

Marios Méndez

Programme and abstracts for the 16th SCAPE meeting

Kongskilde Friluftsgård November 1–3 2002

Edited by

Thomas Hansen[†], Jens Mogens Olesen[‡],
Marianne Philipp[†] and Yoko Dupont[‡].

[†] Botanical Institute, University of Copenhagen,
Øster Farimagsgade 2D, DK-1353 Copenhagen K, Denmark.

[‡] Department of Ecology and Genetics, University of Aarhus,
Ny Munkegade, Building 550, DK-8000 Aarhus C, Denmark.

29 October 2002

Thomas Hansen
Jens Mogens Olesen
Marianne Philipp
Yoko Dupont

THE UNIVERSITY OF CHICAGO

PHILOSOPHY DEPARTMENT

NOTES

BY [Name]

LECTURE NOTES

PHILOSOPHY DEPARTMENT

CHICAGO, ILL.

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Øster Farimagsgade 2D, DK-1353 Copenhagen K, Denmark.

[‡] Department of Ecology and Genetics, University of Aarhus,
Ny Munkegade, Building 550, DK-8000 Aarhus C, Denmark.

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Programme

Friday November 1st.

18:00-19:00	Arrival and registration
19:00-20:00	Dinner
20:00-21:00	Poster session
21:00-	Informal get-together

Saturday November 2nd.

07:30–08:30 Breakfast

08:30–08:40 Welcome and practical information. (Jens Mogens Olesen and Marianne Philipp)

Session: Plant Reproductive Ecology

Chair: Jens Mogens Olesen

08:40–09:00 Sylvi M. Sandvik and Ørjan Totland Quantitative importance of the staminodes for female reproductive success in *Parnassia palustris* L.

09:00–09:20 Alfredo Valido Preliminary results of reproductive ecology of *Neochamaelea pulverulenta* (Cneoraceae), an endemic plant from Canary Islands

09:20–09:40 Jane C. Stout Pollination ecology of *Rhododendron ponticum* in native and introduced habitats

09:40–09:50 **Short break**

09:50–10:10 Christopher N. Kaiser Effects of bees and wind on the reproductive success of an anemophilous tropical grass

10:10–10:30 Bente Eriksen Frequency of sexual reproduction in the facultative agamosperm *Potentilla nivea* L. (Rosaceae) – evidence from paternity analyses.

10:30–11:00 **Coffee break**

Chair: Marianne Philipp

11:00–11:20 Steen R. Knudsen Pollination biology of the Andean root crop arracacha (*Arracacia xanthorrhiza* Bancroft)

11:20–11:40 Kristine K. Rasmussen and Johannes Kollmann Poor generative reproduction in *Sorbus torminalis* at the northern distribution limit

11:40–12:00 Hafdís H. Ægisdóttir and Thóra E. Thórhallsdóttir Reproductive biology and genetic diversity in populations of *Campanula uniflora* in Iceland, Greenland and Svalbard

12:00–12:20 María J. Bañuelos and José R. Obeso Maternal effects, sibling rivalry and seed mass variability: a case study with *Rhamnus alpinus*

12:20–14:30 **Lunch break**

continues...

Saturday November 2nd. continued...

Session: Evolution

Chair: Ørjan Totland

14:30–14:50	Magnus Larsson	Pollinator effectiveness of specialist and generalist flower-visitors in <i>Knautia arvensis</i> (Dipsacaceae)
14:50–15:10	Tove H. Jørgensen and Stefan Andersson	Evolution of a pollen colour dimorphism in two subspecies of <i>Nigella degenii</i> (Ranunculaceae)
15:10–15:30	Stefan Andersson	Genetic constraints on floral evolution
15:30–15:40	Short break	
15:40–16:00	Kathleen M. Kay	Evidence for reinforcement of speciation in pollinator-sharing Neotropical <i>Costus</i>
16:00–16:20	Johanne Maad and L. Anders Nilsson	On the mechanism of floral shifts in speciation: gained pollination efficiency from tongue- to eye-attachment of pollinia in <i>Platanthera</i> (Orchidaceae)?
16:20–16:40	Anita Diaz and G. Kite	Evolution in lure-and-trap pollination
16:40–17:00	Coffee break	

Session: Pollination in agricultural landscapes

Chair: Manja Kwak

17:00–17:20	Frank Hoffmann	The impact of plant community diversity and agricultural use on the reproductive success of wild plant species
17:20–17:40	Louise Cranmer	The use of linear landscape features by pollinators
17:40–18:00	Lizzie Cant	Insect pollinator movement and plant gene flow along linear features in the landscape
19:00–20:00	Dinner	
20:00–21:00	Poster session	
21:00–∞	Party	

Sunday November 3rd.

08:00–09:00 Breakfast

Session: Pollination at the community level

Chair: Christine Müller

09:00–09:20	Mikkel Bundgaard	Temporal and spatial variation in a plant/pollinator network
09:20–09:40	Oostermeijer <i>et al.</i>	Life history traits, breeding system and colonization ability of epiphytic bromeliads in Costa Rica
09:40–10:00	Jeff Ollerton	The pollination ecology of an assemblage of grassland asclepiads in KwaZulu-Natal, South Africa
10:00–10:20	Anne Jakalaniemi	Patch dynamics in the meta-populations of two rare plants
10:20–10:50	Coffee break	

Session: Small and/or fragmented plant populations

Chair: Bodil Ehlers

10:50–11:10	Thomas Bergsdorf and Manfred Kraemer	Differences in reproductive success of <i>Acanthopale pubescens</i> (Acanthaceae) among rainforest fragments
11:10–11:30	Carolin Mix	Effects of landscape fragmentation on dispersal traits of plants
11:30–11:50	Sheila H. Luijten	Is there pollen limitation in the narrow endemic <i>Centaurea corymbosa</i> ?
11:50–12:10	Mirella H.M. Groot	Population viability of <i>Gentiana pneumonanthe</i> in Switzerland
12:10–	Lunch Departure	

Session: Plant Reproductive Ecology

1. Quantitative importance of the staminodes for female reproductive success in *Parnassia palustris* L.
By Sylvi M. Sandvik and Ørjan Totland
2. Preliminary results of reproductive ecology of *Neochamaelea pulverulenta* (Cneoraceae), an endemic plant from Canary Islands.
By Alfredo Valido
3. Pollination ecology of *Rhododendron ponticum* in native and introduced habitats.
By Jane C. Stout
4. Effects of bees and wind on the reproductive success of an anemophilous tropical grass.
By Christopher N. Kaiser
5. Frequency of sexual reproduction in the facultative agamosperm *Potentilla nivea* L. (Rosaceae) – evidence from paternity analyses.
By Bente Eriksen
6. Pollination biology of the Andean root crop arracacha (*Arracacia xanthorrhiza* Bancroft).
By Steen R. Knudsen
7. Poor generative reproduction in *Sorbus torminalis* at the northern distribution limit.
By Kristine K. Rasmussen and Johannes Kollmann
8. Reproductive biology and genetic diversity in populations of *Campanula uniflora* in Iceland, Greenland and Svalbard.
By Hafþís H. Ægisdóttir and Thóra E. Thórhallsdóttir

9. Maternal effects, sibling rivalry and seed mass variability: a case study with *Rhamnus alpinus*.

By María J. Bañuelos and José R. Obeso

Quantitative importance of the staminodes for female reproductive success in *Parnassia palustris* L.

Sylvi M. Sandvik and Ørjan Totland.
Email: sylvia.m.sandvik@hia.no

Institute of Sciences, Agder University College. Service Box 422, N-4604 Kristiansand. Norway.

Abstract

We studied the quantitative importance of staminodes in *Parnassia palustris* by staminode removal in two populations occurring in contrasting environmental conditions. The staminodes acted as extra attractant structures and increased pollinator flower visitation rate and duration both at a low and high elevation site. We used fruit mass as a measure of female reproductive success. Staminode removal reduced fruit mass in the high elevation population, possibly due to pollinator limitation. In contrast, staminode removal had no effect in the low elevation population where pollinator availability was high. Flowers in both populations were highly dependent on pollinator visitation for maximum seed set. At the low elevation site, pollinators primarily cross-pollinated flowers, whereas at the high elevation site they facilitated self-pollination. Simple linear analysis indicated a strong relationship between mean number of rays on the staminodes at the low elevation population. However, multiple regression showed that ray number was not directly influencing fruit mass, suggesting that the relationship between ray number and fruit mass was caused by correlation with other traits that affected fruit mass. Thus, our results indicate that staminodes in *P. palustris* affect female reproductive success by enhancing pollinator visitation, mainly where low pollinator density severely limits pollination success.

Preliminary results of reproductive ecology of *Neochamaelea pulverulenta* (Cneoraceae), an endemic plant from Canary Islands

Alfredo Valido.

Email: alfredo.valido@biology.au.dk

Department of Ecology & Genetics, Aarhus University, Ny Munkegade 540, DK 8000-Aarhus C, Denmark.

Abstract

The present communication analysis some preliminary data of reproductive biology of *Neochamaelea pulverulenta* (Cneoraceae), an endemic shrub from Canary Islands. This plant species is andromonoecious (presence of hermaphrodite and male flowers in the same individual) in a similar way that the other related species (*Cneorum tricoccon*) from the Mediterranean Basin. However, and in contrast with the relative one, in *N. pulverulenta* there is not overlap in the flowering phenology in both types of flowers, and the number of pollen grains is significantly lesser in hermaphrodite than male flowers. Besides, in Canary Island only ants visit the flowers for nectar and could be act as true pollinators, while in *C. tricoccon*, flying insects (basically bees) are the principal flowers visitors.

The preliminary results obtained in hand-pollination experiments show us that pollen from male flowers (in xenogamy crosses) appeared to be more fertile than the rest of pollen source used in the different pollination treatments. Although I have not data about pollen viability, not differences in pollen external morphology between male and hermaphrodite flowers was found.

These results indicate that this plant species present different mechanisms (to compare with *C. tricoccon*) to avoid a potential autogamy in an insular environment characterized by few insect species and where ants are the principal flowers visitors in the different islands where this plant species is present (Gran Canaria, Tenerife, La Gomera).

Pollination ecology of *Rhododendron ponticum* in native and introduced habitats

Jane C. Stout.
Email: stoutj@tcd.ie

Botany Department, Trinity College Dublin, Ireland

Abstract

Rhododendron ponticum is native to the Iberian Peninsula where it exists as fragmented populations in small areas of suitable habitat. It was introduced into the British Isles in the 18th century and was widely planted in gardens and as cover for game. The species has spread extensively and is now a serious threat to native biodiversity and agribusiness throughout the British Isles. It is difficult and expensive to eradicate and produces thousands of tiny, wind-dispersed seeds. Little is known about its breeding system, however, or its interactions with pollinators, even in its native habitat. Populations of *R. ponticum* were studied in the spring of 2002, near Gibraltar in Southern Spain, and in Killarney National Park, Connemara National Park and Co. Dublin in Ireland. I found that *R. ponticum* is visited by a wide range of Hymenoptera, Diptera, Lepidoptera and Coleoptera, both in Spain and Ireland. Bees were frequent flower visitors in Spain, and by far the most abundant visitors in Ireland. *R. ponticum* flowers produce large volumes of nectar, but visitation rates were unexpectedly low in some parts of Ireland, possibly due to climatic factors and/or insect phenology. In addition to examining pollen loads, the role of pollinators in mediating pollen transfer will be analysed using pollinator exclusion experiments, measurements of dispersal of pollen analogues and microsatellite paternity analysis. The results of this research will provide insight into invasive-plant native-pollinator mutualisms and will be of value in predicting future range expansion of *R. ponticum*.

Effects of bees and wind on the reproductive success of an anemophilous tropical grass

Christopher N. Kaiser.

Email: c.kaiser.zfmk@uni-bonn.de or chris_kaiser@gmx.net

University of Zurich, Institut der Umweltwissenschaften, Winterthurerstrasse 190, 8057 Zurich, Switzerland.

Abstract

I investigated bee visitation at the tropical grass *Brachiaria platynota* (K. SCHUM.) (Poaceae: Paniceae) in the Kakamega Forest Nature Reserve in Kenya. The aim of the study was to assess the influence of anemophily and entomophily on seed set of this grass and the study, lasting from June to August 2001, included 270 hours of observation. To establish differences in flowering phenology, environmental parameter, such as temperature, relative humidity, cloud cover and wind speed, were recorded in five study plots. 192 racemes were protected either from bees visiting flowers or from wind by tripod netting. Self-pollination experiments were performed to reveal possible apomixis and cleistogamy in *B. platynota* and aerial pollen concentration was measured with adhesive pollen traps.

Seed development, consisting of seed set, non-pollinated flowers, seed loss, and fungal infestation were recorded for 19739 spikelets. Despite abundant insect visitations on *B. platynota* in the previous year, the solitary bee, *Lipotriches gerstaecker* (Halictinae), and honeybees, *Apis mellifera* L. (Apinae) were observed gathering pollen for only five days during the entire observation period. As a consequence no significant influence of bees on seed set of the grass could be found.

Due to unusually high rainfall, the density of flowering plants was reduced, the flowering period of the grasses was shortened, and bee abundance was very low. The gathering of grass pollen by *Lipotriches* supports a trend towards generalism in this system and selection pressure towards secondary entomophily may be enforced by unstable climatic conditions, as these were shown to have a strong influence on bee activity and grass phenology.

Frequency of sexual reproduction in the facultative agamosperm *Potentilla nivea* L. (Rosaceae) – evidence from paternity analyses

Bente Eriksen.

Email: bente.eriksen@botany.gu.se

Botanical Institute, Göteborg University, Box 461, SE-405 30 Göteborg, Sweden.

Abstract

A population of *Potentilla nivea* in northern Swedish Lapland was studied in order to establish the potential for apomixis as well as the actual proportion of apomictic offspring produced after intra- and interspecific crossings, respectively. The sympatric species *P. crantzii* was used for reciprocal interspecific hybridization. Offspring from all crosses were germinated and grown and used for morphometric analyses as well as molecular paternity determination. The potential for apomixis, given as the average number of unreduced megagametophytes produced per flower, is ca. 25% in *P. nivea*. The average Seed:Ovule-ratio after interspecific pollination is 0.15 and the offspring show no sign of being hybrids. Rather their morphology and genotypes indicate that they are produced by apomixis. Fifteen percent seed set is within the limit for the potential number of apomictic offspring that can be produced. The average Seed:Ovule-ratio after conspecific mating is 0.40. The AFLP-data from the paternity analysis shows that interspecific crossings give a minimum of 30% sexual offspring, but most probably all offspring are sired by the applied pollen. In contrast, the offspring from interspecific hybridisation are of maternal type. The conclusion is that sexuality plays an important role in the reproduction of *Potentilla nivea* and that apomixis is mainly induced by illegitimate mating.

Pollination biology of the Andean root crop arracacha (*Arracacia xanthorrhiza* Bancroft)

Steen R. Knudsen.
Email: srk@kv1.dk

Botanical Section, Royal Veterinary and Agricultural University, Rolighedsvej 21, DK-1958 Frederiksberg C, Denmark

Abstract

The reproductive biology of the clonal propagated Andean root crop arracacha (*Arracacia xanthorrhiza* Bancroft) (Apiaceae) has been the subject of several studies during the last decade, but hardly any results has been published and the information available on the pollination methods and compatibility barriers is very limited. The present study aimed to identify pollination methods and investigate the cross- and self-compatibility in arracacha. Different pollination methods were investigated; 1) emasculation followed by hand-pollination; 2) exposure to natural environment (insect pollination); 3) isolation, preventing any interaction from insects. The experiments were conducted at the University of Cajamarca, Peru during 2000 and 2001; it included 18 arracacha cultivars and 8 collections of wild relatives, which is believed to be the ancestral to arracacha. About 300 plants were used in the experiments. The performed hand-pollinations revealed that there were no significant differences between any of the performed self- and cross-pollinations. All cultivars were compatible and there were no self-incompatible barriers found, also crosses between the wild *Arracacia* material and cultivars were possible. The hand-pollination resulted in an average per plant of 27% (0–85%) well-developed fruits (two seed per fruit) in 2000, and 63% (0–100%) in 2001. For flowers exposed to the natural environment the average per plant were 44% (17–88%) well-developed fruits, and 0–2% for flowers isolated from pollinator interaction. The flowers pollinated with 1-year-old pollen yielded an average of 8% (0–18%) well-developed fruits. On basis of the study it can be concluded that arracacha is self- and cross-compatible, however it does not seem to be possible to self-pollinate within the same flower, as the style dry up before the pollen is shed. And the flower needs an active pollinator to produce seeds.

Andromonoecy - peripheral male flowers

Protogynous

♂ open first

Poor generative reproduction in *Sorbus torminalis* at the northern distribution limit

Kristine K. Rasmussen and Johannes Kollmann.

Email: kkj@kv1.dk

Department of Ecology, Royal Veterinary and Agricultural University, Rolighedsvej 21, DK-1958 Frederiksberg C, Denmark

Abstract

As a potential factor controlling the northern distribution limit of the rare fleshy-fruited tree *Sorbus torminalis* the impact of pollen quality and quantity was investigated.

A pollination experiment was carried out in 2001 and 2002 in two distant populations in southern Denmark, which defines the northern distribution limit of *Sorbus torminalis*. Treatments were designed to test for inbreeding and outbreeding depression, pollen limitation, apomixis and self-incompatibility. Because of poor flowering in 2001 and a general high abortion in the species, too few fruits remained in 2001 for statistical analysis. In 2002 fruit development was checked regularly and abortion rates were used for statistical comparison of treatments in this year.

The trend of 2001 and results of 2002 both show that fruit development in the isolated populations of *Sorbus torminalis* is limited by poor pollen quality as well as quantity and that apomixis and self-pollination is not successful in this species. These findings are compared to the results of a similar experiment carried out on *Prunus mahaleb* on its northern distribution limit in Switzerland, and consequences for the population dynamics on the margin of distribution of such rare species are discussed.

Reproductive biology and genetic diversity in populations of *Campanula uniflora* in Iceland, Greenland and Svalbard

Hafdís H. Ægisdóttir and Thóra E. Thórhallsdóttir.

Email: hhae@hi.is

Institute of Biology, University of Iceland, Grensásvegur 12, 108 Reykjavík, Iceland.

Abstract

Campanula uniflora is a widespread but occasionally rare high-arctic species. It is quite common in Greenland but rare in Iceland and Svalbard. Here we present work done on the reproductive biology and genetic diversity in populations of *Campanula uniflora* in Qeqertarsuaq, W Greenland and Svalbard summer 2000 and N Iceland summer 2001.

Both populations in W Greenland and N Iceland were self-compatible but the results suggest that the breeding system of *C. uniflora* in W Greenland is different from that in N Iceland. In W Greenland, *C. uniflora* has the same floral development as other *Campanula* species, being strongly protandrous with pollen deposited by the anthers directly onto the style. Later on, the style elongates and the stigma becomes exposed. At the time when the bud opens the anthers are half the length of the style. In N Iceland, *C. uniflora* was also protandrous but in nearly all cases, pollen was deposited by the anthers directly onto the highest part of the style and the stigma itself before the bud opened. When the bud opens, the anthers are longer than the style, and bend over the immature stigma. The style subsequently elongates and the stigma, already cluttered with pollen, splits open.

Flowering started earlier in Greenland summer 2000 than in Iceland summer 2001 but otherwise the populations showed similar phenology with a short and synchronized flowering period.

Leaves were collected in Iceland, Greenland, Svalbard and Norway for isozymes electrophoresis analysis. Little genetic variation was observed within populations but some variation was observed among population and countries.

Maternal effects, sibling rivalry and seed mass variability: a case study with *Rhamnus alpinus*

María J. Bañuelos and José R. Obeso.

Email: mjbm@kv1.dk

Department of Ecology, Botanical Section, Royal Veterinary and Agricultural University, Rolighedsvej 21, DK-1958 Frederiksberg C, Denmark

Abstract

We study the sources of variability in seed provisioning in *Rhamnus alpinus*, a dioecious shrub producing 3-seeded fleshy fruits (range 1–4). Discarding position effects in access to resources as a source of variation, since pyrenes are radially oriented inside the fruit, we conducted a pollination experiment, in which different pollen donors were used to make single and mixed pollinations on different female plants. We found strong maternal effects on brood size and seed mass. Differences found among males in size and number of pollen grains per anther suggested that prezygotic male competition could occur when different donors were involved in pollination. Although we found no effects of pollen load or pollen source on fruit set, brood size or seed mass, all variables show enhanced values after multiple pollination treatments. Furthermore, we found an increase of intra-brood variance in seed mass after multiple pollination, suggesting that multiple siring really occurs when multiple donors were involved in pollination, and that sibling rivalry could be a mechanism implicated in seed provisioning, discarding maternal choice as the alternative scenario. Our results on resource provisioning fits with the hierarchical model, since disparities in shares increased down the dominance rank, being the middle sized seed the least sensitive to resource partitioning, and the disparities were reduced when more resources were available in terms of fruit mass. Maternal effects, number of pollen donors, and sibling competition are therefore accounting for seed mass variability in *Rhamnus alpinus*.

Session: Evolution

1. Pollinator effectiveness of specialist and generalist flower-visitors in *Knautia arvensis* (Dipsacaceae).
By Magnus Larsson
2. Evolution of a pollen colour dimorphism in two subspecies of *Nigella degenii* (Ranunculaceae).
By Tove H. Jørgensen and Stefan Andersson
3. Genetic constraints on floral evolution.
By Stefan Andersson
4. Evidence for reinforcement of speciation in pollinator-sharing Neotropical *Costus*.
By Kathleen M. Kay
5. On the mechanism of floral shifts in speciation: gained pollination efficiency from tongue- to eye-attachment of pollinia in *Platanthera* (Orchidaceae)?
By Johanne Maad and L. Anders Nilsson
6. Evolution in lure-and-trap pollination.
By Anita Diaz and G. Kite

Pollinator effectiveness of specialist and generalist flower-visitors in *Knautia arvensis* (Dipsacaceae)

Magnus Larsson.

Email: Magnus.Larsson@ebc.uu.se

Department of Plant Ecology, Evolutionary Biology Center, Uppsala University, Villavägen 14, SE-752 36 Uppsala, Sweden.

Abstract

A critical issue in pollination biology is when floral specialization occurs from a generalist pollination system. When pollinator effectiveness is asymmetric among specialist vs. generalist pollinators, the generalist pollination system is predicted to evolve towards specialization. I measured the pollinator effectiveness of the solitary bee species *Andrena hattorfiana*, a species narrow-oligolectic on *Knautia arvensis* (Dipsacaceae), a plant species that exhibits a generalist pollination system. Female plant fitness was measured as pollen deposition on stigmas, and male plant fitness as pollen export during a single bee visit. The results indicate that female fitness is often maximized by only a few visits of *A. hattorfiana*. Female as well as male plant fitness tended to increase with bee visit duration. I found that this specialist bee was superior in terms of pollen load and pollen deposition if compared to generalist pollinators. Solitary bees are often phenologically, ethologically and morphologically adapted to forage pollen on their host-plant, and solitary bees may thus exert selection on floral traits of their preferred plants. The co-adaptive response of the plant is predicted to be either "positive" when pollination is increased or "negative" when pollination is decreased, viz. floral traits for facilitation or escape, respectively. I briefly discuss possible co-adaptive selection involving *K. arvensis* and *A. hattorfiana*.

Evolution of a pollen colour dimorphism in two subspecies of *Nigella degenii* (Ranunculaceae)

Tove H. Jørgensen and Stefan Andersson.

Email: Tove.Hedegaard@sysbot.lu.se

Systematic Botany, Department of Ecology, Lund University, Sölvegatan 37, S-223 62 Lund, Sweden

Abstract

Causes of variation in heritable traits in natural populations have long been an active area of research. Local adaptations arising from spatial and temporal heterogeneity in selection pressures are thought to be responsible for much of the phenotypic diversity seen in the wild but stochastic processes may be of equal importance. Here we present the first results from a study aimed at understanding the genetic mechanism and evolutionary processes that lead to the persistence of a colour dimorphism within two subspecies of *Nigella degenii* (Ranunculaceae) endemic to islands in the Aegean region (Greece). A comparative study of the morph frequency variation will be presented. Further, we present results from experimental tests of the role of direct and indirect selection in shaping patterns of variation in morph frequency.

Genetic constraints on floral evolution

Stefan Andersson.

Email: Stefan.Andersson@sysbot.lu.se

Systematic Botany, Department of Ecology, Lund University, Sölvegatan 37, S-223 62 Lund, Sweden

Abstract

In a number of quantitative genetic studies, I have examined the role of genetic constraints in shaping evolutionary change in floral morphology. Particular attention has been given to the overall level of heritable variation in floral characters (relative to non-floral characters), the pattern of genetic correlation between floral and non-floral characters, and the direct effects of inbreeding on traits related to floral morphology. My results indicate that natural populations of plants exhibit appreciable levels of quantitative genetic variation in floral characters, that the costs of producing and maintaining flowers sometimes play a minor role in shaping patterns of resource allocation, that pleiotropic relationships with non-floral morphological characters could act as a constraint on floral evolution, and that inbreeding effects could facilitate the reduction in floral morphology accompanying the evolution of autogamy.

Evidence for reinforcement of speciation in pollinator-sharing Neotropical *Costus*

Kathleen M. Kay.
Email: kaykath1@msu.edu

Department of Plant Biology, Michigan State University, 166 Plant Biology Building, East Lansing, MI 48824, USA

Abstract

Plant biodiversity is ultimately the product of speciation events, yet the mechanisms that contribute to speciation are poorly understood, especially the roles played by plant-pollinator interactions and post-pollination processes. I investigate reproductive isolating factors in the understory herbaceous genus *Costus* (Costaceae) for a closely related sympatric pair of species and in a comparative study of mechanisms across the genus. *Costus pulverulentus* and *C. scaber* are studied at two sympatric sites, Barro Colorado Island in Panama and La Selva Biological Station in Costa Rica, where they overlap extensively in spatial distribution, phenology, and the identity of their hummingbird pollinators. Experimental arrays at La Selva show that interspecific pollen flow may be substantial, yet few hybrids are produced in hand pollinations due to strong interspecific pollen-stigma incompatibility that inhibits pollen germination. This incompatibility mechanism acts locally between sympatric populations, does not function in interspecific crosses between Barro Colorado Island and La Selva populations, and therefore is consistent with sympatric reinforcement of prezygotic isolation. A comparative study of crossing relationships throughout the Neotropical subgenus *Costus* shows that regardless of genetic distance, hybrids are easily produced except for sympatric species pairs sharing the same pollination syndrome. I suggest that for these pairs, which have the greatest possibility of interspecific pollen flow, direct natural selection has led to pollen-stigma incompatibility to prevent hybridization. This study provides the first evidence of reinforcement in plants, and suggests that post-pollination incompatibility may be an important mechanism of plant speciation.

On the mechanism of floral shifts in speciation: gained pollination efficiency from tongue- to eye-attachment of pollinia in *Platanthera* (Orchidaceae)?

Johanne Maad and L. Anders Nilsson.
Email: johanne.maad@chembio.ntnu.no

Department of Botany, NTNU, NO-7491 Trondheim, Norway.

Abstract

The purpose of the present work was to explore the mechanism of floral shifts that results in speciation. The model organisms chosen were the moth-pollinated pollinator-limited orchid species *Platanthera bifolia* and *P. chlorantha*. *Platanthera bifolia* exhibits tongue-attachment of pollinia on pollinators, a mechanism that previously has been found to be the ancestral state. The close relative *P. chlorantha* exhibits the derived state of eye-attachment of pollinia on pollinators. We reasoned that differences between the species in pollination efficiency could give insights into the mechanism of floral shifts. There was no significant difference in the pollen export and import efficiency per visit-night between the two species. Pollen export and import was achieved faster in the *P. chlorantha* population compared to the *P. bifolia* population. This was mainly due to higher pollinator visitation frequency in the *P. chlorantha* population. Pollen export occurred c. 0.65 nights earlier than pollen import in *P. bifolia*. In *P. chlorantha*, there was no temporal difference in export and import of pollen. Speed of pollination may be significant for floral evolution, but it is not clear if the differences in pollination speed found in the present study are general at the species level. 14

Evolution in lure-and-trap pollination

Anita Diaz[†] and G. Kite[‡].

Email: adiaz@bournemouth.ac.uk

[†] Bournemouth University, School of Conservation Sciences, Talbot Campus, Fern Barrow, Poole, Dorset. BH12 5BB, England

[‡] Royal Botanic Gardens, Kew, Richmond, Surrey, TW9 3AB, England

Abstract

Many plant species have evolved pollination systems in which both plant and pollinator benefit as pollinators are provided with rewards such as nectar. Interestingly though, some species achieve pollination by producing inflorescences that lure in pollinators with false promise of rewards and then trap them until flowering is complete. The evolutionary processes causing speciation in lure-and-trap pollination systems are currently little understood. Such understanding requires knowledge of the relationship between genetic divergence and pollination system divergence. This study explores the evolutionary processes in lure-and-trap pollination by comparing the pollination ecology and genetic structure of two closely related lure-and-trap species of *Arum* lily, *A. maculatum* and *A. italicum*. Results presented show the differences in pollination system and insect capture by plants of *A. maculatum* and *A. italicum* from a range of sites in Britain France and Spain. Differences in insect capture appear to be greater in plants from the south of this range. There is also some evidence of a greater difference in species insects caught in sympatric populations.

Session: Pollination in agricultural landscapes

1. The impact of plant community diversity and agricultural use on the reproductive success of wild plant species.
By Frank Hoffmann
2. The use of linear landscape features by pollinators.
By Louise Cranmer
3. Insect pollinator movement and plant gene flow along linear features in the landscape.
By Lizzie Cant

The impact of plant community diversity and agricultural use on the reproductive success of wild plant species

Frank Hoffmann.

Email: f.hoffmann@biol.rug.nl

Laboratory of Plant Ecology, University of Groningen, PO Box 14, 9750 AA Haren, The Netherlands.

Abstract

In agricultural landscapes, values for nature conservation are concentrated in highly dynamic, mostly linear, landscape fragments. For many flowering plant species these patches are a refugium. Plant-visitor and plant-pollinator community dynamics are analysed in the context of land use, local management and habitat arrangement. The study is being performed in three areas differing in agricultural intensity. First results showed that both plant and insect species diversity were decreasing with increasing agricultural intensity. Insect diversity appeared to be related to plant diversity and flower abundance. For several plant species the visitor compositions differed between locations.

In order to find out how plant community diversity and agricultural use influence reproductive success of a plant species, a field experiment with potted plants was performed.

Of a number of selected plant species artificial patches were made. The sites chosen for the plant species were differing in plant and insect species richness, and land use. At all sites, flowering plant diversity and flower abundance, insect visitor composition, and visitation rate were measured. For some plant species visitation rates and insect visitor compositions appeared to differ between sites.

The use of linear landscape features by pollinators

Louise Cranmer.

Email: l.cranmer@talk21.com

University College Northampton, Boughton Green Road, Northampton, NN2 7AL.

Abstract

This paper summarises the results of fieldwork on a mixed arable farm in Northamptonshire, England. Observations along 30m transects, perpendicular to eight different hedgerows revealed that linear flight was more likely to occur close to the hedgerow. To examine more closely the influence of linear features on *Bombus* spp. flight behaviour, an artificial linear feature was created in an experimental array of 3 equidistant patches of *Phacelia tanacetifolia* (Hydrophyllaceae). The artificial feature connected two of the patches and results demonstrated that there was greater abundance of *Bombus* spp. in the connected patches than in the unconnected patch, even when the position of the artificial feature was changed. In a landscape investigation, there was a positive relationship between seed yield of *Salvia pratensis* (Labiatae) growing in patches with high hedgerow connectivity compared with those plants growing within poorly connected patches. The results showed that pollinator abundance, pollen grains per stigma and seed yield were greater in highly connected patches compared with patches with fewer connections. Using various techniques, the project demonstrates that the overall connectivity of a landscape may be important to pollinator movement and plant reproductive success.

Insect pollinator movement and plant gene flow along linear features in the landscape

Lizzie Cant.

Email: lizzie.cant@bbsrc.ac.uk

Rothamsted Research, Plant and Invertebrate Ecology Division, Harpenden Herts, AL5 2JQ. United Kingdom.

Abstract

The aim of my PhD is to establish the degree to which linear landscape features in an agricultural setting facilitate the movement of foraging pollinators and thus gene flow between patches of plants.

I hope to present my findings from the first year of this three year study, looking at the influence of both natural and artificial linear features on pollen and gene flow from scales of 25 to 100m. In years two and three I intend to expand this scale of investigation to several hundred meters.

White clover (*Trifolium repens*) was used to directly investigate gene flow, while fluorescent dye movement was used to indirectly observe the direction of pollen movement within the experimental arrays. A mark-re-sight method has been used to observe the movement of Hymenopteran, Dipteran and Lepidopteran flower visitors. Results of a pilot test of the capabilities of harmonic radar for directly observing butterfly foraging movements will also be reported.

Session: Pollination at the community level

1. **Temporal and spatial variation in a plant/pollinator network.**
By Mikkel Bundgaard
2. **Life history traits, breeding system and colonization ability of epiphytic bromeliads in Costa Rica.**
By G. Oostermeijer, A. Cascante, J. Wolf, M. de Jong and E. Borg
3. **The pollination ecology of an assemblage of grassland asclepiads in KwaZulu-Natal, South Africa.**
By Jeff Ollerton
4. **Patch dynamics in the meta-populations of two rare plants.**
By Anne Jakalaniemi

Temporal and spatial variation in a plant/pollinator network

Mikkel Bundgaard.

Email: mikkelbio@stofanet.dk

Department of Ecology and Genetics, Ny Munkegade building 540, DK-8000 Aarhus C, Denmark.

Abstract

Earlier studies have focused at a limited aspect of plant/pollinator networks, i.e. single plant species or the influence of single insect genus either through time or space. This study was made in an attempt to get a broader understanding of the fluctuations in such a network and to see if there were similar types of variation through time and through space. The study was made during 5 weeks in the flowering season and the site was splitted in 5 equally sized sections, lying end to end. The observations were then analysed for the typical characteristics through time, through space and through time and space combined.

Life history traits, breeding system and colonization ability of epiphytic bromeliads in Costa Rica

Gerard Oostermeijer, Alfredo Cascante, Jan Wolf, Maaïke de Jong and Ethan Borg.
Email: oostermeijer@science.uva.nl

Inst. Biodiversity and Ecosystem Dynamics, University of Amsterdam, P.O. Box 94062, NL-1090 GB Amsterdam, The Netherlands.

Abstract

During the regrowth of montane forests, the developing canopy is colonized by epiphytes. Bromeliads are the most dominant colonists, but there are considerable differences among species in colonization success. Ecologists have tried to explain these differences from the niche-assembly theory, in which there are early and late successional species depending on the development of different microhabitats within the canopy. In general, there seem to be small ecological differences among species, which has led to the dispersal assembly hypothesis. In this hypothesis, colonization success depends on whoever arrives at a microsite first, which would be determined largely by seed quantity and dispersal. According to this hypothesis, good colonizers will have better dispersal, higher seed production, a shorter turnover time from germination to flowering, and are largely selfing to be independent from pollinators. In the montane forests in Costa Rica, we have found interesting differences among Tillandsioidae species in flower and seed production, length of the flowering period, flower morphology and biomass allocation to vegetative and reproductive parts. On one end of the variation, the good colonizer *Guzmania monostachya* produces many flowers in a very short time and has an anther cap covering the inserted stigma in a small white flower with a narrow tube. On the other end, the slow colonizer *Tillandsia fasciculata* produces few flowers during a long flowering period and has large purple flowers with exerted anthers and stigma. We hypothesize that the former species is a selfer and the latter a predominant outcrosser, and are currently testing this by genotyping mother-offspring arrays with microsatellites. So far, outcrossing seems rare in both species, although higher levels of within-population variation suggest that it is indeed more common in *Tillandsia fasciculata*.

The pollination ecology of an assemblage of grassland asclepiads in KwaZulu-Natal, South Africa

Jeff Ollerton.

Email: jeff.ollerton@northampton.ac.uk

School of Environmental Science, University College Northampton, Park Campus, Northampton NN2 7AL, United Kingdom.

Abstract

Studies of plant-pollinator interactions involving assemblages of phylogenetically related, co-occurring plant species can potentially yield insights into the ecology of niche overlap, competition for pollinators, adaptation and convergent evolution for species sharing common descent. The grasslands of KwaZulu-Natal offer excellent opportunities for such studies as they are botanically rich, relatively ancient and contain many examples of genera which have radiated in situ. In this paper we present the results of a study of the pollination ecology of an assemblage of asclepiads (Apocynaceae: Asclepiadoideae sensu Endress & Bruyns 2000) co-occurring and co-flowering in an upland grassland in Kwazulu-Natal, South Africa. The asclepiads are of particular interest because of their highly specialized floral morphology. Three months of field work during November 2000 to January 2001 yielded answers to some of the following questions:

1. To what extent do asclepiad species within this assemblage share pollinators?
2. Do those species which share pollinators possess similar floral traits?
3. How ecologically specialized are these asclepiads in their pollinator requirements?
4. Are the pollinators of the specialized species subsets of the pollinator fauna of more generalized species, indicating a nested pattern of diversity?
5. What are the relative contributions of phylogenetic identity and functional adaptation in relation to the biomechanics of flower-pollinator interactions?

Patch dynamics in the meta-populations of two rare plants

Anne Jakalaniemi.

Email: anne.jakalaniemi@metsa.fi

Oulanka Biological Station, University of Oulu, Liikasenvaarantie 134, 93999 Kuusamo, Finland.

Abstract

In this research the dynamics of two rare species *Silene tatarica* and *Erigeron acer* subsp. *decoloratus* from periodically disturbed river-side habitats were compared in a large spatio-temporal scale. Species have no seed bank or ability to vegetative reproduction and therefore the establishment of plants is only due to seed dispersal by water and wind. Because the lack of unsuitable habitats the distribution area of species was divided into patches in a way that five meters empty area lead to distinction of next patch. Altogether 43 kilometers of river-side we mapped during 1999–2002 and in every year formation of new patches and disappearance of old patches, divisions and unions of patches were documented. The number of individuals in each patch and the distance between the patches were measured. The total number of patches varied around 1000 in *Erigeron* and 650 in *Silene*. Principally, the total number of patches showed increasing trend in *Silene* and decreasing course in *Erigeron*. Instead, the variation in the numbers of new and lost patches varied similarly among the species and the years. New patches emerged by colonizations and patch divisions, whereas lost of patches took place through extinctions or unions to the neighboring patch. The extinction was the main reason for patch lost in both species and new patches were established mainly by colonization. The colonization rate of *Silene* was slightly smaller than extinction rate, whereas in *Erigeron* extinctions were more common than colonizations. Notably, the size of colonized and extinct patches was small in both species, mostly being under five individuals. In both species, the colonizations were typical to bare ground areas quite near the neighboring patches and most extinctions took place in more remote patches in bare ground sites or in more closed vegetation. This study showed that in a continuous habitat area the existence of species is dependent on regional processes i.e. the river dynamics creating new bare ground areas to colonize and opportunity to rare long-distance dispersal by water and river channel. Thus these species have the dynamics typical to meta-populations.

Session: Small and/or fragmented plant populations

1. Differences in reproductive success of *Acanthopale pubescens* (Acanthaceae) among rainforest fragments.
By Thomas Bergsdorf and Manfred Kraemer
2. Effects of landscape fragmentation on dispersal traits of plants.
By Carolin Mix
3. Is there pollen limitation in the narrow endemic *Centaurea corymbosa*?
By Sheila H. Luijten
4. Population viability of *Gentiana pneumonanthe* in Switzerland.
By Mirella H.M. Groot

Differences in reproductive success of *Acanthopale pubescens* (Acanthaceae) among rainforest fragments

Thomas Bergsdorf and Manfred Kraemer.

Email: tbergsdorf@web.de

Alexander Koenig Research Institute and Museum of Zoology; Adenauerallee 160, D-53113 Bonn, Germany.

Abstract

It is widely recognized that fragmentation of natural habitats not only affects the distribution and the abundance of organisms, but important biological processes like pollination as well. We analyse the alterations in plant-pollinator interactions caused by habitat fragmentation and the consequences for the long-term maintenance of tropical biodiversity.

The study is carried out at the Kakamega Forest, Western Kenya, where we compare pollination interactions of five different sized forest fragments to continuous forest. *Acanthopale pubescens* is a honeybee-pollinated under-story shrub.

In all forest plots we collected data of the different levels of pollination, i.e., frequency of flower visits, primary pollination success, fruit production rate and seed production.

No differences in pollinator diversity exist among sites, but pollinators differ widely in abundance. Interestingly, the abundance of honeybees is highest in the fragment that is most disturbed. Furthermore, study sites differ significantly in visiting frequency, primary pollination success, fruit production and seed production (ANOVA, LSD-test). These differences are not consistent throughout, however.

Forest fragments and continuous forest also differ in the mentioned parameters. The decrease in fruit production from 72 % in the main forest to 54 % in forest fragments is highly significant. As visiting frequency does not differ among those sites, fruit production of *A. pale* is not pollinator limited. Other factors like differences in light regime or soil parameters may result in differing fruit production.

Effects of landscape fragmentation on dispersal traits of plants

Carolin Mix.

Email: cmix@sci.kun.nl

Aquatic Ecology and Environmental Biology, Toernooiveld 1, 6525 ED Nijmegen, The Netherlands.

Abstract

One of the main impacts men have on the environment is the fragmentation of the landscape. Plant populations become smaller, get more isolated from each other and they become exposed to the negative effects of inbreeding. One of the few possibilities out of it is to disperse and to receive new genes (by pollen or seeds) from populations that also can disperse. Dispersal prevents inbreeding by increasing the number of individuals of a population and by increasing the genetic diversity. On the other hand inbreeding can have negative effects on the dispersal capacity of plant species. This dilemma can be different for plant species with different survival strategies.

In this presentation we will show the effects of inbreeding on dispersal traits as seed length, pappus length, thorn length, weight.. on two plant species, *Succisa pratensis* and *Hypochaeris radicata*. The species differ in their mode of dispersal capacity and longevity. Results indicate that inbreeding depression on dispersal traits was expressed in both species. The level of inbreeding depression in *Hypochaeris radicata* was higher probably due to its common presence in the Netherlands.

Is there pollen limitation in the narrow endemic *Centaurea corymbosa*?

Sheila Helen Luijten.

Email: luijten@isem.univ-montp2.fr

Institut des Sciences de l'Evolution (ISEM), Université de Montpellier 2, Place Eugène Bataillon, F-34095 Montpellier Cedex 05, France.

Abstract

Centaurea corymbosa Pourret (Asteraceae) is a narrow endemic known from only six populations to the Massif de La Clape in the south of France. The species is monocarpic and highly self-incompatible. Populations are very small and their effective size ranges from 10 to 200 flowering individuals. Although the populations are distributed within an area of 2.3 km², they are genetically highly differentiated, indicating that seed or pollen dispersal among populations is very limited. Reproductive data from three successive years has shown that seed:ovule ratios in *C. corymbosa* are widely varying among populations and years. This was mainly the result of variation in fertilization rates than of abortion or predation rates. Although the fertilization rate in *C. corymbosa* was significantly and positively related to the plant density, most of its variance was unexplained (70–90%). Information on visitation rates, mate availability, competition for pollinators and/or resource limitation are needed to understand the large variation observed in fertilization and seed production. To get more insight on reproduction of this endemic species in the natural populations, we examined (1) pollen limitation in one small and one large population, and (2) visitation rates of individual flower-heads in all six populations.

Population viability of *Gentiana pneumonanthe* in Switzerland

Mirella H.M. Groot.

Email: mirella_groot@yahoo.com

Institute of biodiversity and ecosystem dynamics (IBED), University of Amsterdam, P.O. Box 94062, NL-1090 GB Amsterdam, The Netherlands.

Abstract

Demographic viability of populations and environmental maternal effects of the rare perennial *Gentiana pneumonanthe* was investigated in Switzerland. Two types of populations could be distinguished through *K*-means clustering: 1) a relatively high proportion of the younger age states; this cluster is similar to the invasive type described by Oostermeijer *et al.* (1994), 2) a high proportion of generative adults with one stem; this type can be interpreted as stable as described by Oostermeijer *et al.* (1994). The younger age states were shown to be more sensitive to environmental stochasticity, which should be considered when management regimes are changed. *Gentiana pneumonanthe* displayed a preference for open vegetation with a certain cover of bryophytes. Two populations showed pollen limitation; population Bern and Cudrefin A. This can be explained by either the small size of the populations or heterospecific pollen of co-flowering plants in the vegetation. The environment of the maternal plants has an indirect effect on the offspring fitness. When the vegetation is more open, the plants receive more light and can produce more biomass and reproductive features, which could result in higher seed set. However, in hand-pollinated fruits the seed set was relatively low. This can be explained by a shortage of resources to provide energy for all the fertilized ovules. The naturally pollinated group showed seedlings with a relatively low biomass related to relatively heavy seeds. This strange result indicates a genetic effect of the maternal plant; small isolated populations can have an inbreeding effect or exhibit the Allee-effect. Further research on this topic is recommended.

Session: Posters

1. Position effects on floral gender in non-hermaphroditic species: mononecy.
By Marcos Méndez
2. Pollination of plants in habitat fragments with different connectivities: a bioassay approach.
By Louise Cranmer
3. Pollination of a native slipper orchid *Cypripedium fasciculatum* by a parasitic wasp (Hymenoptera: Diapriidae).
By Carol Ferguson and Kathleen Donham
4. They came from the east - the story of *Alisma wahlenbergii*, a rare aquatic plant in the Baltic Sea.
By Anders Jacobson
5. Pollination biology of *Buxus balearica* Lam.
By Amparo Lázaro and Anna Traveset
6. Population differentiation in flowering phenology in *Arabidopsis lyrata* ssp. *petraea*.
By Saskia Sandring
7. Impact of introduced honeybees on native pollination interactions of *Echium wildpretii* in Tenerife, the Canary Islands.
By Y.L. Dupont, D.M. Hansen and A. Valido
8. Flies *Thricops* sp. pl. (Muscidae, Diptera) as pollinators of some bell shaped flowers in Bulgarian mountain flora.
By E. Kozuharova, V. Lavchiev and T. Lennartsson
9. Effects of plant size on reproductive output and offspring performance in the facultative biennial *Digitalis purpurea*.
By Nina Sletvold

10. Pollination of four Acanthaceae species from Chamela (Mexico).
By M. Méndez, M. Manktelow and S. Manktelow
11. Genetic diversity and reproduction of *Honckenya peploides* (L.) Ehrh. (Caryophyllaceae) in populations in West Greenland, Svalbard and Southern Norway.
By Astrid Eithun and Inger Nordal
12. Population ecology of a rare and vulnerable beach plant, *Eryngium maritimum* L., along the Skagerak coast.
By Catrine Curle and Inger Nordal
13. Pattern of allozyme variation within *Saxifraga tricuspidata* Rottb. populations in seed bank and vegetation.
By Kjersti Hansen and Inger Nordal
14. Seed-dispersal and invasions.
By Winnie H. Christensen
15. Phylogenetics, reproductive biology and conservation in *Trochetia*, an endemic Mascarene genus in the Malvaceae.
By Dennis M. Hansen
16. The structure of an arctic plant-insect network.
By Rebekka L. Lundgren
17. The effect of habitat quality on the population biology of *Erigeron acer* subsp. *decoloratus*.
By Anna Kilpiä

Position effects on floral gender in non-hermaphroditic species: mononecy

Marcos Méndez.

Email: Marcos.Mendez@botan.su.se

Botaniska Institutionen, Stockholm Universitet, SE-106 91 Stockholm, Sweden.

Abstract (Poster)

Within hermaphroditic species, position effects on fruit or seed set, as well as on seed mass, have been studied for 20 years. Along an inflorescence axis, all reproductive variables above mentioned use to decrease. I postulate that a coupling can be made between such patterns and position effects on floral gender in non-hermaphroditic species, with emphasis in monoecy. Monoecy has been explained as a result of either resource partition among flowers or avoidance of interference between gender functions. In both cases, position effects should be expected in floral arrangement along inflorescence axes. Those position effects are in fact known to all taxonomists but have been largely ignored by evolutionary ecologists. Here I describe five potential position effects, related to inflorescence architecture: (1) male above, female below; (2) female above, male below; (3) male central, female periferal; (4) female central, male periferal; (5) no position effect. A survey of Flora Europea showed that all five patterns are found among monoecious taxa. Male above, female below, as well as no position effect (solitary flowers or separate male and female inflorescences) were the commonest patterns. However, the other three patterns were also represented, sometimes within the same family. The most likely correlate to the patterns was not pollination syndrome (entomo- vs. anemophily) but acro- vs. basipetally. This points to apical dominance and resource partitioning as responsible for such position effects.

Pollination of plants in habitat fragments with different connectivities: a bioassay approach

Louise Cranmer.

Email: l.cranmer@talk21.com

University College Northampton, Boughton Green Road, Northampton, NN2 7AL

Abstract (Poster)

The typical arable landscape of lowland Britain is characterised by numerous linear features such as hedgerows, which are important habitats for wildlife. Previous fieldwork had suggested that artificial linear features did influence pollinator flight behaviour and that hedgerows appeared to facilitate pollinator movement across the landscape. Therefore, plants in semi-natural habitat patches possessing numerous connections, may receive greater pollinator visitation than those patches with few or no connecting hedgerows. This investigation sought to elucidate the relationship between seed yield of *Salvia pratensis* (Labiatae) growing in patches with high connectivity and compare it with those plants growing within poorly connected patches. The results showed that pollinator abundance, pollen grains per stigma and seed yield were greater in highly connected patches compared with patches with fewer connections. The overall connectivity of a landscape may therefore be important to both pollinators and those plants which depend on them for greater reproductive success.

Pollination of a native slipper orchid *Cypripedium fasciculatum* by a parasitic wasp (Hymenoptera: Diapriidae)

Carol Ferguson and Kathleen Donham.

Email: KDonham@Prodigy.net

Environmental Education, Southern Oregon University, 3776 Devils Garden Road, Medford, Oregon 97504, USA.

Abstract (Poster)

A four-year field study conducted in southwest Oregon field sites examined the relationships between blooming *Cypripedium fasciculatum* and associated insect visitors. *C. fasciculatum* has a one-way pollinator path that will accommodate insects of 5 mm or less, offers no nectar reward, and dispenses a bilobed pollen mass from each of two anthers. Insect visitors in the field sites were monitored primarily with sticky cards. Diapriid wasps (sub-family Belytinae) in the genus *Cinetus* were the only insects found vectoring *C. fasciculatum* pollen. Intact pollen masses were examined using scanning electron microscopy (SEM). *C. fasciculatum* pollen was always situated as a single or double mass on the sculpted mesonotum of female *Cinetus* wasps. Belytines are documented parasites of fungus gnat larvae and pupae, and sciarids have consistently been the most abundant insects captured in Oregon orchid sites. Diapriids were captured in orchid field sites prior to orchid emergence, but peak diapriid activity corresponded to peak orchid bloom in May. Diapriid activity declined abruptly by mid-June. Numbers of captured fungus gnats were steady throughout the cool and damp spring. Diapriids are presumably attracted to *C. fasciculatum* by deceit, probably by scent. *C. fasciculatum* odor is inconsistently noticeable during the blooming season, and the chemical composition of the odor has yet to be analyzed. Possible sources of the odor on the orchid were examined using SEM.

They came from the east - the story of *Alisma wahlenbergii*, a rare aquatic plant in the Baltic Sea

Anders Jacobson.

Email: Anders.Jacobson@sysbot.lu.se

Systematic Botany, Department of Ecology, Lund University, Sölvegatan 37, S-223 62 Lund, Sweden

Abstract (Poster)

Alisma wahlenbergii (Holmb.) Juz. (Alismataceae) is a rare aquatic plant, endemic to the Baltic Sea region. It has an odd disjunct distribution consisting of three isolated regional populations: Lake Mälaren in Sweden, the northern part of the Gulf of Bothnia and the inner part of the Gulf of Finland. The species has obligately cleistogamous flowers and there is very little, if any, gene flow by pollen. Due to relatively long geographical distances, seed exchange between populations is unlikely.

Alisma wahlenbergii is probably a "young" species that has evolved in the Baltic Sea region from the much more widespread *Alisma gramineum* C.C. Gmel. after the last Ice Age, i.e. during the last 10000 years.

Preliminary RAPD and allozyme data show that *Alisma wahlenbergii* is distinct from Central and most Eastern European populations of *A. gramineum*. The finding of much closer resemblance between *A. wahlenbergii* and *A. gramineum* populations in Lake Peipsi, Estonia indicates that the ancestor of *A. wahlenbergii* probably has entered the Baltic Sea from the east after the last Ice Age. Lack of variation within each region, but clear distinction between them, indicates that the three regional populations probably originate from rare long-distant dispersal events and have been isolated from each other for a substantial period of time.

Pollination biology of *Buxus balearica* Lam

Amparo Lázaro and Anna Traveset.
Email: vieaalc@tomir.uib.es

Instituto Mediterráneo de Estudios, Avanzados (I.M.E.D.E.A.), C.S.I.C.-U.I.B., C/Miquel Marqués no 21, 07190 Esporles, Balears, Spain.

Abstract (Poster)

Buxus balearica Lam. (Buxaceae) is a species relatively widespread around the Mediterranean Basin, although its distributional range has been considerably reduced in recent times, being considered in risk of extinction in some fragmented populations. In this study we compare its pollination biology among three island and two continental populations at the occidental extreme of its distribution. Our specific questions are: (1) Does the reproductive system vary among populations? (2) Do fruit/seed set and fruit/seed traits depend on the source of pollen?. In spring of 2002, we carried out insect censuses and performed hand-pollination experiments to detect whether pollen is limiting the production of seeds and to determine the relative importance of each pollination system (selfing, anemogamy and xenogamy). Results suggest that the species is both anemophilous and entomophilous (the main flower visitor being *Apis mellifera*) and that pollen may be limiting in all populations, either insular or continental. The levels of selfing are always lower than the rest of treatments and vary significantly among populations, both in the island and the continent. Preliminary data obtained from one of the populations show a trend to have higher pollination success when pollen comes from another population, which suggests that inbreeding might be important. Fruit and seed dimensions vary both among populations and treatments. Selfed fruits are smaller and lighter and have a higher number of aborted seeds than those from the rest of treatments, especially the outcrossing.

Population differentiation in flowering phenology in *Arabidopsis
lyrata ssp. petraea*

Saskia Sandring.

Email: saskia.sandring@ebc.uu.se

Department of Plant Ecology, Evolutionary Biology Centre, Uppsala University, Villavägen 14, SE-752 36 Uppsala, Sweden

Abstract (Poster)

No abstract submitted by Monday 28-10-2002.

Impact of introduced honeybees on native pollination interactions of *Echium wildpretii* in Tenerife, the Canary Islands

Yoko L. Dupont, Dennis M. Hansen and Alfredo Valido.
Email: bioyd@biology.au.dk

Department of Ecology and Genetics, Ny Munkegade building 540, DK-8000 Aarhus C, Denmark.

Abstract (Poster)

Honeybees (*Apis mellifera* L.) have been introduced to most regions of the world including many oceanic islands. The impact of introduced pollinators is of special concern in island ecosystems, which may be particularly sensitive to invasion by alien species. We investigated if and how introduced honeybees affect native plant-flower-visitor interactions in *Echium wildpretii* ssp. *wildpretii*, a plant endemic to the sub-alpine mountain region of Tenerife. Honeybees are naturally absent from this high altitudinal zone. However, thousands of bee hives are introduced by bee-keepers during the short sub-alpine summer. We monitored patterns of flower-visitation by native and introduced animals, nectar secretion and fruit set in two study populations of *Echium wildpretii*: One population (pop1) was located close to introduced bee hives, and therefore was dominated by honeybees during the summer. The other population (pop2) was isolated by a crater rim and visited by a much smaller number of honeybees. In pop1, visitation rate of native bees remained low throughout the flowering season. Following the onset of honeybee activity, flowers were completely depleted of nectar. On the contrary in pop2, visitation rate by native bees was significantly higher than honeybees throughout the season. Standing nectar crop was lowered during the activity period of insects, but the level never reached zero. Furthermore, honeybees visited more flowers and stayed longer on the same inflorescence than native pollinators, and may therefore promote inbreeding. Fruit set was slightly higher in pop2 than pop1. However, seed viability did not differ significantly. In conclusion, honeybees apparently have a minor effect on reproductive success of the plants, but seem to be strong competitors of the native animals.

Flies *Thricops* sp. pl. (Muscidae, Diptera) as pollinators of some bell shaped flowers in Bulgarian mountain flora

E. Kozuharova, V. Lavchiev and T. Lennartsson.

Email: ina@pharmfac.acad.bg

Department of Pharmacognosy and Botany, Faculty of Pharmacy, Medical University of Sofia, Dunav 2, Sofia 1000, Bulgaria.

Abstract (Poster)

Insect visitors of *Gentiana* sp. pl. and *Campanula* sp. pl. — blue or yellow bell shaped flowers adapted to bumblebee pollinators, were observed in the mountains of SW Bulgaria: Mt. Vitosha, Rila Mts, Pirin Mts, Western Stara Planina Mts and Mt. Ljulin during the period July to September of the years 1989 to 1998 at altitudes between 1000 m and 2000 m. Flies *Thricops* sp. pl. demonstrated high visitor activity. *Thricops* flies occurred significantly more often than coadaptively specialised pollinators such as bumblebees in the flowers of *Gentiana lutea* L. subsp. *symphyandra* (Murb.) Hayek *G. punctata* L. *G. asclepiadea* L. and especially in the flowers of *G. pyrenaica* L. *Campanula velebitica* Borb., *C. patula* L. *C. sparsa* Friv.

Distribution in space and time of *Thricops* sp. pl. is discussed as well as their plant choice.

Individual pollinator effectiveness of *Thricops* flies is lower than that of bumblebees in the flowers of the investigated plant species. These flies are small compared to the flower morphology and they may not touch generative organs in some of their visits. They carry less pollen grains on their body surface compared to bumblebees and other bees. At the same time they are numerous and often main flower visitors. They remain active even in cool and wet weather when bumblebees are absent. *Thricops* flies contribute to the separation of male and female stages of gentians flowers being pollen eaters and thus to avoid self-pollination.

Effects of plant size on reproductive output and offspring performance in the facultative biennial *Digitalis purpurea*

Nina Sletvold.

Email: nina.sletvold@bio.uio.no

Department of Biology, Division of Botany and Plant Physiology, University of Oslo, P.O. Box 1045 Blindern, N-0316 Oslo, Norway.

Abstract (Poster)

Monocarpny in facultative biennials can be favoured by selection when there is a more than proportional increase in fitness with size. This disproportionate increase could arise through: a) larger reproductive output, b) higher offspring quality. These two relationships were investigated in the facultative biennial plant *Digitalis purpurea* L. by relating total seed number, mean individual seed mass and germination percentage/speed to straw mass (rosette leaves and flowering stem excluding fruits and seeds) in 100 individuals of varying size. To examine whether maternal size influences offspring growth, seeds from 32 maternal plants were grown for 14 weeks before harvesting.

Total seed number increased proportionally with size. Seed quality measured as seed size, germination percentage and speed, also increased with maternal size. The combined fitness measures of total seed mass, number of seedlings (seed number \times germination percentage) and total female fitness (seedling number \times offspring dry mass after 14 weeks) all increased disproportionately with size.

The results contradict the idea that monocarpny exists in *D. purpurea* because of a disproportionate advantage in seed output of large individuals (hypothesis a), and support the offspring quality hypothesis (hypothesis b).

Pollination of four Acanthaceae species from Chamela (Mexico)

Marcos Méndez, Mariette Manktelow and Stephen Manktelow.
Email: Marcos.Mendez@botan.su.se.

Botaniska Institutionen, Stockholm Universitet, SE-106 91 Stockholm, Sweden.

Abstract (Poster)

Diversity in floral morphology and pollination systems is very high within Acanthaceae but detailed studies of pollination are scarce in this family. We documented flower morphology, floral rewards, floral biology and floral visitors for four coexisting species of Acanthaceae which flower at the same time in a dry forest of Chamela, Mexico. *Ruellia foetida*, *Siphonoglossa mexicana*, *Stenandrium pedunculatum* and *Carlwrightia* sp. (arizonica?) showed a range in floral morphology from radially symmetric flowers to strong bilateral symmetry and offered variable amount of nectar and pollen as rewards. None of these species was specialized in a single pollinator; pollen collecting bees, euglossine bees, bombylid flies, and butterflies were observed visiting one or several species. However, each species were visited by specific proportions of one or more of those groups and this was related to particular details of floral morphology (floral tube length) and floral rewards (nectar volume, protrusion of anthers). According to those differences, legitimate pollinators in one species could turn into robbers or thieves of another one. Even in non-specialised pollination interactions there is wide room for partition among plant species of the potential pollinator fauna, no matter how strong faith is put into the existence of well defined pollination syndromes.

Genetic diversity and reproduction of *Honckenya peploides* (L.) Ehrh. (Caryophyllaceae) in populations in West Greenland, Svalbard and Southern Norway

Astrid Eithun and Inger Nordal.
Email: astrid.eithun@bio.uio.no

Department of Biology, Division of Botany and Plant Physiology, University of Oslo. P.O. Box 1045 Blindern, N-316 Oslo, Norway.

Abstract (Poster)

Honckenya peploides (L.) Ehrh. is a circumpolar, dioecious beach plant. The species is widespread in S. Norway, common in SW. Greenland (Disko) and rare in Svalbard. We studied one population in each country.

It reproduces both sexually and clonally, forming patches or mats of shoots. *H. peploides* displays two kinds of flowers, female flowers have short petals and long styles, while the hermaphroditic flowers have long petals and short styles. Crossing experiments were done in the population in W. Greenland and S. Norway. 25 individuals in each population were included in the study, both hermaphroditic and female flowers.

Live plant material were collected for allozyme electrophoresis analysis from all three populations. Large genetic variation was observed within populations. Using allozyme analysis we also tested if large patches consisted of one or more clones, by analysing several samples taken from the same patch. We found that some patches consisted of at least two different clones.

Population ecology of a rare and vulnerable beach plant, *Eryngium maritimum* L., along the Skagerak coast

Catrine Curle and Inger Nordal.
Email: c.m.curle@bio.uio.no

Department of Biology, Division of Botany and Plant Physiology, University of Oslo. P.O. Box 1045
Blindern, N-316 Oslo, Norway.

Abstract (Poster)

Eryngium maritimum L. is regarded as a rare and vulnerable plant in Norway and Sweden. The populations in these countries are small and disjunct. To evaluate the possibility of seawater dispersal, fruits from 2 populations in Norway and in 3 populations in Sweden were tested for floating ability in salt water. After floating, a germination experiment was conducted on the fruit set. Germination ability was compared with a fruit set not tested for floating. Isoenzymes were used to evaluate the genetic variability within and between populations. Leaves were taken from 8 populations in Norway and 4 populations in Sweden. Among the enzymes tested, only PGM showed variation.

Pattern of allozyme variation within *Saxifraga tricuspidata* Rottb. populations in seed bank and vegetation

Kjersti Hansen and Inger Nordal.

Email: kjhansen@bio.uio.no

Department of Biology, Division of Botany and Plant Physiology, University of Oslo. P.O. Box 1045 Blindern, N-316 Oslo, Norway.

Abstract (Poster)

Soil seed banks may accumulate and store seed genotypes produced over many seasons. Persisting seed banks may provide information on historical changes in the genetic composition of populations. Genetic structures of *S. tricuspidata* are investigated in six seed bank populations and one surface plant population from Greenland/Disco. Analyses of six polymorphic isozyme loci were used to find to which extent the soil seed banks differed genetically from the Vegetation. Average over the six plots, the seed banks and the adult stage contained very similar levels of genetic diversity. Low difference in allelic frequencies was found between the seed bank and its surrounding vegetation. F_{st} indicate lack of differentiation between the two stages ($F_{st} = 0.016$). Only 1.6% is ascribed to genetic differences among populations and about 98% of the total genetic variation is found within the populations. Additionally, the total genetic diversity in the seed bank and vegetation showed no significant differences (seed bank $H_e = 0.42 \pm 0.21$ [mean \pm SD] vs. vegetation $H_e = 0.39 \pm 0.19$). Genetic diversity lost from extinct adult population can be retained in the long-lived seed bank, and local perturbation may be sufficient to reintroduce this genetic variation into new adults.

Seed-dispersal and invasions

Winnie H. Christensen.

Email: emil_winnie@mobilixnet.dk

Department of Ecology and Genetics, Ny Munkegade building 540, DK-8000 Aarhus C, Denmark.

Abstract (Poster)

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Phylogenetics, reproductive biology and conservation in *Trochetia*, an endemic Mascarene genus in the Malvaceae

Dennis M. Hansen.

Email: marinus_hansen@hotmail.com

Department of Ecology and Genetics, Ny Munkegade building 540, DK-8000 Aarhus C, Denmark.

Abstract (Poster)

Trochetia is a small endemic Mascarene genus of shrubs or small trees with six species, five on Mauritius and one on Réunion. Floral morphology in the genus varies from small orange and medium-sized white flowers, to very large red and pink flowers. The Réunion species, *T. granulata*, is still locally common. The most common Mauritian species, *T. triflora*, is classified as "vulnerable", while *T. blackburniana* is considered "rare", and both *T. uniflora* and *T. boutoni-ana*, are "endangered". A few small populations of *T. parviflora* were rediscovered last year after it had been presumed extinct since 1863.

This study will investigate reproductive biology, including the possibility of cryptic and/or leaky dioecy, of all six species in a phylogenetic context. Molecular and morphological phylogenies will be constructed. This will allow me to correct for relatedness in interspecific comparisons, and also enable me to study the direction of changes in flower morphology, flower colour, and nectar colour (another rare floral trait); e.g. whether evolutionary change in flower size went from small to large or vice versa within the clade. Furthermore, practical conservation issues will be investigated, including in situ vs. ex situ methods. Another avenue of research will include disruption of pollination mutualisms, as some of the *Trochetias* are bird-pollinated and two of three Mauritian nectarivorous passerines are endangered.

My results will hopefully provide new insights into evolution of reproductive systems and radiation in island plants. It will fit in well with ongoing phylogenetic research in the Malvaceae. The possibility of cryptic or leaky dioecy in *Trochetia* could provide an opportunity for much needed further investigation of the evolution of these rare traits. Furthermore, my project will further conservation of endangered island endemic plants and their mutualistic interactions with animals. Finally, it may serve as a focus for Mauritian conservation efforts in relation to native plants and their mutualists.

The structure of an arctic plant-insect network

Rebekka L. Lundgren.

Email: rebekkalundgren@hotmail.com

Department of Ecology and Genetics, Ny Munkegade building 540, DK-8000 Aarhus C, Denmark.

Abstract (Poster)

A pollination network study was conducted in July 2002 in northwest Greenland on Uummannaq Island. The study site consisted of a $100 \times 100 \text{ m}^2$ plot of a *Betula* dominated heath. Observations of the flower-visiting insects were done daily by random census walking in the plot. I spent 20 minutes each observation day on each plant species which in total was around 4 hours depending on the length of the flowering period. A total of 53 interactions between 17 plant species and 24 flower-visiting insect species were observed.

The structure and level of generalization/specialization of the network will be analysed.

The effect of habitat quality on the population biology of *Erigeron acer* subsp. *decoloratus*

Anna Kilpiä.

Email: Anna.Kilpia@oulu.fi

University of Oulu, Department of Biology, PL 3000, 90014 University of Oulu, Finland.

Abstract (Poster)

No abstract submitted by Monday 28-10-2002.

List of participants

Hafdís Hanna Ægisdóttir	Institute of Biology, University of Iceland; Grensásvegur 12, IS 108 Reykjavík, Iceland; e-mail: hhae@hi.is, Tel: +(354) 899-3541, Fax: +(354) 525-4069
Stefan Andersson	Systematic botany, Department of Ecology, Lund University; Sölvegatan 37, S-22362 Lund, Sweden; e-mail: stefan.andersson@sysbot.lu.se, Tel: +46 462-228-975
Katherine Baldock	University of Edinburgh, Institute of Cell, Animal and Population Biology; 6 Winton Way, Woking, Surrey, GU21 3HL, United Kingdom; e-mail: kath_baldock@hotmail.com, Tel: +0044 1483-763981
María José Bañuelos	KVL (Royal Veterinary and Agricultural University), Department of Ecology, Botanical Section; Rolighedsvej 21, DK-1958 Frederiksberg C, Denmark; e-mail: mjbm@kvl.dk, Tel: +45 3528-2813, Fax: +45 3528-2821
Thomas Bergsdorf	Alexander Koenig Research Institute and Museum of Zoology; Adenauerallee 160, D-53113 Bonn, Germany; e-mail: Thomas@Bergsdorf.com, Tel: +049 228/9122-288, Fax: +049 228/216-979
Mikkel Bundgaard	Department of Ecology and Genetics; University of Aarhus; Ny Munkegade building 540, 8000 Aarhus C, Denmark; e-mail: mikkelbio@stofanet.dk, Tel: +0045 8612-5363
Lizzie Tamzyn Cant	Rothamsted Research, Plant and Invertebrate Ecology Division; Harpenden, Herts, AL5 2JQ, United Kingdom; e-mail: lizzie.cant@bbsrc.ac.uk, Tel: 01582-763133 ext.2283, Fax: 01582-760981
Winnie Heltborg Christensen	Department of Ecology and Genetics; University of Aarhus; Ny Munkegade building 540, 8000 Aarhus C, Denmark; e-mail: emil_winnie@mobilixnet.dk, Tel: +45 8942-3331, Fax: +45 8612-7191
Louise Cranmer	School of Environmental Science, University College Northampton; Garden Cottage, Great Purston, Brackley, Northants, NN13 5PL, England; e-mail: l.cranmer@talk21.com, Tel: 0774-7798932
Catrine Curle	Department of Biology, University of Oslo; Box 1045 Blindern, N-0316 Oslo, Norway; e-mail: c.m.curle@bio.uio.no, Tel: +0047 9324-9709 (mobil), Fax: +0047 2285-4664
Hans C.M. den Nijs	IBED, University of Amsterdam; Kruislaan 318, 1098 SM Amsterdam, The Netherlands; e-mail: nijs@science.uva.nl, Tel: +3120 5257660, Fax: +3120 5257832
Anita Diaz	Bournemouth University, School of Conservation Sciences; Talbot Campus, Fern Barrow, Poole, Dorset BH12 5BB, Country England; e-mail: ADiaz@bournemouth.ac.uk, Tel: 01202595679, Fax: 1202595255

Kathleen Ruth Donham	Environmental Education/Southern Oregon University; 3776 Devils Garden Road, Medford Oregon 97504, USA; e-mail: KDonham@Prodigy.net, Tel: 541-772-5044
Yoko Luise Dupont	Department of Ecology and Genetics; Ny Munkegade building 540, 8000 Aarhus C, Denmark; e-mail: bioyd@biology.au.dk, Tel: +45 8942 3127, Fax: +45 8612 7191
Bodil Kirstine Ehlers	Centre d'Ecologie Fonctionnelle et Evolutive; 1919 Route de Mende, 34293 Montpellier, France; e-mail: ehlers@cefe.cnrs-mop.fr, Tel: +33 4 67 61 33 05
Astrid Eithun	Department of Biology, University of Oslo; Box 1045 Blindern, N-0316 Oslo, Norway; e-mail: astrid.eithun@bio.uio.no
Bente Eriksen	Botanical institute; Box 461, SE-405 30 Göteborg, Sweden; e-mail: bente.eriksen@botany.gu.se, Tel: +46 31 773 2684, Fax: +46 31 773 2677
Signe Gammeltoft	Department of Ecology and Genetics; University of Aarhus; Ny Munkegade building 540, 8000 Aarhus C, Denmark; e-mail: signe.gammeltoft@sol.dk, Tel: 86121463
Mirella H.M. Groot	Institute of biodiversity and ecosystem dynamics (IBED), University of Amsterdam; P.O. Box 94062, NL-1090 GB Amsterdam, The Netherlands; e-mail: mirella_groot@yahoo.com, Tel: +31.20.525.7817, Fax: +31.20.525.7832
Urban Gunnarsson	Botanisk Institutt, NTNU; ., NO-7491 Trondheim, Norway; e-mail: urban.gunnarsson@chembio.ntnu.no, Tel: +47 7355 1286, Fax: +47 7359 6100
Melanie Hagen	Zool. Research Institut and Museum Alexander König; Adenauerallee 160, 53113 Bonn, Germany; e-mail: melanie.hagen@web.de, Tel: 0228/9122288
Dennis M. Hansen	Department of Ecology and Genetics; University of Aarhus; Ny Munkegade building 540, 8000 Aarhus C, Denmark; e-mail: marinus_hansen@hotmail.com, Tel: +45 8942 3127, Fax: +45 8612 7191
Kjersti Hansen	Department of Biology, University of Oslo; Box 1045, Blindern, N-0316 Oslo, Norway; e-mail: kjhansen@bio.uio.no
Lise Bach Hansen	Botanical Institute, University of Copenhagen; Øster Farimagsgade 2D, DK-1353 København K, Denmark; e-mail: liseh@bot.ku.dk, Tel: 35322278
Thomas Hansen	Botanical Institute, University of Copenhagen; Øster Farimagsgade 2D, DK-1353 København K, Denmark; e-mail: t.hansen@lifesci.UCSB.edu, Tel: +45 3532 2278, Fax: +45 3532 2259
Frank Hoffmann	Laboratory of Plant Ecology, University of Groningen; PO Box 14, 9750 AA Haren, The Netherlands; e-mail: f.hoffmann@biol.rug.nl, Tel: +31-50-3632231
Anders Jacobson	Department of Ecology, Systematic Botany; Sölvegatan 37, 223 62 Lund, Sweden; e-mail: anders.jacobson@sysbot.lu.se, Tel: +46-46-2228968
Anne Jakalaniemi	Oulanka Biological Station, University of Oulu; Liikasenvaarantie 134, 93999 Kuusamo, Finland; e-mail: anne.jakalaniemi@metso.fi, Tel: +358 40 560 9892, Fax: +358 20 564 6801

Tove Hedegaard Jørgensen	Systematic Botany, Lund University; Sølvegatan 37, 22362 Lund, Sweden; e-mail: Tove.Hedegaard@sysbot.lu.se, Tel: +46 46-2220912, Fax: +46 046-2224234
Christopher Niels Kaiser	University of Zurich/ Institut der Umweltwissenschaften (Institute of Environmental Science); Winterthurerstrasse 190, 8057 Zurich, Switzerland; e-mail: chris.kaiser@gmx.net, Tel: +41 1 635 52 04, Fax: +41 1 635 57 11
Kathleen M. Kay	Department of Plant Biology, Michigan State University; 166 Plant Biology Building, East Lansing, MI 48823, USA; e-mail: kaykathl@msu.edu, Tel: 517-432-5284, Fax: 517-353-1926
Anna Kilpiä	University of Oulu, Department of Biology; PL 3000, 90014 University of Oulu, Finland; e-mail: Anna.Kilpia@oulu.fi, Tel: 0400-479 491
Jens M. Olesen	Department of Ecology and Genetics; University of Aarhus; Ny Munkegade building 540, 8000 Aarhus C, Denmark; e-mail: jens.olesen@biology.au.dk, Tel: +45 8942 3267, Fax: +45 8612 7191
Marianne Philipp	Botanical Institute, University of Copenhagen; Øster Farimagsgade 2D; DK-1353 Copenhagen K, Denmark, e-mail: mari-anp@bot.ku.dk, Tel: +45 35322277, Fax: +45 35322321
Lars Pødenphant Kiær	Botanical Institute, University of Copenhagen; Øster Farimagsgade 2D, DK-1353 København K, Denmark; e-mail: lars.kiaer@risoe.dk, Tel: 46774227
Steen Randers Knudsen	KVL, Department of Ecology; Rolighedsvej 21, 1958 Frederiksberg C, Denmark; e-mail: srk@kvl.dk, Tel: +45 35282802, Fax: +45 35282821
Ekaterina Kozuharova	Department of Pharmacognosy and Botany, Faculty of Pharmacy, Medical University of Sofia; Dunav 2, Sofia 1000, Bulgaria; e-mail: ina@pharmfac.acad.bg, Tel: +359-2-943-13-20, Fax: +359-2-987-987-4
Manfred Kraemer	Alexander Koenig Research Institute and Museum of Zoology; Adenauerallee 160, 53113 Bonn, Germany; e-mail: m.kraemer.zfmk@uni-bonn.de, Tel: 049-228/9122-277
Manja Kwak	Laboratory of Plant Ecology, University of Groningen; PO Box 14, 9750 AA Haren, The Netherlands; e-mail: m.m.kwak@biol.rug.nl, Tel: +31-50-3632225
Magnus Larsson	Department of Plant Ecology; Villav. 14, 752 37 Uppsala, Sweden; e-mail: Magnus.Larsson@ebc.uu.se, Tel: +46 18 471 2870, Fax: +46 18 55 34 19
Amparo Lázaro	Natural Resources Department. IMEDEA (CSIC-UIB); C/Miquel Marqués 21, 07190, Esporles, Balears, Spain; e-mail: vieaal@uib.es, Tel: +34971611719, Fax: +34971611761
Tommy Lennartsson	Swedish Univ. of Agricult. Sciences, Department of Conservation Biology; P.O. Box 7002, 750 07 Uppsala, Sweden; e-mail: tommy.lennartsson@nvb.slu.se, Tel: +46 18672436, Fax: +46 18673537
Sheila H. Luijten	Institut des Sciences de l'Evolution (ISEM), Université de Montpellier 2; Place Eugène Bataillon, F- 34095 Montpellier Cedex 05, France; e-mail: luijten@isem.univ-montp2.fr, Tel: 33 (0) 4 67 14 39 74, Fax: 33 (0) 4 67 14 36 22

Rebekka Laura Lundgren	Department of Ecology and Genetics; University of Aarhus; Ny Munkegade building 540, 8000 Aarhus C, Denmark; e-mail: rebekkalundgren@hotmail.com, Tel: 20929240
Marcos Méndez	Botaniska Institutionen, Stockholm Universitet; Lilla Frescativ. 5, SE-106 91 Stockholm, Sweden; e-mail: marcos.mendez@botan.su.se, Tel: +46 8 161288, Fax: +46 8 162268
Carolin Mix	Aquatic Ecology and Environmental Biology; Toernooiveld 1, 6525 ED Nijmegen, The Netherlands; e-mail: cmix@sci.kun.nl, Tel: 0031-24-3652919, Fax: 0031-24-3652134
Christine Beatrice Muller	Institute of Environmental Sciences, University of Zurich; Winterthurerstrasse 190, CH-8057 Zurich, Switzerland; e-mail: cbm@uwinst.unizh.ch, Tel: ++ 41 (0)1 635 48 06, Fax: +44 (0)207 586 2870
Johanne Maad	Department of Botany; NTNU, 7491 Trondheim, Norway; e-mail: johanne.maad@chembio.ntnu.no, Tel: +47 73550337
Rayna Natcheva	Systematic Botany, Lund University; Sölvegatan 37, 223 62, Lund, Sweden; e-mail: renimoss@yahoo.com
Inger Nordal	Department of Biology, University of Oslo; Box 1045, Blindern, N-0316 Oslo, Norway; e-mail: inger.nordal@bio.uio.no, Tel: 00 47 22 85 46 65, Fax: 00 47 22 85 46 64
Jeff Ollerton	School of Environmental Science, University College Northampton; Park Campus, Northampton, NN2 7AL, United Kingdom; e-mail: jeff.ollerton@northampton.ac.uk, Tel: 01604 735500, Fax: 10604 720636
Gerard Oostermeijer	Inst. Biodiversity and Ecosystem Dynamics, University of Amsterdam; P.O. Box 94062, 1090 GB Amsterdam, Netherlands; e-mail: oostermeijer@science.uva.nl, Tel: +31.20.5257817, Fax: +31.20.5257832
Katrine Petersen	Botanical Institute, University of Copenhagen; Øster Farimagsgade 2D, DK-1353 København K, Denmark; e-mail: katpet@gjk.dk, Tel: +45 32876809
Aina Pihlgren	Department of Conservation biology; Box 7002, 750 07 Uppsala, Sweden; e-mail: ainapihlgren@hotmail.com, Tel: 018-67 22 65, Fax:
Kristine Kjörup Rasmussen	Royal Veterinary and Agricultural University, Department of Ecology; Rolighedsvej 21, 1958 Frederiksberg C, Denmark; e-mail: kkj@kvl.dk, Tel: +45 35282818
Saskia Sandring	Dept of Plant Ecology, EBC, Uppsala University; Villavägen 14, 752 36 Uppsala, Sweden; e-mail: saskia.sandring@ebc.uu.se, Tel: +46 18 4712870, Fax: +46 18 553419
Sylvi M. Sandvik	Agder University College, Department of Natural Sciences; Service Box 422, N-4604 Kristiansand, Norway; e-mail: Email: Sylvi.M.Sandvik@hia.no, Tel: +47 38 14 13 41 , Fax: +47 38 14 12 31
Erik Sjödin	Department of Ecology and Crop Production Science, SLU, Sweden; Street, Box 7043, Sweden; e-mail: Erik.sjodin@evp.slu.se, Tel: 018-672257
Lene Kolind Skougaard	Botanical Institute, University of Copenhagen; Øster Farimagsgade 2D, 1353 København K., Denmark; e-mail: leneks@bot.ku.dk, Tel: 36774648

Nina Sletvold	Department of Biology, Division of Botany, University of Oslo; P.O. Box 1045 Blindern, N-0316 Oslo, Norway; e-mail: nina.sletvold@bio.uio.no, Tel: 47 - 22 85 45 77, Fax: 47 - 22 85 46 64
Adrian Stott	Murray Avenue, Kingsley, Northampton NN2 7BS, England; e-mail: adrian.stott@northampton.ac.uk, Tel: 44 1604 474085
Paula Stott	Murray Avenue, Kingsley, Northampton NN2 7BS, England; e-mail: adrian.stott@ntlworld.com, Tel: 44 1604 474085
Jane Catherine Stout	Botany Department, Trinity College Dublin; University of Dublin, Dublin 2, Ireland; e-mail: stoutj@tcd.ie, Tel: +353-1-6083740, Fax: +353-1-6081147
Ørjan Totland	Department of Biology and Nature Conservation, The Agricultural University of Norway; P.O. Box 5014, N-1432 Aas, Norway; e-mail: orjan.totland@ibn.nlh.no, Tel: +47 64 94 84 81, Fax: +47 64 94 85 02
Alfredo Valido	Department of Ecology and Genetics; University of Aarhus; Ny Munkegade building 540, 8000 Aarhus C, Denmark; e-mail: alfredo.valido@biology.au.dk, Tel: +45 8942 3127, Fax: +45 8612 7191
Eva Wallander	Botanical Institute; P.O. Box 461, SE 405 30 Göteborg, Sweden; e-mail: eva.wallander@botany.gu.se, Tel: 0046 31 773 2662, Fax: 0046 31 773 2677
Stella Watts	School of Environmental Science, University College Northampton; Park Campus, Northampton, NN2 7AL, United Kingdom; e-mail: hummingbird_pe@yahoo.com, Tel: 01604 735500, Fax: 01604 720636
H. Jörgen Wissman	Department of Conservation biology, SLU; Bäcklösavägen 10, Box 7002, 750 07 Uppsala, Sweden; e-mail: Jorgen.Wissman@nvb.slu.se, Tel: 018-672225, Fax: 018-673537
