

PhD position at the University of South Bohemia (Czech Republic)

available from July 2019



Adaptive radiation of cichlid fish in rivers:

Evolutionary genomics of replicated diversification in Neotropical pike cichlids

Project background:

Adaptive radiation is an evolutionary process in which organisms rapidly diversify into a multitude of new forms as a response to new ecological opportunities. Classic examples include Darwin's finches, the cichlid fishes in East African lakes, Anolis lizards, Hawaiian honeycreepers or Hawaiian silverswords. The cichlid fish radiations stand out by their spectacular trophic diversity and richness of sympatric species. Current work suggests that ecological opportunity, intrinsic ecological versatility and genomic flexibility and rapidly evolving behavioural mate choice are some of the factors that facilitated these spectacular fish radiations. However, the intrinsic and environmental factors are still far from being completely understood. In particular, adaptive radiations are often too rapid for the emergence of new relevant mutations between successive speciation events and are thus more likely to utilise standing genetic variation. Hybridization between species can instantaneously boost genetic diversity and create novel phenotypes, and thus facilitate speciation and adaptive radiation. On the other hand, the question whether interspecific hybridization is important as a mechanism that generates biological diversity is a matter of some controversy due to the argument that reduced fitness would typically render hybrids an evolutionary dead end.

The model system:

Whether hybridization is the cause rather than the consequence of the rapid radiation cannot be studied without an appropriate study system. Our research group has recently discovered and introduced an outstanding evolutionary model of replicated diversification that includes two independent riverine lineages of a South American cichlid genus, *Crenicichla*, inhabiting adjacent river basins (of the La Plata River) with similar geomorphology. Both clades show an extremely wide range of morphologies and coloration patterns tied closely with trophic ecology, in which the corresponding (and strikingly similar) ecomorphs from different basins have evolved independently. Further, we have recently demonstrated, based on morphological tests of similarities, ancestral states and rates of evolution that the replicated ecomorphs arose via parallel processes of phenotypic and trophic diversification. These two clades are restricted to their respective river and members of each group occur in sympatry such that their ecomorphological diversity arose in situ (i.e., species flocks) reflecting parallel patterns of evolution well known from African lake-dwelling cichlids.



Goal of the project:

We believe that the above-described exceptional model of two in-parallel diversifying species flocks from the La Plata basin with strikingly similar corresponding ecomorphs is the best known system to study adaptive radiations in Neotropical riverine cichlids. The aim of this project is thus to bring new resolution into the study of microevolutionary processes of diversification within these confined geographical regions based on whole-genome sequencing and RAD-seq genotyping. Phylogenomic and morphological analyses will be used to better understand the biological and environmental factors underlying rapid speciation with special focus on the role of hybridization. To achieve full employment of the WGS/RAD data we will also sequence and assemble a reference genome of an appropriate congeneric species.

Research team:

The student will work in a small team supervised by:

[Lubomír Piálek](#), Department of zoology, University of South Bohemia – principal investigator

[Oldřich Říčan](#), Department of zoology, University of South Bohemia – co-supervisor

The project will be conducted in close collaboration with [Jorge Casciotta](#) and [Adriana Almirón](#) (National University of La Plata, Argentina), [Edward Burress](#) (University of California, USA), and [Milan Malinsky](#) (University of Basel, Switzerland).

Time and place:

The PhD position is available for three years, starting in July 2019 (starting date negotiable) at the Dept. of Zoology, [Faculty of Science, University of South Bohemia](#), Czech Republic. University of South Bohemia (USB) is a state university, founded in 1991. It is located in the regional centre of South Bohemia, the town of [České Budějovice](#) (Budweis; population ca. 100,000), about 150 km south of [Prague](#), 25 km north of [Český Krumlov](#) or 200 km northwest of Vienna, Austria. The town was established in the thirteenth century as a “King’s town” by the Czech King Přemysl Otakar II on the Vltava (Moldau) River.

[USB](#) is a research university focusing mainly on natural sciences, social sciences, and humanities. A significant aspect of the scientific research activities is close cooperation with the Academy of Sciences of the Czech Republic. The university comprises eight faculties, which are located in the historical centre of the town and on the university campus on its western edge. The campus also includes student residences, a mensa, a Rector’s office and the buildings of the Biology Centre of the Academy of Sciences of the Czech Republic.



Applicant’s desired qualification:

Master’s degree in biological sciences

Understanding of the basic principles of population genetics and molecular evolution

Ability to work independently

Experience with computational analysis of biological data

Strong motivation to develop further skills in the above fields

Friendly relationship to fishes and particularly cichlids 😊

Scholarship:

The PhD candidate’s net monthly income starts at 20.500 CZK (ca. 800 EUR) and will increase with experience and achievements during the study. Note that living expenses in the Czech Republic are substantially lower than in Western European countries and that less than a half of this sum will pretty much cover your living costs, especially while staying at the campus.

How to apply:

If interested, send a motivation letter, CV and abstract of your Master (Diploma) thesis in a single PDF file to: lubomir.pialek@prf.jcu.cz until May 31, 2019. Sooner is better - please note that the call may be closed earlier.

To-read list:

- Piálek L., Říčan O., Casciotta J., Almirón A., Zrzavý J. (2012). Multilocus phylogeny of *Crenicichla* (Teleostei: Cichlidae), with biogeography of the *C. lacustris* group: Species flocks as a model for sympatric speciation in rivers. *Molecular Phylogenetics and Evolution* 62, 46–61.
- Burruss E.D., Duarte A., Serra W.S., Loueiro M., Gangloff M.M., Siefferman L. (2013). Functional Diversification within a Predatory Species Flock. *PLoS ONE* 8, 1–10.
- Piálek L., Dragová K., Casciotta J., Almirón A., Říčan O. (2015). Description of two new species of *Crenicichla* (Teleostei: Cichlidae) from the lower Iguazú River with a taxonomic reappraisal of *C. iguassuensis*, *C. tesay*. *Historia Natural, Tercera Serie* 5, 5–27.
- Burruss E.D., Piálek L., Casciotta J.R., Almirón A., Tan M., Armbruster J.W., Říčan O. (2018). Island- and lake-like parallel adaptive radiations replicated in rivers. *Proceedings of the Royal Society B* 285, 20171762.
- Piálek L., Burruss E., Dragová K., Almirón A., Casciotta J., Říčan O. (2019). Phylogenomics of pike cichlids (Cichlidae: *Crenicichla*) of the *C. mandelburgeri* species complex: rapid ecological speciation in the Iguazú River and high endemism in the Middle Paraná basin. *Advances in Cichlid Research III, Hydrobiologia* 832, 355-375.
- Piálek L., Casciotta J., Almirón A., Říčan O. (2019). A new pelagic predatory pike cichlid (Teleostei: Cichlidae: *Crenicichla*) from the *C. mandelburgeri* species complex with parallel and reticulate evolution. *Advances in Cichlid Research III, Hydrobiologia* 832, 377-395.