

Detecting local adaptation from genome scans in populations with complex histories

Matthieu Foll *
matthieu.foll@iee.unibe.ch

Oscar Gaggiotti †
Oscar.Gaggiotti@ujf-grenoble.fr

Laurent Excoffier *
laurent.excoffier@iee.unibe.ch

Detecting genes involved in local adaptation is of fundamental importance in evolution, medical genetics, and agronomy. Genome scans performed in a large number of populations from different origins and environments are becoming increasingly common. Ideally, one would like to analyze all these data simultaneously to find markers under selection, but uneven relationships between populations or population sub-structure may lead to an excess of false positives. Therefore data sets are often split in smaller groups or a series of pairwise analyzes are performed to remove the effect of complex past histories. This strategy generally leads to a global loss of power compared to a single large analysis, and lists of significant genes obtained from separate and sometimes non-independent analyzes are also problematic to compare.

In order to alleviate these problems, we propose a new hierarchical Bayesian method to detect markers under selection from genome scans. We identify selection as a deviation from a realistic neutral model accommodating for populations with complex histories clustered in different large geographic regions. Our method is very versatile as it can identify at the same time local adaptation, adaptation between regions, as well as convergent evolution between regions.

We apply our method to a large SNP genome scan performed in 2 pairs of low- and high-altitude populations from South America and Asia. In addition to two previously known candidate genomic regions for altitudinal selection, the simultaneous analysis of these two geographic regions reveals 15 new candidate gene regions subject to the same adaptive pressure in populations from the Andes and Himalaya.

*Institute of Ecology and Evolution, University of Bern, Baltzerstrasse 6, Bern, CH-3012, Switzerland.

†Laboratoire d'écologie Alpin, Université Joseph Fourier, B.P. 53 - 38041 Grenoble Cedex 9, France.