

Contents lists available at [ScienceDirect](http://www.sciencedirect.com)

Perspectives in Plant Ecology, Evolution and Systematics

journal homepage: www.elsevier.de/ppees

Editorial

Comparative ecological research on oceanic islands

Oceanic islands have long been used as model systems for research in biogeography, ecology, evolution and conservation (Whittaker and Fernández-Palacios, 2007). Islands were crucial for the formulation of Charles Darwin's (1859) evolutionary theory, and later for the observation of evolution in action (Grant and Grant, 2008). The relevance of processes such as biological invasions and demographic stochasticity for conservation were first recognized through examples from islands. In biogeography, the theory of island biogeography (McArthur and Wilson, 1967) is by far the most widely cited and discussed theory, and the subsequent development of metapopulation theory – crucial for conservation biology – is also based upon island research (Hanski, 1999).

One reason why islands have proved so useful is that they represent globally replicated but relatively simplified real-world systems. However, while biogeographers have exploited this research opportunity and assembled large datasets from oceanic island groups, thereby allowing for comparisons at a global scale, island ecologists (among which we include also evolutionary biologists and conservationists) have mostly worked within particular island archipelagos or at best at a regional scale (such as the Mediterranean, Caribbean, Atlantic, Pacific or Indian oceans); thus, comparative ecological studies on a global scale and across regions are rare. The purpose of this special issue is to stimulate comparative ecological studies that transgress single archipelagos or oceanic regions. For this reason, the papers presented here address both the experiences of biogeographers in global comparative studies and the research questions of ecologists and conservationists. The two editors are themselves rooted in ecology and biogeography, respectively, and the articles have been written by experts in both fields.

Towards a multi-scale understanding of phylogenetic and taxonomic diversity on oceanic islands

The first two articles, written by biogeographers, present case studies that highlight some recent developments in biogeography. These articles reflect a shift in island biogeography from highly generalized models of species richness based on classical theory (McArthur and Wilson, 1967) towards studies that include a more complex understanding of the underlying mechanisms and consequently work on a higher spatial and taxonomic resolution. Thanks to this recent shift towards a more context- and case-dependent understanding of species richness, the affinities between biogeography and ecology have become more apparent. We believe that the two case studies presented here illustrate the benefits of collaboration between biogeographers and ecologists;

both highlight the importance of a hierarchical understanding of species richness in island biogeography combining different spatial scales, and both show that patterns may vary substantially among taxonomic or phylogenetic groups.

In the first article, Chiarucci et al. (2010) describe variation in species richness among islands within archipelagos and compare patterns across six archipelagos and between pteridophyte and spermatophyte floras. By applying a novel method – the additive partitioning of diversity – to island biogeography, the authors show that oceanic archipelagos differ significantly in how species diversity is distributed among islands. While in the Azores, for instance, a majority of native species are present on all islands in the archipelago; in Hawaii each island harbours numerous single island endemics.

The second article by Domínguez Lozano et al. (2010) describes work at a higher spatial and taxonomic resolution. The authors compare patterns of plant diversity among habitats for two archipelagos. Their analysis shows that some habitat types contribute disproportionately to taxonomic and phylogenetic diversity, though habitat types are different in the two archipelagos. The study illustrates how species immigration patterns through long-distance dispersal, i.e. a biogeographical process, and habitat factors, i.e. local ecological factors, interact in shaping species richness patterns on islands. This disentangling of local and large-scale processes can only be achieved through comparative studies across islands from different biogeographic regions, but it also requires detailed information about the patterns and processes operating at the island scale.

Oceanic island ecology and conservation in a highly anthropogenic time

The remaining three articles concern ecological topics that have much to gain from a comparative approach. All of them discuss general ecological principles, and all have a strong conservation focus. In addition, all of them demonstrate that anthropogenic disturbance has become a key process influencing the ecology of highly disturbed oceanic island ecosystems.

Caujapé-Castells et al. (2010) discuss the conservation status of native plants on oceanic islands, and present a conceptual framework of the main factors threatening oceanic island floras. By presenting a broad overview of island ecological processes in a highly anthropogenic world, this paper sets the scene for the following two articles. The study shows that the factors threatening island ecosystems vary among archipelagos, and that even neighbouring island archipelagos do not necessarily present the same challenges for management. The authors conclude that

a global network is therefore needed, so that conservationists facing similar problems in different regions can obtain the most relevant information. Caujapé-Castells et al. (2010) emphasize that different threat factors and processes are closely intertwined and cannot be understood in isolation. This entangling of factors also becomes clear in the two articles by Kaiser-Bunbury et al. (2010) and Kueffer et al. (2010).

Kaiser-Bunbury et al. (2010) synthesise current knowledge of plant–animal mutualisms on oceanic islands, and how these are affected by human disturbance. They then propose management options for assuring the long-term functioning of these ecological processes, arguing that islands can be used as model systems for testing new approaches to restoring disrupted biotic interactions in ecosystems. In some cases, restoring biotic interactions may even require the use of non-native analogues of extinct native species (re-wilding).

Kueffer et al. (2010) discuss patterns of non-native plant invasions across 30 island archipelagos in four oceanic regions. They illustrate how biogeographic analysis can be fruitfully applied in a conservation context, and their data indicate that plant invasions on oceanic islands are driven by a complex interplay of plant traits, habitat factors, anthropogenic disturbances and historical contingencies. Very few species were consistently recorded as invasive on most islands where they are present. The authors discuss a number of factors besides species traits that may influence plant invasions on islands, including habitat conditions, history of invasion and community assembly, and propagule pressure. They argue that comparative studies of the same invasive species on different islands provide a useful approach to understanding the interplay amongst these factors.

Towards a common research agenda among biogeographers and ecologists in oceanic island research

Although limited in their scope, the five articles demonstrate the value of comparative ecological research on oceanic islands and allow us to draw some tentative conclusions:

- Diverse processes acting at different spatial scales interact in shaping species richness patterns and ecological processes on oceanic islands. Comparative studies have a high potential for dealing with such complexities and contingencies in ecological research.
- In particular, both natural and anthropogenic patterns on oceanic islands are shaped through the interaction of large-scale biogeographic and local ecological processes. Closer collaboration between island biogeographers and ecologists is important for a better understanding of both kinds of processes. Plant functional ecology, in particular, may have a high potential to bridge biogeographic and ecological research on islands, allowing researchers to address fundamental questions in ecology, e.g. regarding the role of biogeographic, evolutionary and ecological processes in shaping the functional assembly of biotic communities.
- The tight interaction of large-scale and local processes implies that comparative studies are needed that transcend single

oceanic regions. The study by Domínguez Lozano et al. (2010) illustrates the value of comparing ecologically similar islands in contrasting biogeographic settings, and the data of both Caujapé-Castells et al. (2010) and Kueffer et al. (2010) indicate that conservationists with similar management challenges are not necessarily situated on nearby islands. Therefore global networking among island biogeographers, ecologists and conservationists is necessary to tackle some of the most relevant issues in conservation and research.

We hope that this special issue will stimulate more comparative ecological research on oceanic islands and encourage island biogeographers and ecologists to collaborate. But we end by emphasising the urgency of conserving the world's oceanic island floras. The analysis by Caujapé-Castells et al. (2010) clearly shows that a major proportion of island plants are at the brink of extinction. If we do not act rapidly, an important proportion of global plant diversity and a unique natural laboratory for ecological and evolutionary research will be lost!

References

- Caujapé-Castells, J., Tye, A., Crawford, D.J., Santos-Guerra, A., Sakai, A., Beaver, K., Lobin, W., Florens, F.B.V., Moura, M., Jardim, R., Gomes, I., Kueffer, C., 2010. Conservation of oceanic island floras: present and future global challenges. *Perspect. Plant Ecol. Evol. Syst.* 12, 107–129.
- Chiarucci, A., Bacaro, G., Arévalo, J.R., Delgado, J.D., Fernández-Palacios, J.M., 2010. Additive partitioning as a tool for investigating the flora diversity in oceanic archipelagos. *Perspect. Plant Ecol. Evol. Syst.* 12, 83–91.
- Darwin, C.R., 1859. *On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life*. John Murray, London.
- Domínguez Lozano, F., Price, J., Otto, R., Fernández-Palacios, J.M., 2010. Using taxonomic and phylogenetic evenness to compare diversification in two island floras. *Perspect. Plant Ecol. Evol. Syst.* 12, 93–106.
- Grant, P.R., Grant, B.R., 2008. *How and Why Species Multiply. The Radiation of Darwin's Finches*. Princeton University Press, Princeton.
- Hanski, I., 1999. *Metapopulation Ecology*. Oxford University Press, Oxford.
- Kaiser-Bunbury, C.N., Traveset, A., Hansen, D.M., 2010. Conservation and restoration of plant–animal mutualisms on oceanic islands. *Perspect. Plant Ecol. Evol. Syst.* 12, 131–143.
- Kueffer, C., Daehler, C.C., Torres-Santana, C.W., Lavergne, C., Meyer, J.-Y., Otto, R., Silva, L., 2010. A global comparison of plant invasions on oceanic islands. *Perspect. Plant Ecol. Evol. Syst.* 12, 145–161.
- McArthur, R.H., Wilson, E.O., 1967. *The Theory of Island Biogeography*. Princeton University Press, Princeton, NJ.
- Whittaker, R.J., Fernández-Palacios, J.M., 2007. *Island Biogeography. Ecology, Evolution, and Conservation 2nd ed.* Oxford University Press, Oxford, UK.

Christoph Kueffer*
Institute of Integrative Biology, ETH Zurich, CH-8092 Zurich, Switzerland

Department of Botany, University of Hawaii at Manoa, Honolulu, HI 96822, USA
 E-mail address: kueffer@env.ethz.ch

José María Fernández-Palacios
Departamento de Ecología, Facultad de Biología, Universidad de La Laguna, La Laguna, 38206 Tenerife, Canary Islands, Spain

*Corresponding author at: Institute of Integrative Biology, ETH Zurich, CH-8092 Zurich, Switzerland.