Katedry genetiky a biochémie PriF UK
a občianske združenie *NATURA*

Vás pozývajú na 142. prednášku v rámci Kuželových seminárov:

prof. Peter Vďačný

Katedra zoológie, Prírodovedecká fakulta UK

EVOLUTIONARY EMERGENCE OF EUKARYOTIC MAGNETOTAXIS VIA A TRIPARTITE SYNTROPHIC NETWORK

ktorá sa uskutoční **4. decembra 2026** (piatok) o **13:30**
v miestnosti **CH1-222** Prírodovedeckej fakulty UK

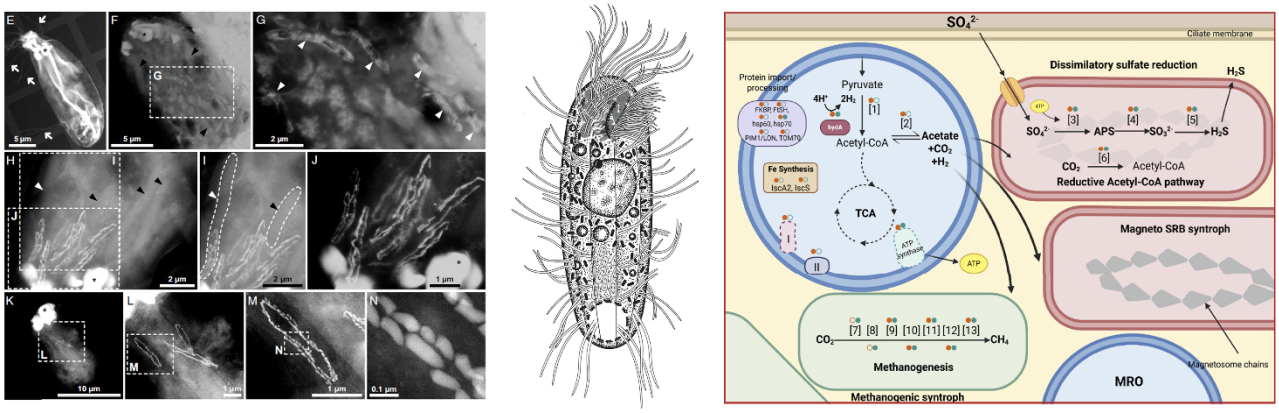
http://www.naturaoz.org/seminare.html
http://www.naturaoz.org/KuzeloveSeminare.html

prof. Peter Vďačný

2023-present: Head of the Department of Zoology, Faculty of Natural Sciences, Comenius University
2015-2026: Associate Professor, Faculty of Natural Sciences, Comenius University
2013: Visiting Professor, Shin Lab, Department of Biological Science, College of Natural Sciences, University of Ulsan, Ulsan, South Korea
2010-2015: Assistant Professor, Faculty of Natural Sciences, Comenius University
2010: Visiting scholar, Epstein Lab, Biology Department, Northeastern University, Boston, Massachusetts, USA
2008-2010: PhD. studies, Foissner Lab, Faculty of Natural Sciences, Paris Lodron University of Salzburg, Salzburg, Austria
2001-2006: BSc. and MSc. studies, Department of Zoology, Faculty of Natural Sciences, Comenius University

Synopsis of the talk

While magnetotaxis is well-characterized in bacteria, where genetically controlled biomineralization of nano-crystalline magnets guides swimming along the Earth's magnetic field, the evolutionary mechanisms behind this trait in eukaryotes remain poorly understood. We discovered a novel magnetotactic ciliate, *Tropidoatractus magnetotacticus*, which acquires magnetotaxis via syntrophy rather than endogenous biomineralization. This ciliate navigates using internal ferrimagnetic magnetite nanoparticles organized in parallel, necklace-shaped chains. Electron microscopy revealed that these chains reside within intracellular, rod-shaped bacteria. Metatranscriptomic and genomic sequencing of magnetically sorted ciliate cells identified an internal population of magnetotactic bacteria that actively express a magnetosome gene cluster closely related to "*Candidatus* Desulfarcum epimagneticum". Concurrently, the ciliate host houses a second endosymbiotic population affiliated with the hydrogenotrophic methanogen *Methanoregula*. Metatranscriptomes show host expression of hydrogenosomal [Fe]-hydrogenase genes and electron transport chain components indicative of H_2-producing, mitochondria-related organelles. Active gene expression across these pathways reveals a tripartite syntrophic network: anaerobic fermentation products from *T. magnetotacticus* fuel both the magnetosome-producing bacteria and the methanogenic archaea. These findings demonstrate a unique evolutionary paradigm where a complex behavioral trait like magnetotaxis can emerge in eukaryotes through metabolic interdependence and symbiosis.



Microscopic analyses of magnetotactic ciliates (showing intracellular rod-shaped bacteria with magnetosome chains) and a metabolic model of T. magnetotacticus and its internal syntrophic partner populations.

Selected publications:

Bukovinská K., Rurik I., **Vďačný P.** (2026) Diversification and hybridization within the *Spirochona gemmipara* complex driven by gammarid host range shifts. *iScience* 29 (11): 117803. https://doi.org/10.1016/j.isci.2026.117803

Chitnis M., Kaub L., **Vďačný P.**, Beiers L.M., Sturm S., Coskun Ö.K., Mills D.B., Gomez-Saez G.V., Mengue L., Gottschaldt K.-D., Gilder S.A., Obert T., Rurik I., Sturm E.V., Orsi W.D. (2026) Magnetotaxis in an anaerobic ciliate via tripartite syntrophy. *Proceedings of the National Academy of Sciences of the United States of America* 123 (30): e2609513123. https://doi.org/10.1073/pnas.2609513123

Pecina L., Rurik I., **Vďačný P.** (2025) Macroevolutionary trends and diversification dynamics in the hindgut order Clevelandellida (Ciliophora, Armophorea). *Zoologica Scripta* 54 (2): 253–269. https://doi.org/10.1111/zsc.12701

Pecina L., **Vďačný P.** (2022) DNA barcoding and coalescent-based delimitation of endosymbiotic clevelandellid ciliates (Ciliophora: Clevelandellida): a shift to molecular taxonomy in the inventory of ciliate diversity in panesthiine cockroaches. *Zoological Journal of the Linnean Society* 194 (4): 1072–1102. https://doi.org/10.1093/zoolinnean/zlab063

Vďačný P. (2018) Evolutionary associations of endosymbiotic ciliates shed light on the timing of the marsupial-placental split. *Molecular Biology and Evolution* 35: 1757–1769. https://doi.org/10.1093/molbev/msy071

Vďačný P., Érseková E., Šoltys K., Budiš J., Pecina L., Rurik I. (2018) Co-existence of multiple bacterivorous clevelandellid ciliate species in hindgut of wood-feeding cockroaches in light of their prokaryotic consortium. *Scientific Reports* 8: 17749. https://doi.org/10.1038/s41598-018-3624