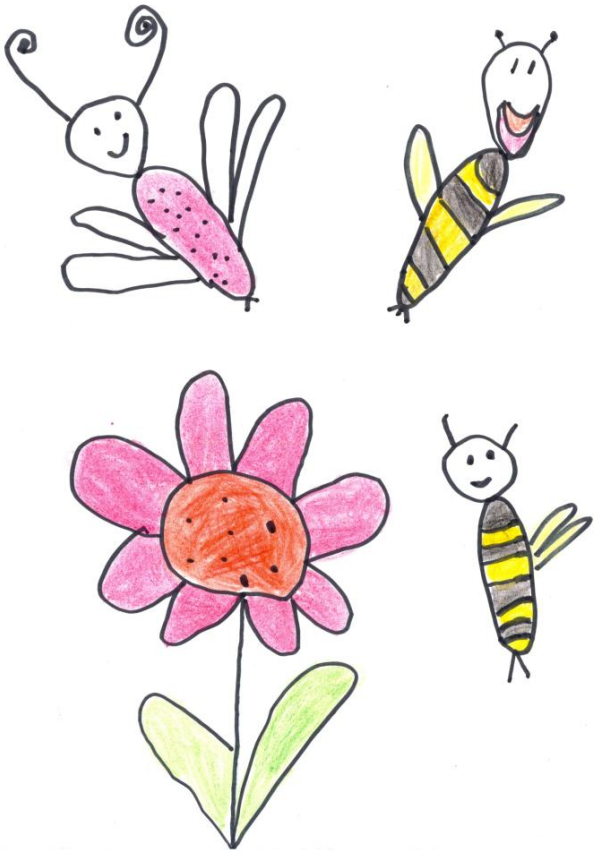
SCAPE 2013



24-27 October

Lammi Biological Station, Finland

Cover drawing: © Olga Laukkanen (5) “The bumblebee is laughing really hard because she was the first to reach the flower, before the butterfly and the hoverfly.”

Welcome to SCAPE 2013!

It is a great pleasure to host the 27th Annual Meeting of the Scandinavian Association for Pollination Ecologists (SCAPE) on 24-27 October 2013 in Lammi Biological Station, Finland.

SCAPE organises an annual meeting for ecologists working with pollination, plant reproductive biology and related fields. The meeting is open to participants from all countries, and the number of nationalities and participants from outside the Nordic countries has steadily increased over the last years. The meeting is especially targeted to let PhD-students present their work and get high-quality feedback in a friendly environment.

This year's meeting comprises talks and a poster session as well as ample opportunity to get in touch with fellow researchers during dinners, the excursion and of course sauna. We have invited two keynote speakers: Prof. Dr. Judith Bronstein from the University of Arizona, USA, and Prof. Dr. Florian Schiestl from the University of Zurich, Switzerland.

We hope that this year's meeting will become a success and wish all participants a pleasant and exciting time.

Organising committee

Anne Muola	(University of Turku)
Niek Scheepens	(University of Turku)
Sofia Gripenberg	(University of Turku)
Anna-Liisa Laine	(University of Helsinki)

Acknowledgements

The organising committee would like to express sincere gratitude to the following foundations for their financial support to SCAPE 2013:

TSV – Federation of Finnish Learned Societies

Turun Yliopistosäätiö

Practical information

General enquiries: if you want to ask something, you can identify SCAPE organisers and helpers by their blue name badge.

Field station regulations: please, only use the main door of the main building, do not open windows and other doors to the outside, and do not keep the front door open for too long. (The electronic burglar alarm may be triggered.)

The main door of the main building will be locked outside office hours. It can be opened with the following door code: 4860

Name badges: will be provided upon arrival. You are allowed to add more information, bees and flowers.

Participants with a poster: please put up your poster on a poster board in the designated area (still unknown at the time this booklet was printed).

Oral presenters: please copy your presentation to the conference laptop well in advance of your presentation, latest during a longer break before the session you will present in, and test your presentation to be sure it runs smoothly.

In emergency situations: immediately inform one of the organisers/helpers. In the exceptional situation of a major emergency, dial 112. The address of our location is: Lammi Biological Station, Pääjärventie 320, 16900 Lammi, Finland.

Our phone numbers if you get lost in the surrounding forest or Hämeenlinna castle:

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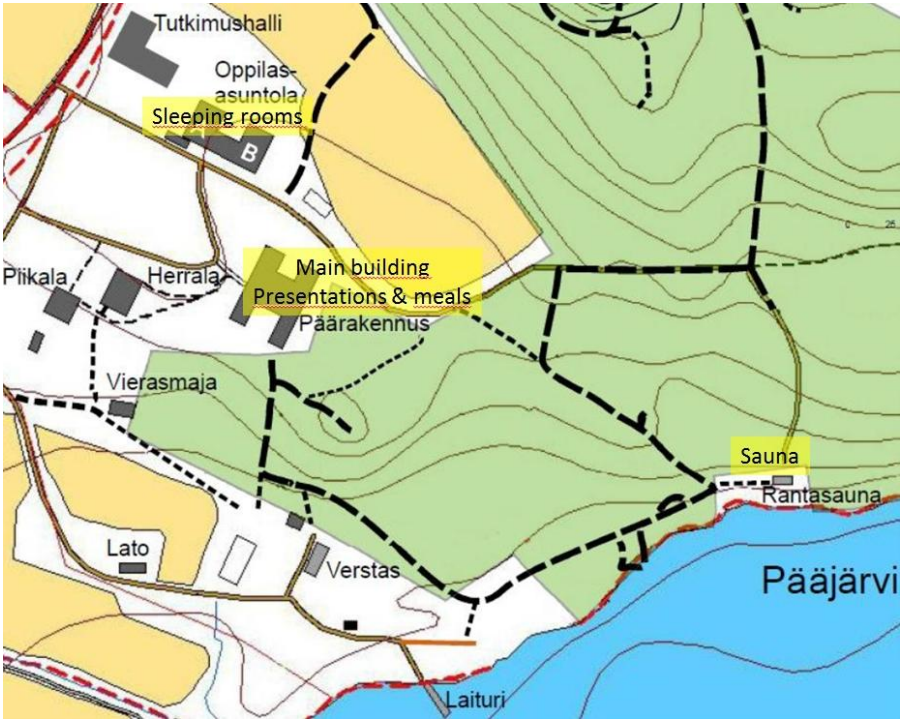

Map of the area of Lammi Biological Station, Finland.

SCAPE conference time schedule

Thursday 24 October

16.30-18.00	Arrival from Helsinki + registration
18.00-19.00	Dinner + welcome speech
19.00-19.30	Free time
19.30-20.30	Keynote speaker: Florian P. Schiestl: Pollinator-mediated evolution in plants
20.30-20.40	Short break
20.40-21.00	Wesselingh & Natalis: The roles of pollinators in hybridization between two *Rhinanthus* species
21.00-21.20	Razanajatovo et al.: Successful naturalization of alien plant species is related to pollinator visitation
21.20-	Pollination bar

Friday 25 October

08.00-09.00	Breakfast
09.00-09.20	Grøndahl et al.: Thyme polymorphism and *Maculinea* host plant choice
09.20-09.40	Burdon et al.: Volatiles from *Penstemon digitalis*: deciphering a silent language
09.40-10.00	Claytor: Population differences in defense trait expression in *Passiflora incarnata*
10.00-10.20	Wester et al.: Small mammal pollinators attracted by potato scent of the South African Pineapple Lily, *Eucomis regia* (Hyacinthaceae)
10.20-10.40	Coffee break
10.40-11.00	Elshibli et al.: Genetic variation in urban forests: case study of oak (Quercus robur) populations from Helsinki city in southern Finland
11.00-11.20	Susi & Laine: The effect of co-infection to pathogen epidemiology in *Plantago lanceolata – Podosphaera plantaginis* –interaction
11.20-11.40	von Numers: Climate dependent distribution of “island” vascular plants in the archipelago of SW Finland?

11.40-12.00	Méndez et al.: Do environmental stress and plant size influence sexual lability in *Neochamaelea pulverulenta* (Rutaceae)?
12.00-13.00	Lunch
13.00-13.15	Free time
13.15-14.30	Lammi biological station guided tours: Suvi Ikonen & Hanna Susi
14.30-15.00	Coffee break
15.00-16.00	Keynote speaker: Judith Bronstein: The dark side of mutualism
16.00-16.10	Short break
16.10-16.30	Ehrlén & Ågren: Mutualists and antagonists drive among-population variation in selection and evolution of floral display in a perennial herb
16.30-16.50	Chapurlat et al.: Spatial variation in pollinator-mediated selection on floral traits in the fragrant orchid *Gymnadenia conopsea*
16.50-17.10	Lankinen et al.: Sexual selection, sexual conflict and mating system evolution in a mixed-mating plant
17.10-17.30	Sletvold & Ågren: There is more to pollinator-mediated selection than pollen limitation
17.30-18.00	Pollination bar
18.00-19.00	Dinner
19.00-	Pollination bar, fireplace
19.30-	Sauna

Saturday 26 October

08.00-09.00	Breakfast
09.00-09.20	Lunau et al.: How flowers manipulate the behavior of hoverflies on flowers and how flies learn to respond
09.20-09.40	Papiorek & Lunau: Ultraviolet reflection properties alter the meaning of yellow flower colours for bees
09.40-10.00	Bossems et al.: Colour preferences in Neotropical stingless bees considering the impact of colour attributes
10.00-10.20	Binkenstein: The correlation between flower colour and morphology in temperate grasslands
10.20-10.50	Coffee
10.50-11.10	Parachnowitsch: Floral signals and rewards: Is there any honesty?

11.10-11.30	Dellinger et al.: Floral food-bodies and a bellows-like mechanism in bird-pollinated *Axinaea* (Melastomataceae)
11.30-12.10	*Inter- and intraspecific variation in functional plant traits and their relevance for community ecology* Junker: Part I: Species- and individual-specific phenotypes control community composition of flower visitors Hoffmeister et al.: Part II: Consequences and dynamic of herbivory as source for variation in flower traits
12.10-13.10	Lunch
13.15-16.45	Excursion to Hämeenlinna castle
16:45-17:30	Free time
17.30-19.00	Poster session
19.00-21.00	Conference dinner
21.00-	Party + pollination bar

Winter time sets in!

Sunday 27 October

08.00-09.00	Breakfast
09.00-09.15	Free time
09.15-09.35	Benadi et al.: Is phenological synchrony with flowering plants most important for specialist pollinators? Evidence from an altitudinal gradient
09.35-09.55	Nitter: Effects of sheep grazing on bumblebee abundance in an alpine ecosystem
09.55-10.15	Santamaría et al.: How spatial heterogeneity influences diversity of pollination interactions
10.15-10.40	Coffee
10.40-11.00	Perez-Barrales: Ecotypic differentiation and pollination of three sympatric species of *Linum* in the Spanish Pyrenees
11.00-11.20	Strandh et al.: Geographic variation of selfing rate and floral traits in the mixed mating species *Collinsia heterophylla* (Plantaginaceae)
11.20-11.30	Free time
11.30-12.30	Lunch
12.30-13.00	Preparing to leave
13.00-	Bus transportation to Helsinki

Poster presentations

Gripenberg et al.:	Plant-seed predator interactions in a species-rich tropical plant community
Kalske et al.:	Interactive effects of inbreeding in a specialized plant-herbivore interaction
Lebeau et al.:	Fitness consequences of declines in wild flower nectar availability for butterflies in agricultural landscapes
Muola et al.:	Artificial selection for host-plant use of a seed-predator: fitness consequences, inbreeding depression, and genetic variation
Salonen et al.:	Bee *Varroa* free!
Zych et al.:	FLORATHECA – a new source of old botanical illustrations for teaching botany and pollination biology
Zych et al.:	Spatio-temporal variation in pollination system of a common umbellifer

Abstracts of oral presentations (in chronological order)

Pollinator-mediated evolution in plants

Florian P. Schiestl
Institute of Systematic Botany, University of Zurich, Switzerland

Many plants use animals as vector for their gametes. For maintaining interactions with such pollinators, plants have evolved floral signals, such as color and fragrance, which advertise rewards such as nectar. Because floral signals mediate interactions between plants and pollinators, their evolution is strongly influenced by such interactions. In my talk I will discuss evolutionary transformation and diversification in plants mediated by plant-pollinator interactions, with a special focus on the role of floral signals. My first example is population transformation triggered by polyploidisation. Polyploidisation can lead to changes in floral signals, but also higher reproductive success of polyploid plant individuals. The possible consequence of this is that polyploids can displace diploids in natural populations. Diversification can be the outcome if plants adapt to different pollinators, leading to floral isolation. I will elaborate on this using the example of the orchid genus *Ophrys*, where pollinator switches mediated by floral signals lead to strong floral isolation. In the second part of my talk I will show that floral signals and the corresponding preferences in pollinators do not necessarily co-evolve on a macro-evolutionary scale. In a meta-analysis among beetle-pollinated Araceae I show that floral scent and the pollinators' olfactory preferences do not co-evolve; instead, the pollinators' preferences are older and floral scent evolves through pre-existing bias.

The roles of pollinators in hybridization between two *Rhinanthus* species

Renate A. Wesselingh & Laurent C. Natalis
Biodiversity Research Centre, Earth & Life Institute, Louvain University, Louvain-la-Neuve, Belgium

Biotic pollination is thought to have played an important role in the diversification of the angiosperms, as a driving factor for speciation. The role of pollinators has often been studied in species pairs with constrasting flower shape and colour, often emphasizing reproductive isolation brought about by the difference in pollinator assemblage. Much less is known about situations where the two hybridizing plant species share the same pollinator guild, and where the opportunities for hybridization are much higher. I will give an overview of the data we have thus far collected on the effects of bumblebee behaviour on the formation of first- and advanced-generation hybrids between *Rhinanthus minor* and *R. angustifolius*, look at the expected effects on the long term and discuss the role of differences in selfing rate between the two species.

Successful naturalization of alien plant species is related to pollinator visitation

Mialy Razanajatovo*, Christine Föhr, Markus Fischer, Daniel Prati &Mark van Kleunen
**Ecology, Department of Biology, University of Konstanz, Germany*

Many plant species have been introduced, for example as garden plants, to regions where they do not have their usual pollinators. Nevertheless, some of these alien plant species managed to establish reproducing naturalized populations, and some have become invasive. Recent studies have shown that many naturalized alien species are capable of attracting native pollinators. However, it is not known whether alien species that did not establish naturalized populations are less successful in attracting pollinators. We tested whether naturalized alien species have similar pollinator-visitation rates as native species, and whether non-naturalized alien species have lower pollinator-visitation rates. To this aim, we conducted a multi-species comparative study on pollinator visitation of 185 native, 37 naturalized alien and 224 non-naturalized alien plant species in the Botanical Garden of Bern, Switzerland. Indeed, non-naturalized alien species received fewer pollinator visits than both naturalized alien and native plant species. The average duration of individual pollinator visits did not differ among native, naturalized alien and non-naturalized alien plants. Native, naturalized alien and non-naturalized alien species were visited by similar pollinator communities. However, we found a marginally significant trend for non-naturalized alien species of attracting a less diverse set of pollinators. We show evidence that the capacity to attract pollinators in non-native regions distinguishes naturalized from non-naturalized alien plant species. Therefore, we conclude that successful naturalization of alien plants is related to pollinator visitation.

Thyme polymorphism and *Maculinea* host plant choice

Eva Grøndahl*, Bodil K. Ehlers, Lars P. Christensen & Johan Ehrlén
**University of Southern Denmark, Department of Biology, Campusvej 55, DK-5230 Odense M.*

The threatened butterfly species *Maculinea arion* has a specialised life cycle, including an obligate interaction with plants of the genus *Thymus* and a specific ant species; *Myrmica sabuleti*. The adult butterfly female will lay eggs on thyme plants, and after 3 larval stages, the caterpillar will let itself drop to the ground, where it is picked up by a worker of *Myrmica sabuleti*. After this, the caterpillar will stay in the ant nest during the winter, feeding on the ant brood.

It is known that thyme plants of several species show a polymorphism regarding the terpene composition of the aromatic oil produced in the leaves. This is also the case for *Thymus serpyllum* – the host plant for *Maculinea arion* in Northern Europe.

Previous research on the *Maculinea* food plant choice has focused on flower phenological stage at the time of egg deposition; it is our belief though, that the terpene composition could very well have an effect, since it has been shown for other thyme species, that different terpenes have different effects on associated species (e.g. herbivore preferences).

Field work was carried out on the Swedish island Öland, by collecting and subsequently analysing leaf samples from thyme plants chosen for egg deposition, and control plants from the same and different thyme populations.
The results show that 1) There is a variation in *Thymus serpyllum* oil composition within and among populations and 2) There is a difference in oil composition between plants chosen for egg deposition and control plants.

Volatiles from *Penstemon digitalis*: deciphering a silent language

R.C.F. Burdon*, A. L. Parachnowitsch & R. A. Raguso
**Plant Ecology and Genetics, Uppsala University, Sweden*

Floral odour is dynamic in both time and space. Investigating the spatial and temporal patterns of olfactory cues can help us determine how such a variable trait can be a reliable floral signal to animals. Here we present temporal emissions as well as organ- and stage-specific odours in *Penstemon digitalis.* Total odour emission was greater during the flowering stage and peak pollinator activity hours suggesting its use as a cue. Beyond potential attractive properties of general floral emissions, we found spatial variation in scent production. Penstemon's are known for their fifth and infertile stamen, the staminode. We discovered that this protruding staminode uniquely produces methyl cinnamate in a scentless corolla, suggesting it may be useful as a nectar guide. We also found reward specific odours including S-(+) linalool in nectar and L-actinidine from pollen. Scented reward is thought to be an honest signal of reward to pollinators and yet we found no such correlation between the amount of nectar available and emission rate. We suggest that by knowing more about when, where and how scent varies, we can enrich hypothesise in its function in plant-insect interactions.

Population differences in defense trait expression in *Passiflora incarnata*

Aline Waguespack Claytor
Department of Biology, Duke University, USA

My research addresses the impact of plant investment in defense traits. *Passiflora incarnata* ('maypop') is a perennial vine native to the southeast United States that produces both direct, physical defenses (leaf toughness and trichomes) and indirect defenses (extrafloral nectar in a defense mutualism with ants). When grown in a common garden, I found differences in defense trait expression and herbivore preference between plants from southern U.S. (Florida) and northern (North Carolina) populations. In the future, I plan to utilize this data to investigate why plants produce multiple, seemingly redundant defenses, and also look at linkages between floral sex ratio, defense investment, and herbivore damage.

Small mammal pollinators attracted by potato scent of the South African Pineapple Lily, *Eucomis regia* (Hyacinthaceae)

P. Wester[1,2], S. Johnson[1] & A. Pauw[2]
[1] *School of Life Sciences, University of KwaZulu-Natal Pietermaritzburg, Private Bag X01, Scottsville 3209, South Africa;* [2] *Department of Botany and Zoology, University of Stellenbosch, Private Bag X1, Stellenbosch 7602, South Africa*

Plants adapted to small mammal-pollination show characters like visually inconspicuous, bowl-shaped flowers near ground level, stiff stamens, easily accessible nectar and characteristic scent. The South African Pineapple lily *Eucomis regia* is hypothesised to be small mammal-pollinated on the basis of sharing these characters and as it differs from insect-pollinated *Eucomis* species mainly in scent. Under natural conditions and in the laboratory mice and an elephant shrew were observed to become dusted with pollen as they licked nectar in the flowers. Pollen and dye was transferred to stigmas. Live-trapped mice had large amounts of *E. regia* pollen in the fur around the snouts and in the faeces. Selective exclusion of vertebrates, but not insects, led to significant reduction in seed set. Controlled pollination experiments showed that *E. regia* is self-incompatible and thus entirely dependent on pollinators for seed production. Spectral reflectance of floral tepals is very similar to the green bracts and leaves, rendering flowers inconspicuous to insects. The scent of flowers and nectar is reminiscent of boiled potatoes due to the presence of the sulphur compound methional, confirmed by analysing headspace scent samples with gas chromatography–mass spectrometry. Also the nonane derivative *exo*-Brevicomin was found in two of the three studied populations, the first record in flowers. Choice experiments showed that mammals are strongly attracted to the scent of flowers and methional. *E. regia* resembles other *Eucomis* species pollinated by spider-hunting wasps and carrion-flies in floral morphology and colour as well as nectar properties, but differs heavily in floral scent. Available evidence thus suggests that pollination systems in *Eucomis* are mediated mainly by scent rather than visual cues.

Genetic variation in urban forests: case study of oak (*Quercus robur*) populations from Helsinki city in southern Finland

Sakina Elshibli[1], Juha Raisio[2], Saila Varis[1], Pekka Vakkari[1] & Pertti Pulkkinen[1]
[1] *Finnish Forest Research Institute (METLA), Finland;* [2] *City of Helsinki, Finland*

The aim of this work was to assess, at generational levels, genetic variation in oak populations in three islands in Helsinki city, namely Seurasaari, Pukinsaari and Maila Talvio. We also proposed to highlight the factors which might have naturally influenced the maintenance of genetic variation in the considered populations. Over the five tested microsatellite loci, the overall number of scored alleles among adult trees and seedlings was 20±6.0 and 19.6±4.2; expected heterozygosity was 0.839±0.099 and 0.836±0.081; observed heterozygosity was 0.713±0.099 and 0.739±0.114 respectively. Seurasaari adult trees and seedlings as well as Pukinsaari adult trees showed a general trend to heterozygous deficit. Seurasaari populations constitute the largest among the tested, however, showed the more pronounced heterozygous deficiency apparent in the significant ($p < 0.001$) inbreeding coefficients in both generations. Pairwise genetic distances indicated significant ($P < 0.01$) differentiation among Seurasaari adult trees and seedlings. Although significant ($P < 0.001$) genetic structuring exists among populations at geographical locational level, however 95% of genetic variability explained by within populations' variation. Background pollination, on the other hand, contributed by up to 26% of the genetic diversity in seedling generations within locations and 9% from other oaks in the surrounding area. These results indicated that, fragmentation as such may not constitute an absolute factor that obstructs beneficial gene flow in urban landscape, but a combination of different factors such as factors related to the biological nature of plant species as well as the surrounding environment in the specific urban landscape.

The effect of co-infection to pathogen epidemiology in *Plantago lanceolata – Podosphaera plantaginis* –interaction

H. Susi & A-L Laine
Metapopulation Research Group, Department of Biosciences P.O.Box 65, 00014 University of Helsinki, Finland

Pathogens occur often as co-infection where several genetically different individual infect same host. However, there is a lack of knowledge how co-infection affects to epidemics.
To understand how co-infection affects to evolution of virulence and epidemiology of the disease we used *Plantago-Podospa*hera interaction as a model. Natural populations of *Plantago lanceolata* infected by *Podosphaera plantaginis* were surveyed and the pathogen populations were genotyped to test the prevalence of co-infection and examine the epidemiological consequences.
Experimental approach was taken to pinpoint the effect of co-infection in genetically controlled hosts that vary in their resistance levels. We studied how *Po. plantaginis* performance differs in co-infection and single infection using host populations with qualitative, quantitative and susceptible resistance strategies in semi-natural conditions
The impact of competition was high in experimental populations suggesting that the within host dynamics can be linked to the spread of the disease. The host resistance strategy affected to the epidemics and to the outcome of competition. Surprisingly, the quantitative resistance did not result lower infection. The results from two year survey in natural populations showed that there were high levels of co-infection in this system, and that the occurrence of co-infection varies between host population, plant and within plant scales. The patterns observed in the natural populations showed increased levels of disease in co-infected plants and populations.

Climate dependent distribution of "island" vascular plants in the archipelago of SW Finland?

Mikael von Numers
Environmental and Marine Biology, Department of Biosciences, Åbo Akademi University, Finland

Aims: To find indications of climate change by studying the changes in the frequency and in the distribution patterns of 18 plant species occurring predominantly on islands, by comparing historical and contemporary occurrences.

Location: The study was conducted on 436 islands in the archipelago of SW Finland in the northern Baltic Sea. The contemporary data was collected from 1996 to 2012 and the historical mainly in the 1930s.

Methods: Predictors, including area, large and small scale exposure and topographical diversity, potentially mirroring the climate of each of the islands, were measured in a GIS. Islands with extinctions were compared to islands with colonizations using binomial logistic regression.

Results: The number of island plant observations increased with (8.4%), but not with as much as the all plant species occurring on the studied islands (10.6%). There was no consistent pattern in the species´ relations to the environmental predictors, and thus the interpretation had to be made at the species level. An undisputed effect of climate warming on the selected island plants is not evident at least compared to other more noticeable factors such as overgrowth or decline in traditional land use. One of the proposed reasons for this is the small scale topography and the mosaic of different microclimates on the islands that buffer the effect of a large scale climate warming.

Do environmental stress and plant size influence sexual lability in *Neochamaelea pulverulenta* (Rutaceae)?

Marcos Méndez[1], Néstor Pérez[2] & Alfredo Valido[2]
[1] *Área de Biodiversidad y Conservación, Universidad Rey Juan Carlos, c/ Tulipán s/n., 28933 Móstoles, Madrid;* [2] *Depto. Ecología Integrativa, Estación Biológica de Doñana-CSIC, c/ Américo Vespucio s/n., 41092 Sevilla*

Many angiosperms are able to modify their sexual expression between reproductive events. However, very few cases of sexual lability, in which extreme sex changes occur, have been documented. These cases have been related to optimization of reproductive investment as a result of changes in resource availability derived from changes in environmental conditions or in internal nutrient status. Identification of sexually labile species is complicated, because it entails monitoring the same individuals along successive reproductive events. In addition, many putative cases of sexual lability might actually be growth-mediated maturation phenomena in which species achieve their usual stable sexual expression only after reaching a threshold size. We have studied sexual expression in the Canarian endemic shrub *Neochamaelea pulverulenta* (Rutaceae).

We monitored sexual expression of labelled individuals along five reproductive events in four Tenerife populations spanning a rainfall gradient.

N. pulverulenta showed a labile sexual expression. Three kinds of individuals were identified: (1) constant males, (2) labile individuals, varying from cosexuality and pure maleness among reproductive events, and (3) constant cosexuals, that modified their sexual expression but never become pure males. Constant males were the smallest individuals in terms of DBH and volume, while constant cosexuals were the largest individuals. No significant relationship was found between the percentage of individuals reproducing as males and rainfall during the month preceding each reproductive event. At some populations, individuals with higher fruit production showed a significant trend to become more male in the next reproductive event and the opposite ocurred to individuals with low fruit production. In conclusion, *N. pulverulenta* changes sex but ascertaining the influence of environmental stress and nutrient status will require experimental manipulation.

The dark side of mutualism

Judie Bronstein
Department of Ecology and Evolutionary Biology, University of Arizona

Two major, yet contradictory questions drive current research on mutualism: what prevents unbounded population growth, and what prevents unbounded cheating that would extinguish mutualism? Both areas of inquiry are making assumptions about the benefits and costs of these interactions. While the benefits of mutualism are relatively well-understood, the costs of mutualism are not, due to the difficulty of studying them in the field. I describe my group's studies of a system that offers unusual ease of measuring both benefits and costs. It is an interaction between a hawkmoth (*Manduca sexta*) and a plant (*Datura wrightii*), in which the moth is both the dominant pollinator (in its adult phase) and dominant herbivore (as a larva). Considering the interaction both from the insect and the plant perspective, and measuring both the costs and the benefits to each partner, I document the complex physiological and functional interrelationships that shape even a comparatively simple interaction. Costs and benefits drive mutualism dynamics, but field studies show that their relative magnitudes can be rather counterintuitive. Furthermore, a community/ecosystem perspective is critical even when studying a tight pairwise interaction: I will suggest that (a) honeybees remove pollen and thus potentially threaten the *Datura-Manduca* pollination mutualism, whereas (b) nectar of bat-pollinated species partially subsidize moth flight and thus facilitate the mutualism's persistence. I conclude by linking these results to the most exciting questions driving mutualism research today.

Mutualists and antagonists drive among-population variation in selection and evolution of floral display in a perennial herb

Johan Ehrlén[1] & Jon Ågren[2]
[1] *Department of Ecology, Environment and Plant Sciences, Stockholm University, Sweden;* [2] *Department of Plant Ecology and Evolution, Evolutionary Biology Centre, Uppsala University, Sweden*

Spatial variation in the direction of selection drives the evolution of adaptive differentiation. Yet, few experimental studies have examined the relative importance of different environmental factors for variation in selection and evolutionary trajectories in natural populations. We combined 8 years of observational data and field experiments to assess the relative importance of mutualistic and antagonistic interactions for spatial variation in selection and short-term evolution of a genetically based floral display dimorphism in the short-lived perennial herb *Primula farinosa*. Natural populations of this species include two floral morphs: long-scaped plants that present their flowers well above the ground and short-scaped plants with flowers positioned close to the ground. The direction and magnitude of selection on scape morph varied among populations, and so did the frequency of the short morph (median 19%, range 0-100%; N = 69 populations). A field experiment replicated at four sites demonstrated that variation in the strength of interactions with grazers and pollinators were responsible for among-population differences in relative fitness of the two morphs. Selection exerted by grazers favored the short-scaped morph, whereas pollinator-mediated selection favored the long-scaped morph. Moreover, variation in selection among natural populations was associated with differences in morph frequency change, and the experimental removal of grazers at nine sites significantly reduced the frequency of the short-scaped morph over eight years. The results demonstrate that spatial variation in intensity of grazing and pollination produces a selection mosaic, and that changes in biotic interactions may trigger rapid genetic changes in natural plant populations.

Spatial variation in pollinator-mediated selection on floral traits in the fragrant orchid *Gymnadenia conopsea*

E. Chapurlat, J. Ågren & N. Sletvold
Department of Plant Ecology and Evolution, Evolutionary Biology Centre, Uppsala University, Norbyvägen 18D, Uppsala, SE 752 36, Sweden

Most plants encounter a geographic mosaic of pollinator communities. Models explaining floral diversification often assume that these communities differ in the selection they exert on floral traits, causing spatial variation in pollinator-mediated selection, eventually leading to adaptation to the local pollinator community. Accordingly, most studies of phenotypic selection on floral traits infer that any detected selection is mediated by pollinators while other selective agents can be involved. Thus, the quantification of pollinator-mediated selection remains scarce and has rarely been connected to geography or to specific pollinators while this is central to our understanding of adaptive differentiation. We tested for variation in natural selection on phenology, floral display and spur length among four populations of the orchid *Gymnadenia conopsea*. We assessed if this variation was caused by variation in pollinator-mediated selection by comparing selection in open-pollinated plants and hand-pollinated plants (N circa 120 per treatment). Finally, we attributed selection to either diurnal and nocturnal pollinators using an exclusion experiment in two populations. The targets (single traits or combination of traits) and strength of natural selection varied spatially, which could be explained by variation in pollinator-mediated selection despite similar pollen limitation, and this could partly be attributed to diurnal or nocturnal pollinators.

Sexual selection, sexual conflict and mating system evolution in a mixed-mating plant

Åsa Lankinen[1], Josefin Madjidian[1, 2], Scott Armbruster[3], Stefan Andersson[2], Evan Hersh[2] & Maria Strandh[1]
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Despite theoretical and empirical evidence, sexual selection in plants has remained controversial for the past 30 years. Few plant studies have considered sexual conflict, even though this development of sexual selection theory has flourished in recent years. In our study species, the hermaphroditic annual *Collinsia heterophylla*, experiments suggest a sexual conflict over timing of stigma receptivity. Delaying timing of stigma receptivity is advantageous for the female function in terms of enhanced pollen competition leading to increased offspring quantity and quality. However, early fertilization would benefit the male function as competition with later arriving pollen is avoided. Another interesting feature of this study species is that it has a mixed mating system, i.e. outcrossing and selfing occurs in the same individual. In another experiment we found that enhanced pollen competition between self pollen reduced inbreeding depression, indicating that fertilization by low quality self pollen is avoided. Thus, traits that enhance pollen competition, such as delayed stigma receptivity, may contribute to persistence of mixed mating. We are currently aiming to understand more about the interrelation between sexual selection and mating system evolution by investigating sexual conflict traits, cost of early fertilization and degree of outcrossing across several populations.

There is more to pollinator-mediated selection than pollen limitation

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The strength of pollinator-mediated selection ($\Delta\beta_{poll}$) is expected to be positively related to the degree of pollen limitation (PL). For 2-5 years, we quantified net selection and $\Delta\beta_{poll}$ on floral traits in two populations each of two orchid species that differ in PL. In both species, $\Delta\beta_{poll}$ varied among years and populations, and spatio-temporal variation in $\Delta\beta_{poll}$ explained much of the variation in net selection. PL ranged from 0.64-0.73 in the strongly pollen-limited species, and from 0.17-0.55 in the less pollen-limited species. Selection was consistently stronger in the former species, and the proportion of selection that was pollinator-mediated was higher. Within species, variation in PL could not explain variation in $\Delta\beta_{poll}$ for any trait, indicating that factors influencing the covariance between trait expression and pollination success govern a major part of the observed variation in $\Delta\beta_{poll}$. Separating the effects of variation in mean interaction intensity and in trait-fitness functions will be necessary to understand spatio-temporal variation in selection exerted by the biotic environment.

How flowers manipulate the behavior of hoverflies on flowers and how flies learn to respond

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The response of imagoes of the hoverfly *Eristalis tenax* towards visual floral cues has been tested in behavioural studies with artificial flowers. Naïve and non-trained flies prefer to land on yellow artificial flower, to walk towards yellow colour patches and to extend their proboscis towards yellow colour patches. Following training the flies can learn to land on artificial flowers other than yellow, but do not learn to walk towards other colour patches than yellow ones and to extend their proboscis towards other colour patches than yellow ones. Even after differential conditioning with rewards on yellow and punishment on blue colour patches the flies prefer to extend their proboscis towards yellow. Admixing small amounts of ultraviolet and blue light towards yellow stimuli inhibits the proboscis extension, whereas admixing red light has no effect. Both sexes of *Eristalis tenax* show identical colour preferences. These results are interpreted in the contexts of the categorical colour vision in flies and of the floral colour pattern of hoverfly-pollinated plants. It is discussed how floral colour cues, particularly UV-absorbing yellow pollen, anthers and pollen-mimicking floral guides, exploit the failure if classical conditioning of the proboscis reflex and how the pollen colour can protect against visual detection by hoverflies.

Ultraviolet reflection properties alter the meaning of yellow flower colours for bees

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Yellow flowers often display a pattern of UV-reflection, with UV-absorption restricted to the center of the flower. This pattern is for example known as the "bulls-eye" of asters. In this study we measured the spectral reflection properties of yellow flowers adapted to the pollination by either bees or birds from the New and the Old World, respectively. We found that only yellow bee-pollinated flowers display the mentioned pattern of UV-reflection, whereas yellow bird-pollinated flowers are most often entirely UV-absorbing. Additionally, we performed choice experiments with two species of stingless bees, *Melipona mondury* and *Melipona quadrifasciata,* in Brazil and also with honeybees (*Apis mellifera carnica*) and bumblebees (*Bombus terrestris dalmatinus*) in Europe. One set-up of tested target colours comprised entirely UV-reflecting and UV-absorbing artificial flowers; the other set-up comprised patterned artificial flowers with UV-absorbing center and UV-reflecting periphery and artificial flowers displaying a reciprocal pattern. *Melipona mondury* showed a significant preference for entirely yellow, UV-absorbing over entirely UV-reflecting artificial flowers, whereas all other tested bee species did not prefer any of the offered artificial flowers. Choice experiments with yellow artificial flowers offering a pattern of UV-reflection do likewise not show a consistent preference throughout the tested bee species, but all tested species make their first contact with the artificial flowers by means of their antennae at the UV-absorbing parts of the pattern while approaching artificial flowers. The results are discussed in an ecological context of competition between bees and birds as primary visitors of flowers adapted to the pollination by different pollen vectors.

Colour preferences in Neotropical stingless bees considering the impact of colour attributes

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The colour vision of stingless bees is almost completely unexplored, although they are important pollinators in the neotropics. Colour vision, innate and learned colour preferences of bees are important determinants for flower choice and flower constant foraging. It is evident that bees process floral colour cues, like peak wavelength (respective to subjective colour impression 'hue'), colour purity (respective to 'saturation') and intensity (respective to 'brightness') of a flower colour, but the experimental evidence for the impact of these colour attributes on colour preference is less clear. In this study we applied a new method to test spontaneous colour preferences of two different species of stingless bees, *Melipona quadrifasciata* and *M. mondury*. The new method allows to produce target colours of flower dummies that offer a large amount of combinations of independently varying peak wavelength, colour purity and intensity values. Thus we provide an excellent basis to study the influence of single colour attributes to colour preferences of stingless bees. The results show that experienced workers of both tested stingless bee species exhibit a complex evaluation of colour attributes, in which an interplay between colour purity and intensity might exist. Moreover, it is apparent that the new method is able to carve out subtle differences in the colour preferences even between two closely related species.

The correlation between flower colour and morphology in temperate grasslands

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Coloration and morphology are two central traits of flowers that are believed to guide pollinators foraging for nectar and other floral resources. Pollination syndromes, which are mainly characterised by flower colour and shape, are widely used to organise floral diversity and deduce pollinator groups. In our study we asked: Can colour be a signal for morphological complexity?

To assess the correlation between flower colours and floral morphology in temperate grasslands, we measured flower reflectance spectra of 139 species from 114 plant communities in three German regions, Schwäbische Alb (SA), Hainich-Dün (HD) and Schorfheide-Chorin (SC) and developed a novel index to assess floral complexity of all species incorporating 21 morphological traits. We analysed reflectance data of flower colours as they are perceived by honeybees by studying spectral loci of each flowering plant species in the colour hexagon. Apart from chromatic stimuli we also analysed achromatic stimuli of flowers.

Surprisingly, we found that the correlation between chromatic stimuli of flower colours and flower morphology does not show a simple pattern from the bees point of view. Interestingly, achromatic stimuli seemed to correlate with morphological complexity. These findings may bring forward efforts to understand mechanisms of flower detection and recognition by foraging bees.

Floral signals and rewards: Is there any honesty?

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Much of what we understand about the ecology and evolution of flowers comes from studying floral signals such as flower size, colour, shape and scent. However, floral rewards should directly influence floral visitors and shape their preferences for any particular signal or signal combination. Observed selection on flower signals is often assumed to be due to correlations between floral signals and rewards. However, floral signals may be more constant in natural than rewards because visitation can temporarily deplete rewards. Here, I will review our understanding of the associations among signals and reward, as well as discuss the implications for visitation and selection on floral traits. My talk will pose more questions than provide answers and I hope ignite discussions on how we should think about and incorporate rewards into floral evolutionary ecology.

Floral food-bodies and a bellows-like mechanism in bird-pollinated *Axinaea* (Melastomataceae)

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Pollen as the only reward for buzz-pollinating bees is characteristic for most Neotropical Melastomataceae. In eight genera, however, nectar secretion and related pollinator shifts have been reported. The flowers of the mainly Andean genus *Axinaea* (Merianieae) are characterized by distinctive bulbous anther connective appendages. It has been hypothesized that these appendages play a key role during pollination and serve as food-bodies to attract pollinators other than bees. To test this hypothesis, we conducted field studies in southern Ecuador, and investigated floral structure in detail using micro-computed tomography (microCT) and other methods. We found that the flowers are not nectariferous and that they attract various species of Tanagers (Thraupidae) which consume the brightly coloured bulbous connective appendages. In addition to their function as a food-body reward, these appendages are an integral part of a complex bellows pollination mechanism. The bellows is activated when a bird squeezes the appendage with its beak in order to remove the stamen from the flower. This action results in a cloud of pollen being expelled from the terminal pore of the anther and landing on the bird's beak and head. Accidental contact with the stigma effectively transfers pollen during floral visits. As Tanagers were the only observed visitors capable of activating this mechanism, they can be recognized as the legitimate pollinators. The evolution of the bulbous connective appendages in *Axinaea* may serve as another example of a shift in pollination syndromes related to growth at higher elevations where bees are less efficient pollinators than birds.

Inter- and intraspecific variation in functional plant traits and their relevance for community ecology
Part I: Species- and individual-specific phenotypes control community composition of flower visitors

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Community ecology moved from descriptive studies to more mechanistic approaches asking questions on the causes and consequences of community composition and interactions between species. Many ecological processes are shaped by the presence or absence of functional groups, not necessarily species. Thus, the similarities or differences in functional traits across species, i.e. *inter*specific variation, are key features of plant communities with consequences on other trophic levels. *Intra*specific variation of traits that mediate interactions with other species may additionally contribute to the complexity of community assembly and is the basis for evolutionary shifts in frequencies of phenotypes.
I will present results on studies that quantified functional flower traits of 1.) multiple species constituting a community and 2.) of multiple individuals of one plant species and recorded their interaction partners. These data allowed us to identify those traits that determine the interaction frequencies between plant species / individuals and arthropod species. The interspecific data set suggested a hierarchical sequence of traits that determine the niches of flower visitors. The intraspecific variation in functional traits was pronounced, too, and strongly affected the composition of flower visitors on plant individuals.
These results in combination with the results of Hoffmeister, Wittköpper and Junker (presented here, too) indicate that species do not necessarily represent uniform ecological entities but display plastic responses to previous interactions. Furthermore, we contribute to the understanding of community patterns by linking the variation in functional plant traits with interaction frequencies and fostering a trait-based definition of niches and functional groups.

Inter- and intraspecific variation in functional plant traits and their relevance for community ecology
Part II: Consequences and dynamic of herbivory as source for variation in flower traits

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Herbivory may induce various responses in plants, thus altering the plants' phenotype. Responses to herbivory may cause changes depending on tissue type, plants' developmental stage and plants' resources. However, only few studies confirm changes in flower traits and underlying mechanisms, consequences for flower visitors and plants' reproductive success are poorly understood. Beside the plants' individual capability to cope with herbivory, reproductive success also depends on the co-occurring plant community. We investigated (1) whether herbivore pressure during different plant developmental stages triggers short-term and long-term effects on reproductive traits in *Sinapis arvensis* and (2) whether and how herbivory affects a Brassicaceae multi-species plant community and associated flower-visitors. Our results (1) indicate that both floral phenology and reproductive traits in *S. arvensis* are differentially affected by timing as well as the strength of herbivory, thus leading to intraspecific variation. Further (2) we recorded interactions between herbivore-induced and control plants of four Brassicaceae species and their flower-visitors and conducted olfactometer choice tests with the most frequent flower-visitors. Herbivory clearly had an effect on quantitative flower-visitor composition and visitation frequency both on species- and community-level. However, initial choices for herbivore-induced and control plants as well as choices in olfactometer trials did not differ.

We conclude that plastic responses to herbivory by plants also affect reproductive organs with strong effects on flower-visitor interactions both on single plants as well as on the community-scale.

Is phenological synchrony with flowering plants most important for specialist pollinators? Evidence from an altitudinal gradient

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One of the most noticeable effects of anthropogenic climate change is the shift in timing of seasonal events towards earlier occurrence. The high degree of variation in species' phenological shifts has raised concerns about the temporal decoupling of interspecific interactions, but the extent and implications of this effect are largely unknown. In the case of plant-pollinator systems, more specialized species are predicted to be particularly threatened by phenological decoupling, since they are assumed to be less flexible in the choice of interaction partners, but until now this hypothesis has not been tested. In this study, we recorded phenology and interactions of plant and pollinator communities along an altitudinal gradient in the Alps as a model for the possible effects of climate change in time. Our results show that even relatively specialized pollinators were much more flexible in their use of plant species as floral resources than their local flower visitation suggested. We found no relationship between local specialization of pollinators and the consistency of their visitation patterns across sites, and also no relationship between specialization and phenological synchrony of pollinators with particular plants. Thus, in contrast to the conclusions of a recent simulation study, our results suggest that most pollinator species included in this study are not threatened by phenological decoupling. However, our results suggest that the observed flexibility of plant-pollinator interactions likely depends on a high degree of functional redundancy in the plant community, which may not exist in less diverse systems.

Effects of sheep grazing on bumblebee abundance in an alpine ecosystem

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Bumblebees are important pollinators of many alpine plant species, including bilberry (*Vaccinium myrtillus*). Many alpine plant species are in decline due to rising temperatures changing the biotic environment, including elevation of the tree line. Changes in the plant community can affect pollinator diversity/abundance which in turn can cause changes in the plant community.. Grazing has been shown to hamper the upwards advancement of the tree line. In this sense in one way preserving, although in other ways also altering, the alpine flora. The main aim of this study is therefore to assess whether (and to what extent) grazing has an impact on the abundance and diversity of an important group of pollinators, namely bumblebees.

Since 2000, a landscape-scale grazing experiment has been running at Hol in Hallingdal. A 2.7 km^2 part of the alpine ecosystem has been permanently fenced and subdivided into 9 separate areas. These subfields have been subjected to control (no sheep), low (historic sheep density) or high densities of sheep, for the full length of the period. The nature of the experiment and detailed knowledge of the area, including readily available vegetation data, makes it a prime site for studying how grazing might affect bumblebee diversity and abundance.

This July (2013), bumblebees were sampled along a 100 m transect in every subfield, in a habitat occupied at least partly by flowering bilberries. Every transect was walked twice a day for 8 consecutive days. Each bumblebee was identified to species and the plant it was visiting was recorded. Data on temperature was obtained at each transect, and wind was recorded by a mobile weather station just outside the enclosures. Floral availability was estimated once for each transect by counting all flowers occurring in 0.5x0.5 m squares placed at 5 meter intervals along the transect. Plans to look for effectiveness of the pollination services, i.e. seed set, was never materialised, but could be an interesting addition. I plan to refine and redo the field work next summer.

How spatial heterogeneity influences diversity of pollination interactions

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Although it is widely accepted that spatial heterogeneity increases species diversity, little is known about the relationship between spatial heterogeneity and interaction diversity. As is the case with species, interactions may be shared or unique among vegetation types. Unique interactions can be divided in unique interactions by species turnover and interactions turnover. We quantified the interactions and visits shared and unique by both kinds of turnover among vegetation types in two alpine pollination networks. We found high spatial heterogeneity of interactions in both analyzed networks. Nevertheless, quantitative information suggested less spatial heterogeneity of interactions than qualitative data. Species turnover was not a good predictor of interaction turnover. Indeed, a high proportion of unique interactions by interaction turnover found in both mountains, caution against the underestimation of interaction turnover when assessing the interaction diversity maintained by spatial heterogeneity. Finally, our results can help us to predict the effect on interactions diversity of changes in land use such as climate change or shrub encroachment. These predictions suggest a major importance of Grasslands in Picos de Europa and all habitats in Sierra Nevada for the conservation of interaction diversity. Both cases reinforce the arguments for the maintenance of spatial heterogeneity in vegetation types in both studied areas.

Ecotypic differentiation and pollination of three sympatric species of *Linum* in the Spanish Pyrenees

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We investigated the frequency of coexistence of the heterostylous *Linum suffruticosum,* L. *narbonense* and *L. viscosum* (Linaceae) and assessed possible causes of interspecific pollen transfer looking at floral phenotypic variation and pollinator behaviour. Our study revealed complex patterns of morphological variation, with significant differentiation in traits involved in pollen pick up and deposition and larger intraspecific than interspecific spatial matching between reciprocal whorls, although some overlap between *L. suffruticosum* and *L. viscosum* was observed. We detected substantial partitioning of the pollinator fauna in sympatric populations, with close match between gap (trait involved in pollinator fit) and the size of most efficient pollinators. These findings support the idea that local ecotypic differentiation and partitioning of pollinators are important mechanisms reducing interspecific pollen transfer between sympatric *Linum* species.

Geographic variation of selfing rate and floral traits in the mixed mating species *Collinsia heterophylla* (Plantaginaceae)

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Genetic differentiation in widely distributed species can result from genetic drift or divergent selection driven by ecology. Relatively few large-scale studies have investigated genetic differentiation in mating-system traits, particularly in relation to the unsolved question of persistent mixed mating (combined selfing and outcrossing). We explored geographic variation in selfing rate, neutral genetic markers (four microsatellite loci) as well as a suite of floral traits related to mating system in the mixed-mating annual *Collinsia heterophylla*. Population means of floral traits were associated with different geographical patterns. Measurements of maternal families in the greenhouse showed that stage of anther-stigma contact covaried positively with stigma receptivity, flower size and floral phenology, indicating genetic correlations between traits. This pattern of trait correlations is similar to that found among species in the genus *Collinsia*. Only one floral trait - stage of stigma receptivity - was significantly negatively correlated to selfing rate. Interestingly, also this pattern is in line with that seen among species. Our populations were genetically isolated by geographic distance at neutral markers suggesting genetic drift for these loci. In contrast, selfing rate did not conform to this pattern, implying an influence of selection for the floral traits involved. In conclusion, variation in selfing rates and floral traits are consistent with a history of natural selection, but traits clearly differ in their relative association with the mating system.

Abstracts of poster presentations (in alphabetical order of surname)

Plant-seed predator interactions in a species-rich tropical plant community

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Herbivorous insects can play an important role in the dynamics of species-rich tropical forests. Their potential effects on plant communities depend on their degree of host-specificity: Where insect species have narrow host ranges they can contribute to the coexistence of plant species by causing density dependent host mortality (as predicted by the Janzen-Connell hypothesis). In cases where the same insect species attack multiple plant species, the dynamics of different plant species may be linked via shared enemies. Despite the effects of insect seed predation on plant recruitment, few studies have assessed the role of insect seed predators at the plant community level. Focusing on the seed predators of the woody plant community of Barro Colorado Island (Panama), our project aims to assess (a) the host-specificity of insect seed predators, and (b) community-level patterns of insect seed predation in relation to morphological and ecological seed attributes. We will present results from an exercise in which >150,000 seeds and fruits of >400 plant species were collected for rearing of internally feeding insect seed predators. The material reveals remarkable levels of host-specificity in this guild of insect herbivores, implying that these insects are potential mediators of diversity-enhancing processes in tropical forests. The presence and species richness of seed predators at the plant community level is also associated with particular plant species traits. We aim to use our insights from our work on Barro Colorado Island to create a predictive framework for community-level patterns of seed predation in other tropical forests.

Interactive effects of inbreeding in a specialized plant-herbivore interaction

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Inbreeding causes inbreeding depression in plant resistance against herbivores, as well as in several fitness-related traits in the herbivores. Furthermore, plant inbreeding may affect herbivore performance due to reduced herbivore resistance or plant nutritional quality. In many natural plant-herbivore systems, both of the interacting species are likely to experience inbreeding and yet, interactive effects of inbreeding of both a host plant and its herbivore have not been extensively studied. We studied the effects of experimental inbreeding of a perennial host plant, *Vincetoxicum hirundinaria*, and its specialist herbivore, the moth *Abrostola asclepiadis*, on plant resistance and herbivore performance in four populations. We were particularly interested in how inbreeding of both the host plant and the herbivore affect host and herbivore inbreeding depression in resistance and performance. Our results demonstrate that the expression of inbreeding depression in herbivore performance depended on whether the herbivore was grown on an inbred or on an outbred host plant and this effect varied among herbivore populations. Inbreeding depression in plants was significantly higher when they were consumed by outbred compared to inbred herbivores. Finally, the expression of inbreeding depression in the host plant in terms of resistance varied among plant and herbivore populations. These findings demonstrate that in plant-herbivore interactions inbreeding depression of one species can be altered depending on the inbreeding of the interacting species. Furthermore, our results suggest that when herbivores are inbred, herbivore-induced selection against self-fertilization in plants may diminish.

Fitness consequences of declines in wild flower nectar availability for butterflies in agricultural landscapes

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Traditionally managed agricultural land has been recognized to be an important biotope for many butterflies. However, intensification of the management and the associated changes in landscape structures and in the quantity, quality and configuration of the ecological resources may strongly affect population viability. Some grassland butterflies occur both in extensively managed meadows (NR, nectar rich) and intensively managed meadows (NP, nectar poor) on agricultural land. This allows studying the consequences of such changes by comparing individuals and populations faced with different habitat quality conditions.
With a first field experiment conducted in meadows under intensive and extensive management, we proposed artificial nectar supply and observed the number of visits by the meadow brown butterfly, *Maniola jurtina*, in both meadow types. Higher number of visits on in the NP meadows suggested constrained nectar acquisition in the NP meadows.

In a second experiment, we tested the effect of each condition (NP: few nectar of low quality; NR: much nectar of high quality) on fitness of individuals of the meadow brown butterfly, in an outdoor cage experiment. A 48 hours stay in the experimental conditions induced substantial differences in body mass, lipid content and lifespan of individuals. Butterflies from the NP-treatment lived shorter (22% for males and 43 % for females) and had lower body mass and lipid content compared to conspecifics of the NR-treatment, indicating lower potential fecundity. Furthermore, activity level in the flight cages simulating NP meadows was lower than in the NR condition.

We discuss the results in the context of population viability in agricultural landscapes under intense human use, and the need to include nectar quality and fitness related traits when assessing habitat quality for a given landscape.

Artificial selection for host-plant use of a seed-predator: fitness consequences, inbreeding depression, and genetic variation

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The use of alternative, suboptimal food-plant species affect herbivore's fitness and life-history, and thus has both ecological and evolutionary consequences. Our study species, the seed predator *Lygaeus equestris* uses *Vincetoxicum hirundinaria* as its primary food plant. However, extensive spatio-temporal variation in seed production of *V. hirundinaria* occasionally enforces *L. equestris* to feed on alternative plant species. We conducted a long-term selection experiment to test if this seed predator is able to adapt to a suboptimal food-plant species in more than 20 generations. We measured fitness and adaptation in terms of increase in reproductive output. We replicated the populations within the selection lines to separate the effects of selection from random drift and conducted intra- and inter-population crosses to detect inbreeding and population differentiation. Furthermore, we analysed how population genetic structure changed during the selection experiment. We found that although the fitness of *L. equestris* that had fed on the alternative food plant was almost seven times lower than when feeding on *V. hirundinaria*, it increased significantly during the experiment indicating selection for higher fitness on the alternative food plant. Besides selection, random drift affected adaptation to the alternative food plant as indicated by differences in fitness among the replicate populations. Inter-population crosses within the selection lines resulted to higher fitness than intra-population crosses indicating inbreeding depression. To further underline the negative effects of random drift and inbreeding on adaptive potential of populations, we found that the level of genetic variation was lower in replicate populations feeding on the alternative food plant. Our study is novel in that it combines the analysis of population genetic structure to a more traditional selection experiment to examine host-plant specialization of herbivorous insects.

Bee *Varroa* free!

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Parasitic honey bee mite *Varroa destructor* is a widely spread major threat for apiculture and it is also very likely to play a role in colony collapse disorder. There are no efficient methods known to get rid of this mite so regular treatments are needed to keep Varroa in control. Chemical treatments not only act as a selecting factor to resistant populations but they also have negative effects on honey bees.

In this new approach to the Varroa problem Varroa free hives are imported from the Åland Islands, recently officially declared as a Varroa free region. With these mite free hives Varroa free apiculture is tested in places where no other bee hives are close enough to infect the hives. The other goal is to monitor the rate of invasion in areas where beekeeping, and Varroa, is already prevalent. This research creates a foundation to start developing Varroa free apiculture and thus to eradicate Varroa onwards from the Åland Islands.

FLORATHECA – a new source of old botanical illustrations for teaching botany and pollination biology

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FLORATHECA (http://www.ogrod.uw.edu.pl/floratheca) is a large searchable database including botanical illustrations from the archives of the University of Warsaw Botanic Garden. These consist of photographs, graphics, drawings and press cuttings that have been digitalised and described by historians of art and biologists. Besides information of the technique used and the origin of the material one can find there also botanical descriptions, including a contemporary name of a plant and its taxonomic affinity. Floratheca is made of two separate collections – *Flore Tropicale* and *Roman Kobendza's Photographs*.

Flore Tropicale includes mainly 19th century botanical drawings (the oldest illustrations date back to the 18th century). The collection was created on the turn of the 19th and 20th centuries by a priest Władysław Michał Zaleski, an archbishop and an apostolic nuncio of East India as well as an admirer of botany. It is estimated that the collection includes over 30 000 items, and the description and digitalisation is an on-going project. Until now over 3000 images have been made available on the web.

Roman Kobendza's Photographs is a collection of over 500 glass plate negatives developed in years 1927-1952 by Professor Roman Kobendza – a botanist and, for many years, an inspector of the University of Warsaw Botanic Garden. The collection includes both photographs of plants taken outside and his studio attempts using different backgrounds, close-ups and fragments of plants.

FLORATHECA provides free access, that means that all illustrations can be freely copied and used for non-commercial purposes.

FLORATHECA website was created as a part of the project Digital Heritage with the financial support of the National Audiovisual Institute, Poland.

Spatio-temporal variation in pollination system of a common umbellifer

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Despite the fact that their flowers are visited by many insect species, plants of the Carrot family (Apiaceae=Umbelliferae), regarded as phenotypically generalised, may be functional specialists in terms of pollination systems. For instance, umbels of *Angelica sylvestris* L., a common European umbellifer, are visited by over 245 insect taxa within the species range, yet, as shown for a Polish population, they are effectively pollinated by a relatively narrow assemblage of muscoid and syrphid flies (Niemirski & Zych 2011), hence the plant could be an example of "adaptive generalization" (sensu Gómez & Zamora 2006) of its floral morphology. To test this assumption for three years we studied insect visitors and floral biology in three *A. sylvestris* populations (Milicz, Kleczkowo, Siauliai) located along 500 km-long transect in Central Europe. We were especially interested whether the populations share the same pollinator assemblages and whether there are any phenotypical but non-morphological traits (e.g. nectar or scent composition) that could differentiate them from the pollinator perspective.

Over three years (2011-2013) in all studied populations floral visitors' assemblages were composed of the same morphotaxa and insect functional groups. However, the relative proportions of particular insect functional groups were variable among populations, yet quite stable throughout the study years in a given population. For two populations we observed groups of dominant visitors (Milicz – beetles, especially *Rhagonycha fulva*, Cantharidae, and Kleczkowo – flies), whereas for the third (Siauliai) the visitors' assemblage was more diversified. Our study populations were also rather dissimilar based on nectar traits (e.g. amino acid profile). Our results indicate that *A. sylvestris* could rather be characterized by a "non-adaptive generalization" of the floral morphology but, given the phenotypic traits that seem to attract different groups of potential pollinators, at least functional specialization at the local scale seem highly possible in our study species.

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