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— Special Issue —

Evolutionary Dynamics of Tree Invasions

Heidi Hirsch, Johannes J. Le Roux, and David M. Richardson, Special Issue Editors

Heidi Hirsch, David M. Richardson, and Johannes J. Le Roux

Introduction to the Special Issue: Tree invasions—towards a better understanding of the complexity of their evolutionary dynamics

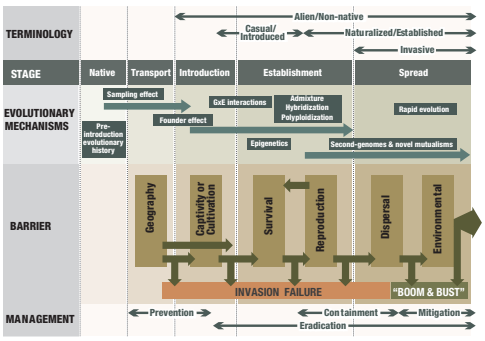
AoB PLANTS (2017) 9 (3): plx014 DOI: 10.1093/aobpla/plx014

This special issue provides a comprehensive overview of the factors that promote and mitigate the invasion success of exotic tree species in many parts of the world. It also shows that incorporating evolutionary concepts is crucial for understanding the complex drivers of tree invasions and has much potential to improve management.

Rafael Dudeque Zenni, Ian A. Dickie, Michael J. Wingfield, Heidi Hirsch, Casparus J. Crous, Laura A. Meyerson, Treena I. Burgess, Thalita G. Zimmermann, Metha M. Klock, Evan Siemann, Alexandra Erfmeier, Roxana Aragon, Lia Montti, and Johannes J. Le Roux

Evolutionary dynamics of tree invasions: complementing the unified framework for biological invasions

AoB PLANTS (2017) 9 (1): plw085 doi:10.1093/aobpla/plw085



Evolution greatly impacts the outcomes of biological invasions. In this paper, the authors review such evolutionary processes with an emphasis on tree invasions, and place them in the context of a unified framework for biological invasions. The processes and mechanisms described are: pre-introduction evolutionary history, sampling effect, founder effect, genotype-by-environment interactions, admixture, hybridization, polyploidization, rapid evolution, epigenetics, and second-genomes. By understanding the mechanisms underlying invasion success, researchers will be better equipped to predict, understand, and manage biological invasions.

Guillaume Besnard and Peter Cuneo

An ecological and evolutionary perspective on the parallel invasion of two cross-compatible trees

AoB PLANTS (2016) 8:plw056 doi: 10.1093/aobpla/plw056

The cultivated olive is an iconic Mediterranean crop that has been spread over the world in all regions with a Mediterranean climate. The species is, however, able to escape from cultivation and can invade new ranges with negative impacts on native vegetation. The parallel invasion of two olive subspecies in different climatic zones of Australia provides an interesting case study of invasion, characterized by early genetic admixture between domesticated and wild taxa. In this synthesis, the authors provide an overview of the history and ecology of invasive olives and identify further research needed to guide future management and invasion risk.

Treena I. Burgess, Casparus J. Crous, Bernard Slippers, Jarkko Hantula, and Michael J. Wingfield

Tree invasions and biosecurity: eco-evolutionary dynamics of hitchhiking fungi

AoB PLANTS (2016) 8: plw076 doi: 10.1093/aobpla/plw076

Non-native plants reach novel environments with hidden fungal hitchhikers. Some remain on their hosts, often contributing to invasiveness, while others move beyond and naturalize, and some cause epidemics on native trees. Among the three main types of fungal associations (pathotroph, symbiotroph, or saprotroph), there are many categories reflecting either the part of the plant with which the fungus forms an association, the type of association, or the type of disease symptom it causes. The likelihood of non-native fungi forming novel host associations in a new environment is dependent upon the type of association.

Evan Siemann, Saara J. DeWalt, Jianwen Zou, and William E. Rogers

An experimental test of the EICA hypothesis in multiple ranges: invasive populations outperform those from the native range independent of insect herbivore suppression

AoB PLANTS (2017) 9 (1): plw087 doi: 10.1093/aobpla/plw087

This paper reports the results of a multi-year manipulative common garden experiment that investigates the roles of variation in plant defense and growth in the competitive ability of an invasive tree in the native range and two introduced ranges. The authors found that plants from invasive populations had more rapid aboveground growth rates that contributed to their success in both introduced and native ranges independent of aboveground herbivory. However, strong variation among sites indicated that plants from invasive populations have a strong advantage in only a subset of sites in the introduced range.

Metha M. Klock, Luke G. Barrett, Peter H. Thrall, and Kyle E. Harms

Differential plant invasiveness is not always driven by host promiscuity with bacterial symbionts

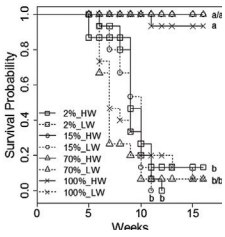
AoB PLANTS (2016) 8: plw056 doi: 10.1093/aobpla/plw056

Acacias have been widely introduced outside their native range, with a subset of species becoming invasive in multiple parts of the world. This study examined whether a key mechanism in acacia life history, the legume–rhizobia symbiosis, influences invasiveness of these species. The authors determined whether more invasive acacias formed symbioses with a wider diversity of rhizobial strains (i.e., were more promiscuous hosts) and found that acacias introduced to California are promiscuous hosts regardless of invasive status. Their results highlight the importance of examining mechanisms driving species invasions on different scales and in their native and introduced ranges.

Thalita G. Zimmermann, Antonio C. S. Andrade, and David M. Richardson

Experimental assessment of factors mediating the naturalization of a globally invasive tree on sandy coastal plains: a case study from Brazil

AoB PLANTS (2016) 8: plw042 doi: 10.1093/aobpla/plw042



Long-term seed persistence in the soil, broad germination requirements (temperature and light conditions), and the capacity to survive in a wide range of light intensity favor naturalization of the alien tree *Casuarina equisetifolia*. In this study, the species exhibited high germination plasticity, although young plants showed low plasticity. The positive effect of phenotypic integration on plastic expression in the shade showed that in stressful environments, traits that show greater phenotypic plasticity values may have significant phenotypic correlations with other characters. However, *C. equisetifolia* did not tolerate water stress and deep shade, which limit its potential to become naturalized on sandy coastal plain.

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Osvaldo E. Sala, Wrigley Chair & Foundation Professor, Arizona State University

Joseph T. Miller, Cang Hui, Andrew Thornhill, Laure Gallien, Johannes J. Le Roux, and David M. Richardson

Is invasion success of Australian trees mediated by their native biogeography, phylogenetic history, or both?

AoB PLANTS (2017) 9 (1): plw080 doi: 10.1093/aobpla/plw080

Two speciose clades of Australian trees, Acacia and Eucalyptus, have shown differential invasive ability when exported, with introduced Acacia species more likely to become invasive. The evolutionary histories of Acacia and Eucalyptus clades do not contain underlying phylogenetic signals for invasiveness as individual component species progress along the introduction–naturalization–invasion (INI) continuum. Geographic and network analyses suggest that potentially invasive clades, like Acacia, may be identified because they contain invasive species with smoother and faster expanding native distributions and are located more to the edges of phylogenetic networks than less invasive clades.

Ian A. Dickie, Jerry A. Cooper, Jennifer L. Bufford, Philip E. Hulme, and Scott T. Bates

Loss of functional diversity and network modularity in introduced plant–fungal symbioses

AoB PLANTS (2017) 9 (1): plw084 doi: 10.1093/aobpla/plw084

Native and alien trees associate with a wide range of beneficial fungi, but the few existing studies of these interactions tend to focus on only a few plant species or locations at a time. Using extensive databases collected by mycologists in the United Kingdom and New Zealand, the authors show that, in the latter region, fungi on alien trees are less functionally diverse than those associated with natives. In both New Zealand and the United Kingdom, however, the structure of the interaction network is simplified and "nested." This suggests that beneficial fungi hosted by alien trees may help facilitate further tree invasion.

John R. Gaskin

The role of hybridization in facilitating tree invasion

AoB PLANTS (2017) 9 (1): plw079 doi: 10.1093/aobpla/plw079

Hybridization can generate additional genetic diversity and create invasive plant species. Invasive tree species are a growing ecological concern worldwide, and some of these invasions involve hybridization events. In this paper the author reviews: 1) abundance of hybrid trees compared to parental taxa in an invasion; 2) hybrid phenotypes that may enhance invasions; 3) the presence of first generation vs. further hybrid generations and introgression; 4) the role of native genetic material in invasive tree hybridization; 5) the importance of intentional hybridization in contributing to tree invasion and 6) the frequency with which hybrid tree invasions are preceded by intentional vs. accidental introduction.

Heidi Hirsch, Isabell Henson, Karsten Wesche, Daniel Renison, Catherina Wypior, Matthias Hartmann, and Henrik von Wehrden

Non-native populations of an invasive tree outperform their native conspecifics

AoB PLANTS (2016) 8: plw071 doi: 10.1093/aobpla/plw071

The authors of this paper compared the seedling growth performance of native and non-native Siberian elm populations in a common greenhouse experiment, to gain knowledge about possible changes in life history traits in populations of non-native woody species. Their results showed that non-native Siberian elm populations are characterized by an enhanced early life cycle performance that likely contributes to their invasion success. The study contributes to a better understanding of the still little-known invasion processes of woody non-native species.

Johannes J. Le Roux, Natasha R. Mavengere, and Allan G. Ellis

The structure of legume–rhizobium interaction networks and their response to tree invasions

AoB PLANTS (2016) 8: plw038 doi: 10.1093/aobpla/plw038

This article provides data on how legume–rhizobium interaction webs react to invasions by exotic legumes. In the first study of its kind, the authors found that general hypotheses derived from aboveground mutualistic webs may not hold for belowground counterparts. Specifically, they found that legume–rhizobium interactions at the community level are highly specialized, resulting in strongly modular webs, which are not nested, and that invasive legumes do not infiltrate existing native webs but rather form unique and novel modules in webs.

For more information, contact the Chief Editor, J. Hall Cushman: jhcushman@cabnr.unr.edu

Rafael Dudeque Zenni, Wanderson Lacerda da Cunha, and Guilherme Sena

Rapid increase in growth and productivity can aid invasions by a non-native tree

AoB PLANTS (2016) 8: plw048 doi: 10.1093/aobpla/plw048

Biological invasions are an important cause of environmental degradation, and they also offer important insights on how species respond to changes in the environment. Invasive species affect native ecosystems, but they are also affected by them. This new study evaluated how invasive populations of a non-native pine responded to climate and other environmental factors. The results showed that many plants at the forefront of six different invasions are growing faster and being more productive than the plants originally planted 40 years ago. Taken together, the capacity for adaptation to different conditions and evolution of increased growth rates make Pinus taeda an invasive species that requires management and control before its spread reaches large areas.

Casparus J. Crous, Treena I. Burgess, Johannes J. Le Roux, David M. Richardson, Bernard Slippers, and Michael J. Wingfield

Ecological disequilibrium drives insect pest and pathogen accumulation in non-native trees

AoB PLANTS (2017) 9 (1): plw081 doi: 10.1093/aobpla/plw081

Non-native plant invasions represent ecological disequilibrium situations; i.e., the immediate breakdown of historically co-evolved interactions once introduced into novel environments. Globalization has led to increased transfer in organisms between countries. Native enemies also undergo host expansions onto non-native plants. Ecological disequilibrium conditions can thus be expected to change unpredictably over time. By retrospectively analyzing the insect pest and pathogen accumulation on established non-native trees in South Africa, the authors review the eco-evolutionary background that may help to explain and predict variation in ecological disequilibrium conditions in non-native trees.

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