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# Toni Goßmann, Ph.D.

Biology

## Bielefeld University

from March to June 2021

Born in 1982 in Leipzig, Germany

Studied Bioinformatics at the University of Jena and the University of Bergen and Biology at the University of Sussex

FELLOWSHIP
College for Life Sciences

PROJECT

# What Are the Imprints of Natural Selection on the Molecular Level?

The role of adaptive evolution is among the most intriguing problems to help humankind understand how the stunning diversity of life has formed through evolution. Seemingly controversially, many molecular changes are believed to have little or no functional effect, hence identifying specific adaptive mutations on the molecular level is incredibly difficult. My research addresses this fundamental limitation by combining novel analytical approaches with large-scale genomic data. Using state-of-the-art genomics, I designed two novel and distinct approaches to unravel the role of molecular adaptation in the evolutionary process. My work is split into two subprojects that address the same question from two completely different angles:

(1) Traces of selection in large scale phylogenies to pinpoint hotspots of rare genetic diseases

The process of natural selection explains biodiversity in anatomy, life history, behavior and species on our planet. However, deciphering the underlying evolutionary forces remains a challenging task in evolutionary biology. Here I propose a novel framework that tackles one of the most important questions in evolutionary biology - what is the role of adaptation in the evolutionary process? This cutting-edge work will take advantage of the vast amount of genomic data sets that are currently being generated world-wide to draw biological conclusions. Subsequently, this approach can be used to link this information to phenotypes and protein function, including experimental verification.

(2) Functional, genetic and epigenetic drivers of DNA methylation evolution

Epigenetics plays a fundamental role in the function and regulation of the genome. From an evolutionary viewpoint, a pressing question is whether epigenetic modifications are a source of adaptive variation. Using novel analytical and technical approaches, I want to address this fundamental knowledge gap using the best understood epigenetic mark, DNA methylation.

Recommended Reading

Yusuf, L., M. Heatley, J. P. G. Palmer, H. J. Barton, C. R. Cooney, and T. I. Gossmann (2020). "Noncoding regions underpin avian bill shape diversification at macroevolutionary scales." Genome Research 30, 4: 553-565. DOI: https://doi.org/10.1101/gr.255752.119. Also as pre-print on bioRxiv. DOI: https://doi.org/10.1101/844951.

Gossmann, T. I., A. Shanmugasundram, S.Börno, L. Duvaux, C. Lemaire, H. Kuhl, S. Klages, et al. (2019). "Ice-Age Climate Adaptations Trap the Alpine Marmot in a State of Low Genetic Diversity." Current Biology 29: 1712-1729. DOI: 10.1016/j.cub.2019.04.020.

Laine, V. N., T. I. Gossmann, K. M. Schachtschneider, C. J. Garroway, O. Madsen, K. J. F. Verhoeven, V. de Jager, et al. (2016). "Evolutionary signals of selection on cognition from the great tit genome and methylome." Nature Communications 7: 10474. DOI: 10.1038/ncomms10474.

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COLLOQUIUM, 11.05.2021

# The OMICS Revolution

Recent technological advances have led to a massive bloom of biological data, in particular in the fields of DNA (genOMICs), RNA (transcriptOMICs), and proteins (proteOMICs). This OMIC ("the totality of some sort") revolution is shaping the way we approach biological questions and is in particular driven by the extreme speed and amount of novel data becoming available. I will showcase examples of how these immense resources are being used to answer pressing (and perhaps not so pressing) questions in biology, ecology, and biomedicine. My working group is currently located at the Department of Animal Behaviour at Bielefeld University and receives funding from the European Research Council.

PUBLICATIONS FROM THE FELLOW LIBRARY

Goßmann, Toni (Cold Spring Harbor,2020)

Noncoding regions underpin avian bill shape diversification at macroevolutionary scales
https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=1725571730

Goßmann, Toni (London,2019)

Ice-age climate adaptations trap the alpine marmot in the state of low genetic diversity
https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=1725187698

Goßmann, Toni ([London],2016)

Evolutionary signals of selection on cognition from the great tit genome and methylome
https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=1725186780