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Student Symposium 2009

22nd September 2009 - Royal Botanic Garden, Edinburgh

CONFERENCE PROCEEDINGS



Editor: Alex Twyford



INTRODUCTION

Twenty years since the last BSS Student Symposium, the recently resurrected symposium was held on the 22nd September 2009, at the Royal Botanic Gardens Edinburgh. Thirty one delegates from 11 institutes attended a packed day of talks covering a wide range of botanical topics, from ecology and evolution through to molecular studies. The symposium highlighted the current focus of Scottish research institutes on the topical issues of climate change and habitat degradation, whilst also covering potential routes to maintain Scotland's biodiversity.

The BSS is committed to supporting research in botany, and the symposium shows the promising future face of botanical research. This booklet contains the abstracts submitted by the presenters at the symposium. I hope that you found the day stimulating, and enjoy reading more about the diversity of current research.

A handwritten signature in black ink that reads "Alex Twyford". The signature is written in a cursive style with a horizontal line underneath the name.

Alex Twyford
Symposium Organiser

PROGRAMME

8.45 Registration opens

9.20 Welcome (Alex Twyford and Chris Jeffree)

SESSION 1 – Conservation Ecology Chair: Richard Ennos (University of Edinburgh)

9.30 Allan Elliott *Meconopsis* seed germination in a phylogenetic context

9.45 Jasper Wubs Mixed mating system in the homosporous fern *Asplenium scolopendrium* L.: implications for colonization potential

10.00 Chantel Davies How do aspen genotypes influence their lichen communities?

10.15 Lorna Wilkie Can artificial seagrass beds be used to restore sediment habitats?

10.30 Sanna Kivimäki Carbon and N cycling in *Sphagnum capillifolium* in response to N deposition and N form

10.45 Coffee (in the conference room)

SESSION 2 – Ecology, adaptation and habitat change Chair: Alex Twyford (RBGE/UoE)

11.15 Rachel Edmans A comparison of the biodiversity of wasteland (post-industrial) mill sites along the Water of Leith

11.30 Gosia Kowalewska Preliminary studies on *Dickeya* spp. isolated from Scottish rivers

11.45 Matti Salmela Adaptive variation in Scots pine (*Pinus sylvestris*) in Scotland

12.00 Elizabeth Bourne Understanding local adaptation in Northern rock cress: coping with the serpentine syndrome

12.15 Louise Ross Impacts of environmental change on Scottish upland vegetation- results from a 50-year re-visitation study

12.30 Lunch and posters (in the conference room) *Garden tour 1pm (optional)*

SESSION 3 – Tropical and temperate ecology Chair: Toby Pennington (RBGE)

2.00 Alex Twyford Pollen Studies in *Begonia*

2.15 Toshie Mizunuma The optimal colour index for the phenological recording of leaf canopies

2.30 Marjan van de Weg Photosynthetic capacity, leaf dark respiration and leaf traits in the canopy of a tropical montane cloud forest in Peru

2.45 Anandan Govindarajulu Traditional uses of Neem (*Azadiracta indica*)

3.00 Coffee (in the conference room)

SESSION 4 – Molecular ecology, taxonomy and evolution Chair: Catherine Kidner (RBGE/UoE)

3.30 Emily Carroll The impact of Scottish winter climbing on cliff-face vegetation

3.45 Nicolas Ruch What is *Orchis purpurea*? Molecular studies in the anthropomorphic group of *Orchis* (*Orchidaceae*)

4.00 Saima Umbreen Evolution of leaf shape in *Begonia* section *Gireoudia*

4.15 Gerald Hochschartner *snoRNA* genes and plant evolution

4.30 KEYNOTE SPEECH:

Richard Abbott Gene transfer and plant evolution: What we have learnt from *Senecio* ?

5.15 Prizes and thanks

5.30 Close

SESSION 1

Conservation ecology

***Meconopsis* seed germination in a phylogenetic context**

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Viability and germination rate of seed of five species and four cultivars of *Meconopsis* were tested. The seed was stored refrigerated (c.4°C) and at ambient temperature (8–17°C) to reflect typical conditions for seed storage in the smaller botanical garden and amateur enthusiast's collection. Seed that had been stored in each of these conditions was sown sequentially 2, 3, 4 and 5 months after harvest. Seed batches were also treated with 0.25 mg/L gibberellic acid (GA) or left untreated. Each of the four combination treatments were associated with an overall reduction in viability and germination rate as time after harvest increased (to a minimum of 66.7% viability and 33.7% germination, except for two species with high viability but no germination in the study period). These reductions were not significantly different between treatments, and use of GA did not significantly increase germination rate. The project assessed the underlying genetic relationship on germination by relating our results to the most recent comprehensive phylogeny of the genus, and we suggest that ecology plays a more important role than phylogeny in germination.

Keywords: *Meconopsis*, Papaveraceae, seed germination, phylogenetic

Mixed mating system in the homosporous fern *Asplenium scolopendrium* L.: implications for colonization potential

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Human-mediated environmental change is increasing selection pressure for colonization capacity in plants. Habitat fragmentation combined with climate change forces species to colonize new areas over longer distances, subjecting them to prolonged periods of inbreeding. Inbreeding depression may hamper reproduction and therefore long-term survival of new colonies.

Experimental crosses were established among *Asplenium scolopendrium* (Aspleniaceae, Pteridophyta) gametophytes, representing outcrossing and two levels of selfing. The experiment included nine genotypes, representing 95% of the non-private intraspecific genetic variation found throughout Europe. Selfing decreased sporophyte production, indicating inbreeding depression. Simultaneously, most tested genotypes (8) were capable of intragametophytic selfing.

In ferns a mixed mating system, with outcrossing when possible and occasional selfing when needed, is a potent colonization strategy. Intragametophytic selfing allows successful colonization of new sites from a single spore. The resulting sporophyte will, over time, start shedding huge amounts of spores; creating a bed of gametophytes in its direct vicinity every year. Any arriving foreign spore is then selectively favoured to reproduce and contribute its genes to the new population. Thus, selfing facilitates initial colonization success, while inbreeding depression promotes genetically diverse populations through outcrossing; thereby increasing the local potential for adaptation to environmental change.

Key words: colonization, homosporous fern, inbreeding depression, mixed mating system, selfing

How do aspen genotypes influence their lichen communities?

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Aspen (*Populus tremula* L.) is a native Scottish tree, formerly widespread but now existing in fragmented colonies. Natural aspen stands contain many trees of the same genotype and mixtures of clones of different genetic structure. Genetic differences may be seen in such physical characters as: leaf morphology; bark texture; timing of bud burst; and range of autumn colour. Clonal differences also exist in the concentrations of phenolic-based chemicals produced to deter herbivory. The bark also has a higher pH and richer nutrient status than many other tree species. Most importantly, the host of organisms associated with aspen, lichens in particular, make it an important species that plays a critical role in supporting biological diversity. My research explores the differences between some physical characters of five aspen clones in Strathspey, Scotland, and how these differences may influence their respective lichen communities.

Can artificial seagrass beds be used to restore sediment habitats?

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The Tay Estuary comprises a number of priority habitats including saltmarsh and beds of the intertidal seagrasses *Zostera marina* var. *angustifolia* and *Z. noltii*. Saltmarsh in Britain is in decline, and there has been an ongoing general decline of seagrass populations since the 1960s. In the Tay Estuary areas of saltmarsh have been lost as a result of lateral erosion of the seaward margin and internal dissection of the marshes.

Seagrasses trap suspended particles and elevate the sediment surface, leading to saltmarsh succession. However, the natural development of saltmarsh can take up to 140 years. Saltmarsh protects the coastline from scour and wave erosion by dissipating the energy of tidal currents and waves. As the requirement for sustainable coastal defence increases, coastal managers are seeking cost-effective and relatively fast-acting ways to use in conjunction with managed realignment, to restore marshes where losses have taken place, or reduce erosion in front of marshes.

In the Tay Estuary transplanted *Z. noltii* and artificial seagrass beds will be compared with naturally occurring beds and bare sediment to investigate the role of *Z. noltii* as an ecosystem engineer by increasing deposition in front of saltmarsh habitat, and to compare habitat restoration techniques.

Carbon and N cycling in *Sphagnum capillifolium* in response to N deposition and N form

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The increased atmospheric N deposition has been found to lead to higher N levels in *Sphagnum* tissues and so affect their productivity, decomposition and/or CO₂ fluxes. The aims of the study were to: 1) compare the effects of different N loads and N forms on *Sphagnum capillifolium* productivity, decomposition and CO₂ fluxes, and 2) to examine how P and K additions influence the effects of increased N.

The study was carried out at Whim experimental study site where the effects of N, both dose (8, 24 and 56 kg ha⁻¹ y⁻¹) and form (nitrate and ammonium) on a peat bog have been studied since 2002. There are also study plots where P and K are added with N. Results from the productivity experiment showed that increased N has a detrimental effect on the growth and productivity of *S. capillifolium*; adding P and K with N alleviated these effects. Supporting this, the results from the CO₂ measurements showed increased CO₂ losses from the N treatment plots. On the contrary, the first results from the decomposition experiment suggest that increased N decreases the rate of decomposition compared to the control plots.

SESSION 2

Ecology, adaptation and habitat change

A comparison of the biodiversity of wasteland (post-industrial) mill sites along the Water of Leith

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This is an investigation into the vegetation biodiversity on post industrial mill sites along Edinburgh's main river, the Water of Leith. It was thought that these post industrial mill sites may contain high levels of biodiversity, due to their previous history and being wasteland sites for numerous years. Therefore vegetation surveys were carried out on five mill sites (and on five control sites), where the percentage cover of each plant species was recorded. This was carried out in both quadrat and transect format.

The raw data was compared against environmental characteristics of the site. These included: age, size, pH, distance to human habitation, distance to water etc. This would conclude which characteristic was having the greatest effect on the biodiversity of the area.

In conclusion, in terms of species richness, control sites have more diversity; however the mill sites do display a greater number of species (which are only found on particular sites). It was found that the characteristics having the greatest effects were site size, site age and distance to water. Therefore the mill sites can be considered diverse. Thus it can be seen that urban wastelands can prove an important source for biodiversity.

Keywords: biodiversity, species richness, post-industrial, wastelands, water mills

Preliminary studies on *Dickeya* spp. isolated from Scottish rivers

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Members of the genus *Dickeya* (syn. *Erwinia chrysanthemi*) are bacterial plant pathogens which can infect a range of hosts, including ornamental plants and crops. A number of *Dickeya* species cause disease in potato and symptoms include vascular necrosis, soft rot and wilting. Recent surveys have detected the presence of *Dickeya* spp. in a very small number of irrigation sources in Scotland. Studies are underway to quantify risk to the Scottish potato industry, identify infection routes and develop diagnostic methodologies. As part of this bigger study, the *recA* and *16S rDNA* genes were sequenced for 69 strains of *Dickeya* spp. and related phytopathogenic members of the family *Enterobacteriaceae*, isolated from a range of sources. Analysis of these data shows that isolates from Scottish rivers are recovered in three separate populations distributed within the genus *Dickeya* and that two of these populations appear to be novel taxa. Pathogenicity studies show that one of the latter is highly virulent on potato when plants are drenched with a bacterial cell suspension. It is therefore clear that the presence of these organisms in Scotland poses a serious threat. Further study is in progress to develop a multi-locus sequence typing method for these organisms to assist future epidemiological studies.

Keywords: *Dickeya*, MLST, potato, plant pathology

Adaptive variation in Scots pine (*Pinus sylvestris*) in Scotland

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Scots pine is a keystone species in the Caledonian forests and also a national icon. Currently native pinewood in Scotland covers 18,000 hectares in 84 separate differently sized fragments. Local adaptation is a common phenomenon in trees, and extensive provenance trials have often been used to develop seed transfer guidelines for various species. Currently there is only little evidence of local adaptation in Scottish pinewoods, and the current seed transfer guidelines are based on molecular variation which might not reflect fine-scale patterns of local adaptation. We are studying adaptive variation in traits related to growth, phenology, and stress in native pinewoods in a common-garden trial consisting of ~3,300 seedlings from 21 populations and 84 open-pollinated families. DNA variation is being studied in candidate genes possibly linked to dehydrative stress and wood formation. The data show that nucleotide diversity in the fragmented Scottish populations is very similar to mainland European populations. In the spring of the 2nd growing season, bud flush generally occurred earlier in populations from cooler regions, i.e. they reacted quicker to rising temperatures. Preliminary results also suggest variation in growth rates and responses to drought among populations that vary in e.g. growing season length and moisture deficit.

Understanding local adaptation in Northern rock cress: coping with the serpentine syndrome

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Understanding local adaptation is essential when predicting the response of populations to environmental change. Serpentine soils present an ideal system to study the processes leading to local adaptation in plant populations. These soils have a scattered distribution, are deficient in several nutrient minerals, high in heavy metals, and have a poor water holding capacity. This study assesses local adaptation to serpentine soil in populations of *Arabidopsis lyrata petraea*, which occurs both on and off this soil type. Measures of morphological traits were made of plants from 23 populations across the Scottish range to explore if there are patterns in traits which are particular to the serpentine sites. To understand if populations are locally adapted to the soil type on which they originally developed, a controlled lab experiment investigated the response of five of the populations to growth on serpentine and non-serpentine soil treatments. Leaf trait data, biomass allocation and water use efficiency measures were taken to assess the adaptations associated with populations growing on and off serpentine, according to the selective drivers associated with these sites. Data from both the field and controlled experiments will be presented, revealing both local adaptation to serpentine soil, as well as the possibility of site specific adaptations.

Impacts of environmental change on Scottish upland vegetation: results from a 50-year re-visitation study

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Environmental change in the Scottish uplands over recent decades has been rapid and complex, with the effects of multiple and interacting drivers of change impacting on the vegetation. However, quantifying longer-term trends in plant community composition is a major challenge due to a lack of suitable baseline data. In this study, we exploit a rare opportunity to re-visit plots in key communities of the North-West Highlands first surveyed in 1956-58 in order to investigate the influence of environmental change on observed community change, using multivariate techniques, diversity metrics, functional group and species attribute analysis. The most notable vegetation change since the late 1950s is in montane and dwarf-shrub heaths, followed by grasslands. The mires have retained more of their original character, although some change is still apparent. The overall pattern of change is characterised by the increased dominance of generalist upland graminoid species, with reduced abundances of dwarf-shrubs, forbs, bryophytes and lichens and shrubs/trees, particularly those with an arctic-montane distribution. The traits and preferences of the increased species suggest that over the past 50 years the North-West Highlands, which were previously thought to have remained relatively unchanged, have become warmer and drier with more acidified soil.

Key words: homogenisation, graminoids, nitrogen, climate change, attribute analysis

SESSION 3

Tropical and temperate ecology

Pollen Studies in *Begonia*

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Pollen is the male megagametophyte, the haploid generation of flowering plants, and its small size makes it vital for the dispersal of genes within or between populations or species. In *Begonia*, a speciose tropical genus, we are investigating the uses of pollen for studies of reproductive barriers, the analysis of hybrid fertility and taxonomy.

Staining with fluorescein diacetate (FDA) is shown to be a good biological indicator of pollen viability of species and hybrids, and is generally correlated with germination of pollen grain *in vitro*. Observations of pollen germination using aniline blue staining of pollinated stigma, as well as analysis with variable pressure scanning electron microscopy (VP-SEM) and experimental crosses reveal a lack of gametophytic reproductive isolating barriers in the neotropical section *Gireoudia*. Therefore species barriers may be maintained by geographic and ecological separation or by hybrid sterility.

In the large sections *Diploclinium* and *Petermannia* convergent evolution of pollen morphology is evident, however pollen form may be taxonomically useful for revealing cryptic species where gross morphology of the plants is similar. Here we recognise a number of pollen groups that are consistent with current species treatments, suggesting their use in future taxonomic descriptions.

Keywords: pollen, *Begonia*, reproductive isolating barriers, taxonomy, pollen viability

The optimal colour index for the phenological recording of leaf canopies

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Phenological observation is becoming increasingly important as climate warms and weather patterns become more extreme. Recently digital cameras (“webcams”) have been placed on the existing network of flux towers to provide a time series of canopy images. The images vary depending on weather, illumination and setting of the cameras as well as the scene itself. There are many possible ways to process digital signals from these cameras (e.g. normalized intensities of RGB signals, vegetation indices, alternative colour models), and it is unclear which of these is best for tracking phenological stages in forest ecosystems. The Phenological Eyes Network (PEN), a network of ground observatories, mounted a digital camera on the top of Mt Tsukuba, Japan (36°13'30"N, 140°5'52.8"E, 868 m above sea level) in autumn 2007 to capture the seasonal change of a temperate forest. Using simple images of a Japanese beech *Fagus crenata* we calculated 12 colour signals and vegetation indices and compared their seasonal patterns through a year. A small number of them show clear signals and minimal ‘noise’; hue is especially good to distinguish canopy changes during the vegetative period, but over the whole year an index based on green and red performs the best.

Keywords: phenology, deciduous forest, digital image, growing season, colour system

Photosynthetic capacity, leaf dark respiration and leaf traits in the canopy of a tropical montane cloud forest in Peru

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When increasing in altitude from lowland tropical rainforests (LTRF) to tropical montane cloud forest (TMCFs), standing biomass and aboveground net productivity (ANPP) decrease. This decrease in ANPP has been attributed to lower temperatures, lower light levels and lower photosynthetic capacity because of less available nutrients at higher altitudes. Recent studies proved, however, that belowground net productivity (BNNP) and biomass do not decrease with altitude, suggesting TMCFs sequester more C than previously thought. Very little is known about TMCF photosynthetic parameters V_{\max} and J_{\max} (which underpin gross CO_2 uptake), TMCF foliar respiration (R_d), and how they vary throughout the canopy and with other leaf traits. We measured the V_{\max} , J_{\max} , R_d , foliar nutrients (N and P) and leaf mass per area (L_a) at different canopy heights of 33 trees in a TMCF in Peru at 3000 m asl. The most important findings were that V_{\max} and J_{\max} values were of a similar value as found in LTRFs (44.3 and 85.2 $\mu\text{mol m}^{-2} \text{s}^{-1}$, respectively at $T=25^\circ\text{C}$) and the slope and intercept of the V_{\max} -N relationship resembled that of temperate forest types. These results show that TMCF C-uptake could be higher and less controlled by foliar nutrients than thought previously.

Traditional uses of Neem (*Azadiracta indica*)

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Now is the time to look back at our traditional knowledge of forests. Here I choose the best known tree from India, where I am from. Neem (*Azadiracta indica* Linn) is a native tree to India and well known for its medicinal purposes. Traditionally it is used as a household disinfectant and insect repellent, and it is best known for its use as a repellent for mosquitoes that may be carrying malaria. Neem seed extract is a common insecticide used in commercial pest control purposes especially for bed bugs. Keeping the leaves of neem in storage containers prevent insect pests at the household level.

Neem is also used as a traditional medicine for Chicken pox. Traditional medicinal cures for Chicken pox are more common in India than fixed doctors appointments. Patients infected with chicken pox apply the paste of neem leaves for three days after infection, and may continue for up to seven days after the infection. Neem seeds are very good fodder and it has germination potential of 90%. The timber is commercially viable with a rotation period of 10-12 years. It has a strong, pale yellow coloured timber, used for making door and window frames.

SESSION 4

Molecular ecology, taxonomy and evolution

The impact of Scottish winter climbing on cliff-face vegetation.

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Cliff habitats can serve as valuable refugia for plants from grazing and human disturbance. However the impacts of winter climbing are hitherto unstudied despite the popularity and aggressive nature of the sport. This investigation described and quantified these impacts in Coire an t-Sneachda, a venue popular for the sport in the Northern Corries of the Cairngorms that also hosts sensitive alpine and sub-arctic flora. Percent cover of vascular plants, lichens and bryophytes, and loss of soil and vegetation cover were compared between climbed and unclimbed areas. Methodology accounted for potential variation between climbed and control areas due to route choice by climbers. Winter climbing routes cover about 9% of the cliff face, and were associated with significant losses of soil volume (mean $44\pm 21\%$ (95%CI)) and vegetation cover (mean $46\pm 10\%$ (95%CI)) from cliff ledges. The ratio of bryophytes to vascular plants was significantly increased with loss of vegetation cover, whilst species richness was lower on climbed routes due to habitat loss. Winter climbing can cause serious levels of damage to sensitive cliff habitats, where potential for recovery is limited. Climbers must be aware of best practice to reduce impact on cliff vegetation, and management is urgently needed to prevent further damage.

Keywords: alpine cliff vegetation, recreation impact, winter climbing, Coire an t-Sneachda; Cairngorms.

What is *Orchis purpurea*? Molecular studies in the anthropomorphic group of *Orchis* (Orchidaceae)

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The anthropomorphic group of the genus *Orchis* (Orchidaceae) is represented in the U.K. by 4 species; *O. purpurea*, *O. anthropophora*, *O. simia* and *O. militaris*. Recent genetic studies have shown that introgression and hybridisation are important factors in this group. At the same time it has been discovered that *Orchis purpurea* falls into 2 separated clades for Internal Transcribed Spacer (ITS) and that this same species shares its plastid haplotypes with *O. simia* and *O. militaris*. AFLP data from *Orchis purpurea* have also shown 2 clusters.

The purpose of the study was to increase the sampling and to study further nuclear regions including Xanthine dehydrogenase (Xdh) and nuclear microsatellites. Samples from throughout western Europe have been analysed and generally support the previous observations. However Xdh has been sequenced and the results do not demonstrate the clusters for *Orchis purpurea* found in the other regions previously studied. The development of the primers for nuclear microsatellites is still ongoing. Their optimisation is a difficult point mainly due to the genome size of these species, which is medium to large. The possible biological reasons are still unknown and more studies have to be done.

Evolution of leaf shape in *Begonia* section *Gireoudia*

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Begonia Section *Gireoudia* species can be found growing naturally from Columbia to southern Mexico, where they are most diverse. Compound and peltate leaves have evolved independently in the section. Segregation of leaf phenotypes in F1 backcross populations suggest that convergent evolution of peltate leaves may be through changes at different loci and that many loci are involved in the evolution of compound leaves.

Key developmental regulators *KNOX* and *ARP* genes are reported to be involved in the evolution of leaf form. Association mapping studies in one of the back cross population of simple and peltate leaved parents indicated that interspecific variation at the *ARP* locus is not linked to the evolution of peltate leaf form. There is also no link between *KNOX* (STM-like) genes and leaf dissection in an F1 back cross population of simple and compound leaved parents. I am currently screening the other aspects of leaf form to see if any are associated with species-level differences at *ARP* and *KNOX* loci. I we will use RT-PCR and *in situ* analysis to determine if changes in expression patterns of *ARP* or *KNOX* are predictive of variation in leaf form.

Estimates of the rate of evolution of *ARP* and *KNOX* CDS and promoters will be used to determine whether these genes have undergone selection. We will examine the evolution of conserved promoter elements such as the K-box and RB-Box of the *KNOX* gene promoters and untranscribed 5' possible regulatory regions in *ARP* genes.

snoRNA genes and plant evolution

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Despite the existence of various marker systems there are still limitations in distinguishing between closely related species, especially when hybridization events are involved. The characterisation of plant small nucleolar RNA (snoRNA) genes and their organisation into multigene clusters provides a potential nuclear marker system which could help in resolving the phylogenetic history of plants. Using three closely related *Senecio* species, we are investigating a combination of fragment and sequence variation of snoRNA-genes to assess the utility of this marker system.

Most of the examined gene clusters showed a similar gene order in *Senecio* and *Arabidopsis*. However, the majority of these clusters have more copies in *Senecio* which can be distinguished by a combined sequencing/genotyping approach. Thus, snoRNA genes/gene clusters seem to be a good marker system for studying gene evolution and may also be useful for studies of plant evolution once single copy genes/gene clusters are identified.

Gene transfer and plant evolution: What we have learnt from *Senecio*

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Interspecific hybridization has long been recognized as an important force in plant evolution. In recent years there has been a renaissance in research aimed at understanding the effects and evolutionary consequences of hybridisation in plants, due largely to the increased availability of a wide range of new molecular tools for analysis. Here, I shall focus on the work that we have conducted on hybrid speciation and introgression (gene transfer) in the genus *Senecio*, which contains some notable examples of both processes occurring in the very recent past. In particular, I shall describe work that we have done on isolating and characterising genes that have been transferred from a diploid to a tetraploid species, and which have brought about significant changes in the floral morphology and outcrossing rate of the recipient species. This work illustrates the potential that introgression has for causing evolutionary change in plants even in situations where there are strong reproductive barriers between species.

POSTER SESSION

Hybrid zones in *Rhododendron* subsection *Taliensia*.

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The genus *Rhododendron*, is extremely species-rich (>1000 described species), with a center of diversity in the Sino-Himalayan region, particularly the eastern Himalayas. At the subgenus level genetic barriers to gene flow between species appear to be almost non-existent, and extensive hybridization occurs in the wild within certain species complexes.

The presented project focuses on subsection *Taliensia*, a species complex which poses major taxonomic problems because of the above mentioned problems. To assess species relationships and putative hybrids, AFLPs were generated for 205 individuals of *R. roxieanum*, represented by three varieties, and *R. clementinae*. The status of the putatively intermediate *R. roxieanum* var. *cucullatum*, and species divergence is discussed.

Revealing functional relationships between ecophysiological and leaf micromorphological traits in two Central American *Begonia* species

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Begonia section *Gireoudia* is a large Central American group with remarkable diversity in morphology and habitat preference. We are using this diversity to try and understand the effect of variation in leaf structure on photosynthetic function and water balance. A range of *Gireoudia* and other *Begonia* species have been surveyed for leaf micromorphology and ecophysiological traits. We place *Begonia* on the leaf economic spectrum which describes the balance of investment and activity of leaves and describe the correlations between leaf structure and function.

We are using hybrids between two very different species to study the relationship between structure and function in more detail. *B. plebeja* is found in Mexico and occurs through out Central America. It has large thin leaves. *B. plebeja* populations in seasonally dry rainforests are deciduous. *B. conchifolia* is found in wet rainforests in Costa Rica and Panama. It is largely epiphytic or epipetric in habitat and has persistent small succulent leaves. The two species are very distinct in morphology and function and in backcross populations these traits segregate. We present preliminary data on genetic association of morphological and functional traits. It is anticipated that further research; the generation of a genetic map and QTL analysis of gross morphology, ecophysiology and leaf micromorphology will lead to an understanding of their interrelationships and an appreciation of their contribution to habitat divergence in the broader genus.

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