

## THE CROSSHARES (XHARES) CONSORTIUM: GENOMIC COMPATIBILITY AS THE BACKSTOP AT THE SPECIES BOUNDARY



*Principal Investigator: Jaakko Pohjoismäki, University of Eastern Finland*

Speciation and species differentiation are fundamental themes in evolutionary biology. Speciation begins as genetic differentiation of populations leading to biological differences that will eventually prevent gene flow from one species to another, thus reinforcing the differentiation process. However, the molecular determinants of species differentiation are presently poorly understood.

Our recent observations from the gene flow between mountain and brown hares suggest that mitochondria play an important role in enforcing the species boundary. Because mitochondrial proteins are partly encoded by maternally inherited mitochondrial DNA (mtDNA) and partly by bi-parental nuclear DNA, backcrossed hybrids can have mix of mitochondrial components from different species. The incompatibility between the two genetic compartments could result in decreased hybrid fitness and constitute an important backstop at the species boundary.

In the present study, we are evaluating the severity of the nucleus-mitochondrial incompatibility by transferring mtDNA from one hare species to another and measuring its fitness effects. The hybrid mitochondria are expected to differ in the efficiency of energy production, production of free radicals, mitochondrial turnover, and changes in the signaling between mitochondria and

the nucleus, as well as having differences in mtDNA maintenance and expression. Comprehensive sequencing of the coding part of the mountain hare and brown hare genomes, combined with molecular modeling, will enable us to identify genes that are important for the genetic compatibility. The function of these genes will be validated through genetic engineering of hare cells as well as performing a genome-wide analysis of 200 hares to detect the signatures of natural selection in specimens with mtDNA from another species.

The study will elucidate the molecular mechanisms of species differentiation, nuclear regulation of mitochondrial function, as well as provide new insight into the variation in pathological mechanisms in human mitochondrial diseases. As hybridization

with invasive brown hare further aggravates the negative impact of the advancing climate change on mountain hares, the study also has important applications in conservation biology.

### RESEARCH CONSORTIUM:

*Consortium PI team,  
University of Eastern Finland (UEF):*

*Dr. Jaakko Pohjoismäki,  
Dr. Steffi Goffart,  
MSc Craig Michell  
and a PhD student.*

*Subproject PI team:*

*Dr. Eric Dufour, Tampere University  
(TUNI) and a PhD student*



*A bad hare day. Photo credits Dr. Mervi Kunnasranta.*

### CONTACT:

*Dr. Jaakko Pohjoismäki,  
e-mail. jaakko.pohjoismaki@uef.fi, tel. +358-29-4453052,  
Department of Environmental and Biological Sciences,  
University of Eastern Finland, Yliopistokatu 7, P. O. Box 111,  
80101 Joensuu, FINLAND.*

<http://www.uef.fi/en/web/mitochondrial-biology>

<https://www.uef.fi/web/hare-research>