "The Kilmarnock volume."

Mrs. Dunlop was so taken with the poem that she sent Burns, who was living only eighteen miles distant at Mossgiel Farm, a request for several copies of his book along with an invitation to visit her at Dunlop House. Thus began a long friendship in which Mrs. Dunlop, serving in the roll of critic, patron and advisor, introduced Burns to Edinburgh society. She also advised him to write an autobiographical letter to Dr John Moore, a letter on which nearly every, if not all, biographies of Burns are based.

Over the years Mrs. Dunlop and Burns carried on a prolific correspondence in which Burns shared his thoughts, opinions, rough drafts, and poems through more letters than he wrote to any other correspondent.

The exchange of letters between them was brought to an abrupt end by Mrs. Dunlop, who as a member of the aristocracy disapproved of Burns' sympathies with French revolutionaries and of his anti-royalist attitudes. Burns, distraught at the loss of the friendship, wrote several more letters to no avail until Mrs. Dunlop finally relented sending him one last letter, which he is said to have read upon his death bed.

In one of Burns' letters to Mrs. Dunlop written on 1 January 1789, the poet discusses how different people have varying impressions when presented with life's sights and experiences. He elaborates saying that for him a May Sunday with its "breezy blue-skyed noon" or a "hoary morning and calm sunny day about the end of autumn" feel like holidays.¹ In the letter Burns also discusses his favourite plants, writing, "I have some favourite flowers in spring, among which are the mountain-daisy, the hare-bell, the fox-glove, the wild brier-rose, the budding birch, and the hoary hawthorn, that I view and hang over with particular delight."² Illustrations of these plants appear on the outside back cover.

Indeed, Burns mentions these six species, the rose over 66 times, in many of his poems to set a scene, establish a mood, or to metaphorically describe a situation, feature or person as he did with “My Luve is Like a Red, Red, Rose” or with his use of the mountain daisy as a symbol of his thwarted early love affair with Jean Armour.

The Plants:

Mountain-daisy, common daisy - *Bellis perennis*:

Wee, modest, crimson-tippèd flow'r,
Thou's met me in an evil hour;
For I maun crush amang the stoure
Thy slender stem:
To spare thee now is past my pow'r,
Thou bonie gem.”³

Burns’ mountain-daisy is to many people the quintessential daisy. The species is native to Europe, but has spread throughout North and South America as well. As with most other members of the family Asteraceae, each daisy “flower” head is actually a miniature bouquet containing a centre of petal-free “disk” flowers and a circle of “ray” flowers each with one petal frequently tipped with a blush of red. Borne on leafless stems, the flower is also called the lawn daisy easily spreading with underground rhizomes.

The hare-bell, Scottish bluebell, lady’s thimble - *Campanula rotundifolia*:

“Mourn, little harebells o'er the lea;
Ye stately foxgloves, fair to see;
In scented bowers;
Ye roses on your thorny tree,
The first o flowers.”⁴

In Burns’ poem, “Elegy On Captain Matthew Henderson,” the harebell is counted among the flora and fauna of nature that will mourn the Captain’s passing. Achieving a height of 16”, the hare-bell produces pale blue to lavender-coloured flowers each with five petals fused into the shape of a bell and capped with pointed green sepals. The species range is circumpolar from latitude 40°N to 78°N.

The fox-glove - *Digitalis purpurea*:

Another species mentioned in Burns' "Elegy On Captain Matthew Henderson," and found throughout Britain, the biennial foxglove's greyish pubescent foliage appears during the first year in a woolly rosette. In its second year the foxglove develops a 90 cm stalk with up to 80 flowers of four possible phenotypes from deep purple to white. The bell-shaped flowers with their interior purple spots are frequented by bees that venture inside seeking nectar.

All parts of the plant are extremely poisonous, but when properly formulated into a medication with a controlled dosage, digitalis is used to treat heart failure.

The wild brier-rose, briar, wild rose - *Rosa canina*:

"The rose upon the brier by the waters running clear
May have charms for the linnet or the bee:
Their little loves are blest, and their little hearts at rest,
But my lover is parted from me."⁵

Referring to wild roses in his poems over 60 times, Burns most likely had in mind the dog rose. Native to Europe and Western Asia, this species is hedges, woods and riverbanks. It can be found on the margins of fields, especially in the shelter of dykes. Its five-petaled flowers are usually soft pink, but can vary from white to deep pink. Stems of the dog rose are covered with prickles, needle-like extensions of the plant's cortex and epidermis, which allow the shrub to climb into trees. In the autumn the dog rose's bare branches are graced with bright red rose hips high in vitamin C.

In the first draft of his poem, "The Posie," Burns also mentions the Eglantine rose, *Rosa rubiginosa*, which like the dog rose is known as sweet briar, "I'll join the scented birk, to the breathing eglantine;"⁶ However, the Eglantine rose is not found as commonly in Ayr as is the dog rose.

The budding birch, silver birch - *Betula pendula*:

"Let Fortune's gifts at random flee,
They ne'er shall draw a wish frae me,
Supremely blest wi love and thee
In the birks of Aberfeldie."⁷

Burns composed this song while standing viewing the Falls of Aberfeldy near Moness, Perthshire. Silver Birch is a medium sized deciduous tree native to Europe. A pioneer species, it was one of the earliest colonisers of Scotland after the Ice Age. Silver Birch grows up to 39 metres tall and has a slender white trunk frequently covered with dark fissures especially at the base. Arching branches end in drooping branchlets whose shoots are hairless and covered with small warty growths. Triangular leaves are three to seven centimetres long with broad bases, pointed tips and doubly serrated margins.

Flowers of the silver birch are produced in the early spring in wind-pollinated catkins and the tiny wind-born seeds ripen in late summer.

The hoary hawthorn, haw, May flower - *Crataegus monogyna*:

“The primrose bank, the wimpling burn,
The cuckoo on the milk-white thorn,
The wanton lambs at early morn
Shall welcome thee, my dearie, O.”⁸

Hawthorns are large shrubs or small trees with dull brown bark having vertical orange cracks. The tree's young stems are covered with sharp thorns and its flowers have five white petals produced in corymbs of five to twenty-five flowers that bloom in late spring. In the autumn the dark red haws appear each containing a single seed. These are an important food source for many birds such as waxwings and thrushes that spread the seeds throughout the countryside in their droppings.

In Scotland the hawthorn, also known as may-tree, is the commonest tree planted in hedgerows, providing habitat for numerous species such as hawthorn shield bugs, yellowhammers, wood mice and slow worms.

(My thanks to David Sibbald of www.robertburns.plus.com for the edit and advice.)

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THREATS AND OPPORTUNITIES FROM CHANGING SPECIES DISTRIBUTIONS: SHOULD WE ACCEPT BEECH AS A NATIVE TREE IN SCOTLAND?

**Professor Alistair Jump, Stirling University
PSNS Botanical Section and Botanical Society of Scotland
A. K. Bell Library, Perth, January 23rd 2019**

Professor Jump described his work on species distribution with particular reference to Beech (*Fagus sylvatica*). This has been regarded as only being native in the southern part of Britain, but is now very widely distributed over the whole island.

He described the factors influencing the distribution of plant species including climate and, temperature, terrain, competitors and diseases. Climate change is also now a factor. Virtually none of the plant habitats in Britain are totally natural, all having been influenced by man.

We were told of the particular characteristics of Beech that make it very successful in many parts of the UK. Beech is thought to have spread from 3 main and several smaller refugia at the end of the last ice age. It spread to southern England between 3000 and 1000 years ago. Outwith this area it has been widely planted and is sometimes regarded as a threat.

Prof. Jump and his team sampled DNA from a wide variety of British populations and also several overseas locations in Europe. Genetic testing showed that although the highest diversity was in Southern England there were few striking differences across the country and northern British populations were descended from those in the south.

This research has led to the conclusion that beech was likely to have been moving north in any case, but that this spread was speeded up by human intervention.

In Scotland, beech now appears to be doing better than in Southern England, perhaps because of the drier climate in the south. It still persists in Southern Europe.

He made a case for regarding beech as a desirable and “new native” tree in northern Britain in areas where native forest is absent. This may be particularly important because of the threats to other tree species from diseases. However, rapid spread of beech into sensitive

habitats such as Atlantic oak woodland represents a serious threat to existing biodiversity. Consequently, we need to carefully prioritise where we remove beech and where we allow it to spread.

Brian Ballinger

ILLUSTRATIONS OF NON-NATIVE INVADERS - 9

***CROCOSMIA* x *CROCOSMIIFLORA* (Lemoine) N. E. Br. (IRIDACEAE)**

Crocospia, so-called from the Greek for 'smell of saffron' prompted by the aroma when dried leaves are placed in hot water, is a small genus of about eight grassland species native to South and East Africa, from the Republic of South Africa to the Sudan. *Crocospia* x *crocospmiiflora*, commonly known as Garden Montbretia or Autumn Gold, is a hybrid of horticultural origin and has no native range. It was produced in 1879 by Victor Lemoine in his Nursery (established 1848, closed 1968) at Nancy, France, when he deliberately crossed two diploid species, *Crocospia aurea* (Pappe ex Hook.) Planch, native in the Cape Province north to Sudan, with *C. pottsii* (Baker) N. E. Br., native in Cape Province and KwaZulu Natal. Lemoine (21 October 1823 – 11 December 1911) was a prolific breeder of garden plants of many genera, especially Lilacs but also including Fuchsias, the first double Zonal Pelargoniums, and the first *Streptocarpus* hybrids. He was the first foreigner to be awarded the Victoria Medal of the Royal Horticultural Society (RHS). *Crocospia* x *crocospmiiflora* arrived in Britain soon after it was first produced, and was first recorded as naturalised in the wild in Britain in 1907 or, according to some authorities, 1911. Since then, *C. x crocospmiiflora* has become a very popular garden plant throughout the warmer parts of the world and many cultivars have been selected with flowers ranging from yellow through orange to red. An illustration of *C x crocospmiiflora* by Janet Dyer is on the front cover.

In some parts of western Great Britain, three *Crocospia* species (*C. masoniorum*, *C. paniculata* and *C. pottsii*) are naturalised in similar habitats, but are not considered to be invasive. New *Crocospia* hybrids, including the popular cultivar *C. x curtonus* 'Lucifer' (*C. masoniorum* x *C. paniculata*, cross-pollinated in 1963, introduced in 1966, and released in 1970) have been produced at Bressingham, Norfolk, by Alan Bloom

(1906-2005), another RHS Victoria medallist, and some of these new cultivars are also now becoming naturalised.

Crocosmia x crocosmiiflora grows vigorously in a variety of soil conditions and is resistant to slug and rabbit damage, which adds to its popularity as a garden plant. It grows best in compost-enriched moisture-retentive but well-drained sandy soil in sun or partial shade.



Drawing of *Crocosmia x crocosmiifolia* by Janet Dyer, photographed by Adrian Dyer.

Since appearing in British gardens, it has escaped from cultivation into a wide range of conditions and can displace native vegetation especially in riparian habitats and moist shrubland. To date, it has been recorded in more than 60% of the hectads (10km squares) of the British Isles and Ireland, making it one of the 10 most widespread neophyte (i.e. introduced since AD1500) aliens. *Crocosmia* is found, often close to gardens, in hedgerows, waysides, woodland, waste places and by lakes and rivers. It is most invasive in open slopes near the coast, including the back of salt marshes, and in roadsides, including Cornish hedgebanks. *Crocosmia* does not tolerate deep shade, or hard frosts, so

is absent from densely forested and mountainous areas. *Crocasmia* is more common in the oceanic climate of the west of the British Isles, and particularly in western Ireland where it is a characteristic hedgerow plant, and where it is often growing with another alien, *Fuchsia magellanica*. *Crocasmia* has been introduced to many other parts of the world and is recorded as invasive in Réunion, Chile, Canary Islands, Madeira, Azores, Hawaii, Dominican Republic, and in Australia and New Zealand where it is particularly widespread. It grows best in damp conditions in a variety of habitats, from disturbed sites and abandoned farms to waysides, woodland and grassland.

Crocasmia x crocosmiiflora is an erect deciduous perennial herb. It is up to about 60cm high, with all-basal iris-like flat leaves up to 50cm long and 2cm wide with a raised mid-rib. In Britain the dead leaves turn brown but are slow to decay through the winter; in warmer climates they remain green all-year-round. The leaves, the slender underground stolons and the round arching flower stems arise from crocus-like corms, 2-3cm in diameter with fibrous scaly outer layers. The slender scaly stolons produce new plants at the tips, some distance from the parent. New corms produced on short stolons form an upright 'tower' or chain of up to six or more corms; contractile roots on the lowest corm pull the chain lower into the soil. The often branched, slightly arching, spike is taller than the leaves and bears on two sides the curved tubular zygomorphic flowers with 6-10mm long bracts. The six tepals are usually deep orange, occasionally yellow or red, lanceolate, 15-25mm long and 6-9mm wide, forming a tube, which widens gradually distally before separating into spreading lobes that are about the same length as the tube. The three stamens are nearly as long as the perianth; the 15-22mm long free filaments bear yellow anthers 6-8mm long. The trilocular ovary bears a single style which projects beyond the stamens and terminates in three slender branches bearing the stigmas at the tips. The flowers evolved for bird pollination but, in Britain, *Crocasmia* plants are pollinated by bees and wind. *Crocasmia x crocosmiiflora* rarely sets seed; the fruit when formed is a short brown dehiscent capsule, 7mm long by 9mm wide. Any seeds formed are brown, wrinkled and usually not viable. Chromosome number $2n=2x=22-24$ and $3x=33$.

The other *Crocasmia* species that are naturalised in similar habitats in Britain, all diploids, are much less common and can be distinguished from *C. x crocosmiiflora* as follows:

Crocasmia paniculata is significantly larger, with strongly pleated leaves, some more than 3cm wide, a perianth 4.5-6.0cm long, and perianth lobes no more than half as long as the tube, and stamens shorter than the perianth.

Crocasmia masoniorum is significantly larger, with strongly pleated leaves, some more than 3cm wide, a perianth 4.5-6.0cm long, and perianth lobes about as long as the tube, and stamens slightly exceeding the perianth.

Crocasmia pottsii taller, up to 80cm, but leaves and flowers not significantly larger, leaves not pleated, perianth tube very narrow at base, widening abruptly distally, perianth lobes about half as long as the tube.

Crocasmia x crocosmiiflora forms expanding dense clumps but, because seeds are rarely formed, it spreads slowly when not disturbed. Dispersal of corms into the wild is mainly due to careless disposal of unwanted plants in garden waste after clumps have become too large. Spread, once in the wild, will be slow in the absence of human disturbance except where river bank clumps can be eroded and washed downstream. However, once established, clumps can rapidly expand and dense infestations become dominant, smothering the native ground flora and small shrubs, and preventing native seedling establishment. There is so far no significant economic impact of these invasions.

Crocasmia x crocosmiiflora is listed under Schedule 9 of the Wildlife and Countryside Act 1981 for England and Wales, which makes it an offence to plant it, or allow it to grow, in the wild, while in Scotland it is covered by the wider 2011 amendment to the 1981 Act, the Wildlife and Natural Environment (Scotland) Act, which makes it an offence "to plant or cause any non-native plant species to grow in the wild". It is listed as a prohibited species by California Invasive Plant Council. Control of small infestations can be achieved by digging out the corms. Chemical control with herbicides such as glyphosate and metsulfuron-methyl has been used in Australia and New Zealand in areas away from native flora and water courses that could be contaminated.

It is still a popular garden plant, available in nurseries and garden centres worldwide, so future deliberate introduction to gardens in new areas will be unavoidable and further escape into the wild very difficult to prevent.

Adrian Dyer

SOLUTION TO CODEWORD 4

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BSS NEWS – INFORMATION AND GUIDELINES FOR CONTRIBUTORS

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PLEASE SEND ITEMS TO BE INCLUDED *ONLY* TO THE RECEIVING EDITOR

Aims of BSS News

The chief aims of BSS News are to communicate with the membership, to keep members informed and to act as a vehicle for members' contributions on all things botanical. All contributions are welcome.

Scope of the Newsletter

The content of BSS News is as kaleidoscopic as possible around the botanical theme and we are keen for this variety to continue. For a list of ideas for contributors see the BSS website (www.botanical-society-scotland.org.uk) and the following list, but please don't feel constrained by it. New ideas are welcome. Regular contributions include the following items:

- Reports of field excursions (leaders please take note), picking out the botanical highlights.
- Descriptions and recommendations of other botanical sites in the UK or abroad (it might help people to plan their holidays)

- Articles of current or historical interest, including ethno- and achemo-botany.
- Biographical profiles of botanists.
- Botanical poems.
- Botanical notes, news items, announcements of future events, reports of meetings attended, correspondence, small ads etc.
- Book reviews.
- Crosswords and quizzes.
- Illustrations, including paintings, photographs and line drawings, or even witty cartoons if they are your forte! A stock of small b/w line drawings of plants would be useful for filling areas of whitespace at the end of articles. Coloured illustrations can only be printed on the inside and outside cover, and usually illustrate articles.

Guidelines for contributors

Do not worry if you cannot comply with all the following guidelines. Just send what you can and the Editors will make adjustments.

File name for email submissions and web uploads.

Please include your own name and indicate article content in the file name. Also add your name, preferred title and affiliation etc. to the end of your article. If possible, please add a contact email address (see our template on the BSS website for full instructions)

Text

The Newsletter is set up on A4 pages in MS Word 2010 using Ariel font (size 15 for major text, 18 for main headings and 14 for references and acknowledgements). Margins are set at 2 cm (sides) and 2.5 cm (top and bottom), with headers and footers at 1.5 cm. Text is justified and single-spaced. Paragraphs are followed by 6pt spacing. **Please use the template on the BSS website to submit articles in this format.**

Illustrations

The cover is the display area for colour pictures. Please include an appropriate caption and the name of the photographer or artist with all images. Line drawings, maps or graphs in the text look best in black-and-white or greyscale.

Submission

Please send your contributions to the Receiving Editor by:

- Post at the address above.
- Email to the Receiving Editor at jill.thompson99@gmail.com
- Through the BSS website at <http://www.botanical-society-scotland.org.uk/content/bss-news-newsletter-botanical-society-scotland>

When sending something by post please phone 0131 258 2358 or email jill.thompson99@gmail.com to let Jill know that something has been posted.

The last deadline for the next issue will be 15th July 2019. Earlier submission would be appreciated.

Back cover pictures

Outside back cover

Illustrations of *The Favourite Flowers of Robert Burns* (Peggy Edwards, p.47 illustrations all by Peggy Edwards)

Top left: Left to right, top to bottom: Mountain Daisy, Harebell,
(composite) Foxglove, Dog Rose, Silver Birch, Hawthorn.

Top Right: Harebell: *Campanula rotundifolia*

Bottom Left: Mountain Daisy: *Bellis perennis*

Inside back cover

British Ecological Society meeting (p.41):

Top: Q and A with speakers at Pie and Pint, November 2018

Bottom: Early career researchers, BES staff, SPG committee members, speakers, and two MSPs at the Policy Workshop, November 2018.



