Functional traits of vascular plants colonizing alpine cushions

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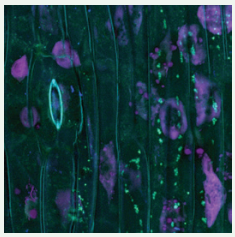
doi: 10.1093/aob/mcy207

Global warming threatens species living in the highest and coldest areas. Alpine cushion plants are potentially endangered by stronger species expanding from lower elevations. This can be inferred from their ecological strategies. **Dolezal *et al.*** analyse traits and habitat preferences of plants colonizing *Thylacospermum caespitosum* (Caryophyllaceae), a dominant pioneer of Himalayan subnival zones. Successful colonizers are fast-growing, clonal graminoids and forbs, sharing the syndrome of competitive species with broad elevation ranges typical for the late stages of primary succession. Since climate change in the Himalayas favours these species, highly specialized cushion plants may face intense competition and a greater risk of decline in the future.

Authors: Jiri Dolezal, Miroslav Dvorsky, Martin Kopecky, Jan Altman, Ondrej Mudrak, Katerina Capkova, Klara Rehakova, Martin Macek, and Pierre Liancourt



Hornwort stomata walls are not built for movement

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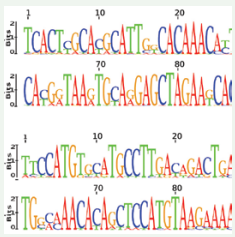
doi: 10.1093/aob/mcy168

Guard cell walls are built to resist bending and deformation to open and close the pore. Pectins provide flexibility and resilience to walls; in particular arabinans and unesterified homo-galacturonans are required for stomata function. **Merced and Renzaglia** use immunolabelling to investigate how wall architecture and pectin composition of *Arabidopsis* stomata compare to the unresponsive stomata of the hornwort *Phaeoceros* (Notothyladaceae, Anthocerotophyta). Walls of the angiosperm with active stomata contain arabinans and homogalacturonans that are completely unesterified, while these components are not present in hornworts. Structure and composition of guard cell walls reflect the divergent function of stomata in hornworts and angiosperms, and support gradual evolution of active movement.

Authors: Amelia Merced and Karen S. Renzaglia



The satellitome of an endangered fern

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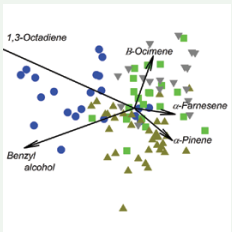
doi: 10.1093/aob/mcy192

Vandenboschia speciosa (Hymenophyllaceae) is a highly vulnerable fern species with a large genome. Gametophytes and sporophytes can reproduce vegetatively, and certain populations hold only independent gametophytes. **Ruiz-Ruano *et al.*** analyse the repetitive fraction of the genome using high-throughput next generation sequencing (NGS) and bioinformatics. They conclude that satellite DNA (satDNA), named the satellitome, does not explain the huge genome of *V. speciosa,* while transposable elements (TEs) mostly contribute to it. Longer (and older) satDNA repeats have higher A+T content and evolved from shorter repeats including microsatellites. Reproduction mode or phase alternation between gametophyte and sporophyte does not entail accumulation or divergence of sat DNA. Additionally, Ruiz-Ruano *et al.* propose a protocol to correct satDNA quantification in contaminated NGS libraries.

Authors: F.J. Ruiz-Ruano, B. Navarro-Domínguez, J.P.M. Camacho, and M.A. Garrido-Ramos



Increasing drought stress alters the emission of floral volatiles

Annals of Botany 123: 601–610, 2019
doi: 10.1093/aob/mcy193

Flowers emit a diversity of volatile compounds that influence interactions with animals, yet little is known about responses of these volatiles to environmental conditions. **Campbell *et al.*** subjected *Ipomopsis aggregata*, *I. tenuituba* (Polemoniaceae) and their hybrids to progressively severe drought conditions. Not only did the composition of floral volatiles change over the two-week experimental drought, but the rates of volatile emission were not linearly related to soil moisture. The monoterpene α-pinene made up the highest proportion of the scent mixture during moderate drought (8–10 days without water), whereas emission of the sesquiterpene α-farnesene accelerated as the drought became severe. Impacts of severe droughts on floral volatiles may not be predictable from responses during milder droughts.

Authors: Diane R. Campbell, Paula Sosenski, and Robert A. Raguso

Heteroblasty adjusts plants to changing environments post fire

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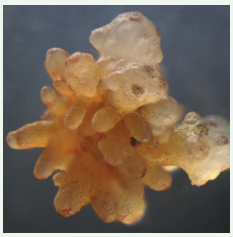
doi: 10.1093/aob/mcy194

Heteroblastic species show an abrupt change in morphology at a fixed ontogenetic stage, and are relatively frequent in Mediterranean type ecosystems with regular fires. Using the Restionaceae from the southern African Cape flora, **Ehmig *et al.*** investigate the potential functional significance of heteroblasty, in particular in post-fire environments. Fires result in enhanced nutrient and moisture availability during the first post-fire year; however, these advantages are soon lost with increasing vegetation density. Heteroblastic changes adjust the plants' economic strategy to best utilize the nutrient spike, and deal with the subsequent impoverishment. Heteroblasty might be a previously unrecognized adaptation to fire-driven environments.

Authors: Merten Ehmig, Mario Coiro, and H. Peter Linder



Ontogenetic development of Pyroloideae revealed by *in vitro* culture

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doi: 10.1093/aob/mcy195

Pyroloids and the related genus *Monotropa* (Ericaceae) are important models for their mixotrophic nutrition, i.e. which mixes carbon from photosynthesis and from mycorrhizal fungi associated with their roots. As their germination is fully heterotrophic and dependant on fungi, early ontogenesis of these interesting species was poorly known. **Figura *et al.*** report a protocol for pyroloids and monotropas *in vitro* cultivation from seeds to leafy plants. This will allow cultivation for research and conservation. They show that a small globular embryo germinates into a structure functionally convergent with orchid protocorm after strong seed dormancy is broken.

Authors: Tomáš Figura, Edita Tylova, Jan Šoch, Marc-Andre Selosse, and Jan Ponert

Amazonian palms and edaphic gradients

Annals of Botany 123: 641–656, 2019
doi: 10.1093/aob/mcy196

Edaphic gradients are strongly associated with floristic patterns and phylogenetic structure of palm communities but, compared to climatic gradients, have received little attention. **Muscarella *et al***. pair palm community data throughout western Amazonia with a large dataset on soil chemistry, phylogeny, metrics of plant size, and inundation intensity. The edaphic conditions seem to underlie diversity patterns in non-inundated upland versus seasonally-inundated floodplain habitats. By linking gradients with community phylogenetic structure, the study reinforces the need to integrate edaphic conditions in eco-evolutionary studies to better understand the processes that generate and maintain tropical forest diversity.

Authors: Robert Muscarella, Christine D. Bacon, Søren Faurby, Alexandre Antonelli, Søren Munch Kristiansen, Jens-Christian Svenning and Henrik Balslev

Biogeography of mycorrhizal specificity in tropical island orchids

Annals of Botany 123: 657–666, 2019
doi: 10.1093/aob/mcy198

For symbiotic organisms to establish on remote islands, they should be generalists capable of associating with a wide range of symbionts. Plants that form obligate symbiotic associations with microbes dominate ecosystems, but the relationship between island inhabitance and symbiotic specificity is unclear, especially in the tropics. To fill this gap, **Swift *et al.*** examine the mycorrhizal specificity of the Hawaiian endemic orchid *Anoectochilus sandvicensis*, and find that it forms highly specific associations with species of mycorrhizal fungi in the genus *Ceratobasidium*. Swift *et al.* highlight how new empirical data can challenge longstanding theories of island colonization, in light of which, additional investigations of tropical island biogeography are direly needed, especially for symbiotic organisms.

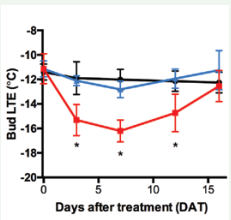
Authors: Sean Swift, Sherilyn Munroe, Chaewon Im, Laura Tipton, and Nicole A. Hynson

Trait divergence determines the success of a newly invasive plant

Annals of Botany 123: 667–680, 2019
doi: 10.1093/aob/mcy200

It is often assumed that the ability of plants to acclimatize to the local environment through non-genetic changes in their anatomy and physiology (phenotypic plasticity) is important for the success of invasive species. In this study, **Marchini *et al*.** describe a case where traits of an invasive grass, the perennial bunchgrass *Brachypodium sylvaticum* (Poaceae) associated with drought tolerance are strongly canalized, and do not display plasticity in response to soil water availability. Instead, the success of this aggressively invasive species appears to be due to rapid genetic differentiation and adaptation to novel climatic conditions in its introduced range in the Pacific Northwest region of North America. Canalization of leaf anatomical and physiological traits associated with drought tolerance is likely to be due to the fact that the leaves of this perennial bunchgrass develop early in the spring when conditions are cool and moist; the same leaves are maintained through the late summer when they are exposed to extreme drought and high temperatures. Photo by Alisa Ramakrishnan.

Authors: Gina L. Marchini, Caitlin A. Maraist, and Mitchell B. Cruzan



ABA and low temperatures increase the freezing tolerance of grapevine buds

Annals of Botany 123: 681–690, 2019
doi: 10.1093/aob/mcy201

Grapevine buds, like the buds of deciduous fruit trees, acclimate to the cold during the autumn and winter seasons and can withstand sub-zero temperatures. In this *in vitro* study using cuttings, **Rubio *et al***. show that abscisic acid (ABA) and low temperatures (LT) synergistically increase the freezing tolerance of grapevine buds, and this effect is mediated by the increased expression of VvCBF/DREB transcription factors. In addition, the dehydration of the buds, the expression of dehydrins and antioxidant genes were also affected by the combination of ABA and LT. The results highlight the importance of ABA and VvCBF/DREB transcription factors in the development of freezing tolerance in grapevine buds.

Authors: Sebastián Rubio, Ximena Noriega Guerrero, and Francisco J. Pérez

Nitrate nutrition improves energy efficiency under hypoxic stress

Annals of Botany 123: 691–706, 2019
doi: 10.1093/aob/mcy202

Plants take up and assimilate nitrogen (N) in the form of nitrate (NO_3^-) or ammonium (NH_4^+), or a combination of both. When oxygen availability is reduced (hypoxia), plants need to generate energy to survive and protect themselves against the hypoxia-induced damage. **Wany *et al***. investigate the role of NO_3^- or NH_4^+ on increasing energy efficiency under hypoxia in Arabidopsis. They find that hypoxic stress under NO_3^- nutrition leads to increased nitrate reductase activity, nitric oxide (NO) production, class 1 phytoglobin gene expression, and in turn ATP production. These effects were reduced under NH_4^+ nutrition. The results indicate that NO_3^- nutrition influences multiple factors in order to increase energy efficiency under hypoxia.

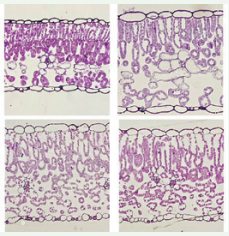
Authors: Aakanksha Wany, Alok Gupta, Aprajita Kumari, Sonal Mishra, Namrata Singh, Sonika Pandey, Rhythm Vanvari, Abir U. Igamberdiev, Alisdair R. Ferine, and Kapuganti Jagadis Gupta

Geographical variation in damage tolerance: the case of oaks and weevils

Annals of Botany 123: 707–714, 2019
doi: 10.1093/aob/mcy203

The assertion that plants at lower latitudes should be better defended against enemies has a long historical basis but is still controversial. In the current study, **Bogdziewicz *et al.*** explore the interaction among holm oaks (*Quercus ilex*, Fagaceae) and seed predating weevils (*Curculio* spp., Coleoptera) in Spain. They show that seed size is a plant trait influencing plant tolerance to endoparasites with higher survival of infested acorns, and oaks produce bigger seeds at southern populations. Consequently, oak tolerance to endoparasites is higher at lower latitudes. Seed-size mediated tolerance to predation is another dimension at which geographical trends in plant defences should be considered.

Authors: Michał Bogdziewicz, Josep Maria Espelta, and Raul Bonal

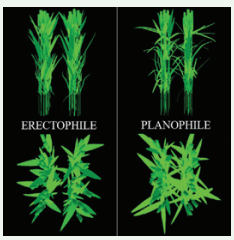


Sink-source imbalance and down-regulation of photosynthesis

Annals of Botany 123: 715–726, 2019
doi: 10.1093/aob/mcy204

Sink-source imbalance could cause accumulation of total non-structural carbohydrates (TNC) and down-regulation of photosynthesis. **Sugiura *et al.*** investigate how sink-source imbalance causes photosynthetic down-regulation in soybean (*Glycine max*), French bean (*Phaseolus vulgaris*), and azuki bean (*Vigna angularis*). Among the three legume plants, maximum photosynthesis was down-regulated with increase in TNC only in French bean, whereas decrease in sink-source ratio caused anatomical changes and increase in cell wall content in source leaves, especially in soybean. The results suggest that down-regulation of photosynthesis is caused not only physiologically such as through a decrease in Rubisco, but also morphologically, such as through an increase in cell wall thickness that could reduce chloroplast CO_2 concentration.

Authors: Daisuke Sugiura, Eriko Betsuyaku, and Ichiro Terashima



FSPM-based investigation of plant interactions in complex wheat canopies

Annals of Botany 123: 727–742, 2019
doi: 10.1093/aob/mcy208

Functional–structural plant models (FSPMs) explicitly describe individual plant architecture, making this approach suitable for unravelling plant–plant interactions in complex canopies. **Barillot *et al.*** developed a comprehensive FSPM accounting for the interactions between plant architecture, light, soil nitrogen and the metabolism of carbon and nitrogen. The model is evaluated by simulating the functioning of post-anthesis wheat canopies (*Triticum aestivum*) of contrasting leaf inclination, arranged in pure and mixed stands. As an emergent property of the detailed metabolism, the model predicts single relationships between absorbed light, carbon assimilation and grain mass. Over the post-anthesis period, planophile plants absorb more light than erectophile plants, resulting in a slightly higher grain mass. By providing access to critical variables such as resource acquisition, internal metabolic concentrations, leaf life span and grain filling, the behaviour of complex canopies could be modelled.

Authors: Romain Barillot, Camille Chambon, Christian Fournier, Didier Combes, Christophe Pradal, and Bruno Andrieu