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## Toni Goßmann, Ph.D.

Biology

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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

### ARBEITSVORHABEN

## 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](https://doi.org/10.1016/j.cub.2019.04.020).

Laine, V. N., T. I. Gossmann, K. M. Schachtschneider, C. J. Garraway, 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](https://doi.org/10.1038/ncomms10474).

## Die "-omik"-Revolution

Die jüngsten technischen Fortschritte haben zu einer massiven Zunahme biologischer Daten geführt, insbesondere in Bezug auf Daten zur DNA (Gen-omik), RNA (Transkript-omik) und zu Proteinen (Prote-omik). Diese "-omik"-Revolution ("Gesamtheit ähnlicher Einzelteile") prägt die Art, wie wir an biologische Fragestellungen herangehen, und wird insbesondere durch die extreme Geschwindigkeit und Menge neuartiger Daten vorangetrieben, die uns jetzt zur Verfügung stehen. Ich präsentiere Ihnen Beispiele, wie diese immensen Ressourcen genutzt werden, um drängende (und vielleicht nicht so drängende) Fragen in der Biologie, Ökologie und Biomedizin zu beantworten. Meine Arbeitsgruppe ist derzeit an der Fakultät für Biologie/Department of Animal Behaviour der Universität Bielefeld beheimatet und erhält Fördermittel vom Europäischen Forschungsrat.

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### PUBLIKATIONEN AUS DER FELLOWBIBLIOTHEK

Goßmann, Toni (Cold Spring Harbor,2020)

Noncoding regions underpin avian bill shape diversification at macroevolutionary scales

<https://kxp.k1oplus.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.k1oplus.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.k1oplus.de/DB=9.663/PPNSET?PPN=1725186780>