Smart songbird's reference genome is milestone for ecological research

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The genetic code of this well-known songbird, the great tit, offers researchers new insight into how species adapt to a changing planet. initial findings are about the evolution of memory and learning, essential for adaptation. And not just for birds. Credit: Netherlands Institute of Ecology (NIOO-KNAW)

A well-known songbird, the great tit, has revealed its genetic code,

offering researchers new insight into how species adapt to a changing planet. Their initial findings suggest that epigenetics—what's on rather than what's in the gene—may play a key role in the evolution of memory and learning. And that's not just true for birds. An international research team led by the Netherlands Institute of Ecology (NIOO-KNAW) and Wageningen University will publish these findings in *Nature Communications* on Monday.

"People in our field have been waiting for this for decades," explain researchers Kees van Oers and Veronika Laine from the Netherlands Institute of Ecology. The reference genome of their favourite model species, the great tit, is "a powerful toolbox that all ecologists and evolutionary biologists should know about."

Coming from a single Dutch bird, the genetic code of the assembled reference genome will help to reveal the genetic basis of phenotypic evolution. This is essential for understanding how wild species adapt to our changing planet.

In addition to looking at the genome, the research team have also determined the so-called transcriptome and methylome. The latter belongs to the field of epigenetics: the study of what you can inherit not in but 'on' your genes. Specific DNA sequences in the genome can be 'methylated': methyl groups are added to them, modifying how the genes function.

The research team sequenced the complete genomes of a further 29 great tit individuals from different parts of Europe. This enabled them to identify regions in the great tit's genome that have been under selection during recent evolution of the bird. These regions appeared to be overrepresented for genes related to learning and cognition.

"The great tit has evolved to be smart," says Van Oers. "Very smart." It's

not your average bird, as it belongs to the top 3% smartest birds when it comes to learning new behaviour. That makes it a perfect candidate for research into the evolution of learning, memory and cognitive processes.

What that research has revealed are so-called conserved patterns of methylation in those same regions, present not only in birds but also in humans and other mammals. It's evidence of a correlation between epigenetic processes such as methylation and the rate of molecular evolution: "the more methylation, the more evolution."

And so the great tit has once more proved that its role as a model species in a variety of biological research fields for over 60 years is by no means coincidental.

More information: Evolutionary signals of selection on cognition from the great tit genome and methylome. Veronika N. Laine, Toni I. Gossmann, Kyle M. Schachtschneider, Colin J. Garroway, Ole Madsen, Koen J.F. Verhoeven, Victor de Jager, Hendrik-Jan Megens, Wesley C. Warren, Patrick Minx, Richard P.M.A. Crooijmans, Pa´draic Corcoran, The Great Tit Hapmap Consortium, Ben C. Sheldon, Jon Slate, Kai Zeng, Kees van Oers, Marcel E. Visser & Martien A.M. Groenen. *Nature Communications*, Jan. 25, 2016 online. DOI: 10.1038/NCOMMS10474

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