Journal of Biogeography

EDITOR'S CHOICE

May 2009

This edition of 'Editor's Choice' includes 4 articles recently published in *Journal of Biogeography*.

The coincidence of glacial refugia of plants and Mediterranean biodiversity hotspots

In the Northern Hemisphere, glacial refugia have played a key role in structuring biodiversity, notably species richness and endemism, but also genetic diversity. Refugia have provided suitable habitats during unfavourable climatic periods occurring since the end of the Tertiary. If these areas have prevented species extinction, they have also favoured diversification events. The Mediterranean Basin, one of the world's major biodiversity hotspots, constitutes both a global refuge area for relict species and an outstanding biogeographical crossroads. In the last few years, phylogeography (the study of the geographic distribution and history of population genetic lineages) has permitted the location of European refugia to be investigated and has emphasized the role of large Mediterranean peninsulas as refugia. However, the phylogeographical patterns of southern refugia are more complex than those found in the north, and the exact distribution and nature of Mediterranean refugia have never been defined.

In a recent article published in the Journal of Biogeography, Frédéric Médail and Katia Diadema from the University of Aix-Marseille (IMEP) investigate the fine-scale location of refugia in the Mediterranean Basin, and their relationship with the current patterns of plant diversity. Based on a unique dataset comprising 82 plant species (41 trees and 41 herbs), the analysis delimits 52 refugia: 33 situated in the western basin and 19 in the east. With a joint total of 25 refugia, the biogeographical importance of the three major Mediterranean peninsulas is confirmed. However, the authors underline the role of other areas located on large islands and mountains, notably in North Africa, Turkey and Catalonia Provence. A significant spatial congruence between the 52 refugia and the major biodiversity areas of the Mediterranean region was found: the main plant endemism areas are entirely included in the identified refugia, and half of them occur in the 10 regional biodiversity hotspots. This suggests that similar evolutionary and biogeographical patterns have influenced different biodiversity components.

Therefore, refugia constitute crucial areas in today's context of global change, and their preservation may be critical for conservation biogeography, because they encompass the bulk of genetic diversity and endemism of Mediterranean plants.

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Source paper: Médail, F. & Diadema, K. (in press) Glacial refugia influence plant diversity patterns in the Mediterranean Basin. *Journal of Biogeography*.

Image: Cushion-plan habitat of high altitude (2500 m), Paglia Orba (NW Corsica). Courtesy of F. Médail.

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Seed dispersal after glaciation is rare, even from nearby glacial refugia

Most organisms currently living in a previously glaciated landscape colonized their current range from somewhere else. There is a growing body of literature that examines the patterns and mechanisms of post-glacial colonization, often in an effort to learn from past migrations how species respond to modern, human-caused climate change.

Previous studies on oaks have considered species that migrated large distances from far-away glacial refugia. In contrast, a recent study of Garry oak, *Quercus garryana*, published in *Journal of Biogeography*, concerns a species that still primarily occupies unglaciated portions of its historical range and did not shift a great distance following the Last Glacial Maximum. Yet, even for this species, the authors found patterns similar to those found for long-distance oak migrations, in the form of low seed dispersal with high levels of regional pollen flow. In the expanded post-glacial range, *Q. garryana* occupied islands, and water may have acted as a barrier to dispersal from the mainland, effectively increasing the distance between the two regions. These results suggest that even in plant migrations of < 200 km, very few individuals are involved in the colonization process and future range movement could be restricted. Once colonization occurs, however, gene flow from pollen appears to increase genetic diversity in newly-established populations.

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Source Paper: Marsico, T.D., Hellmann, J.J. & Romero-Severson, J. (2009) Patterns of seed dispersal and pollen flow in *Quercus garryana* (Fagaceae) following post-glacial climatic changes. *Journal of Biogeography*

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Ecology drives differentiation in wolves from British Columbia

Little genetic structure is predicted for highly mobile carnivores and ecosystem generalists such as grey wolves, which occupy habitats as diverse as arctic tundra, boreal forests, mountains, deserts, and temperate rain forests. The wolves of British Columbia, Canada, provide a good system in which to evaluate the effects of distance and habitat variation on population genetic structure because they are distributed across very different habitats on a scale within the dispersal distance of an individual.

Muñoz-Fuentes and colleagues found strong genetic differentiation between adjacent populations of grey wolves from coastal and inland British Columbia. They show that the most likely factor explaining this differentiation is habitat discontinuity between the coastal and the interior regions, as opposed to geographic distance or physical barriers to dispersal. They hypothesize that dispersing grey wolves select habitats similar to the one in which they were reared, and that this differentiation is maintained largely through behavioural mechanisms. Coastal wolves are highly distinct morphologically, ecologically and genetically, and representative of a unique ecosystem. Consequently, the authors propose they should be considered an Evolutionary Significant Unit (ESU).

Quantifying the degree to which habitat drives genetic differentiation is important. If ecology can drive differentiation in a highly mobile generalist such as the grey wolf, ecology probably

drives differentiation in many other species as well. If habitat specialization drives and/or maintains divergence, when a specific habitat is threatened, a unique population, differentiated from populations of the same species in adjacent areas, may also be threatened. Conservation programmes thus should aim to encompass as much ecological diversity as possible to preserve species-wide genetic diversity and evolutionary potential.

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Source paper: Muñoz-Fuentes, V., Darimont, C.T., Wayne, R.K., Paquet, P. & Leonard, J.A. (2009) Ecological factors drive differentiation in wolves from British Columbia. *Journal of Biogeography*, doi:10.1111/j.1365-2699.2008.02067.x.

Image: A coastal wolf prowls the beaches of the temperate rain forest of British Columbia. Photo credit: Chris Darimont.

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Oscillating sea levels shaped Southeast Asian biogeography

In Southeast Asia there is a great but little studied transition between the plants and animals of continental Indochina and the islands formerly known as the East Indies. One hundred and forty years ago, Alfred Russel Wallace pointed out that the two biotas meet near the narrow Isthmus of Kra on the Thai/Malay Peninsula. In a recent paper published in *Journal of Biogeography*, David Woodruff and Leslie Turner describe the distribution of 325 species of land mammals in this region and, interestingly, they find no major transition of mammal species at the Isthmus of Kra, while they also report 30% fewer species than expected over a distance of 600 km in the narrow northern peninsula. Woodruff and Turner suggest an explanation for the differentiation of the two biotas as a function of variations in sea level. Using a revised global sea level curve, they note that sea levels were as high as today's for only 2% of the last million years and during most of that time they have averaged 62 m below the present level. When sea levels were lower, the mainland was broadly connected by dry land to Borneo, Java and Sumatra, and Southeast Asia became the size of Europe. During warmer interglacial periods the sea level rose, the land was flooded, and the peninsula became recognizable. The authors show how the more than 50 rapid sea level rises of more than 40 m would have driven the mammals back towards today's peninsula and compressed the fauna in the narrow northern part of the peninsula. They argue that repeated faunal compression by rising sea levels caused the extirpation of more than 35 mammal species from the narrow part of the peninsula, and that this accounts for their observation that Indochinese and Indomalay mammals tend to have range limits north and south of this anomalous area.

The repeated faunal compression by rising sea levels may account for the origin of the faunal differences between the continent and the islands and may also explain why coarse mapping suggested that the transition lay near the Isthmus of Kra. Species of forest birds, reptiles and amphibians, butterflies and flowering plants appear to show similar patterns although their distributions have yet to be analysed.

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Source paper: Woodruff, D. S. & Turner, L. M. (2009) The Indochinese–Sundaic zoogeographic transition: a description and analysis of terrestrial mammal species distributions. *Journal of Biogeography*, doi: 10.1111/j.1365-2699.2008.02071.x.

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