

2023 HGF – OCPC – Program for the involvement of postdocs in bilateral collaboration projects

Title of the project:

Functional analysis of epigenetic adaptation in marbled crayfish

Helmholtz Centre or Institute:

DKFZ

Project leader:

Prof. Dr. Frank Lyko

Contact Information of Project Supervisor: (Email, telephone)

f.lyko@dkfz.de, +49 6221 423800

Web-address:

www.dkfz.de/epigenetics

Division or Research Group: (at the Helmholtz centre or Institute)

Epigenetics

Program Coordinator (Email, telephone)

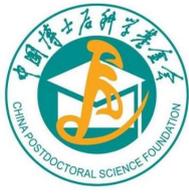
International Postdoc Program
German Cancer Research Center (DKFZ)
Phone: +49 6221 42-1696
Email: postdoc@dkfz.de

Description of the project (max. 1 page):

Marbled crayfish (*Procambarus virginalis*) are a novel freshwater crayfish species that are currently colonizing many habitats around the globe. They are closely related to the red swamp crayfish, which is extensively cultured and represents a major source of nutritional protein in China. Both species are characterized by their considerable adaptivity to changing environments, which is facilitated by epigenetic mechanisms (Coutinho Carneiro and Lyko, 2020). Marbled crayfish reproduce by apomictic parthenogenesis, and represent a genetically monoclonal population. This makes them particularly interesting as model system for clonal genome evolution and epigenetic adaptation, two important research topics of current agricultural and biomedical research.

We have previously established the complete genome sequence of the marbled crayfish (Gutekunst et al., 2018). We have also shown that the marbled crayfish genome encodes a conserved DNA methylation system and have linked DNA methylation to the particular adaptivity of the animals (Gatzmann et al., 2018). More recently, we have taken first steps to establish CRISPR/Cas9 mediated gene editing for the establishment of transgenic crayfish.

We are now looking for a candidate to fully establish a protocol for CRISPR/Cas9 mediated gene



editing of the marbled crayfish genome. We are particularly interested in the establishment of transgenic models that allow the functional analysis of epigenetic adaptation. This can be achieved by generating knockout animals lacking key epigenetic modifiers, such as the DNA methyltransferase Dnmt1 or the adenine deaminase Adar2 and then challenging them in laboratory environments that require organismal adaptation, with salt stress and pathogen exposure as prominent examples. The results will provide fundamentally new insight into the role of epigenetic mechanisms in environmental adaptation and will be of major relevance for improving aquatic livestock performance.

Coutinho Carneiro, V., and Lyko, F. (2020). Rapid epigenetic adaptation in animals and its role in invasiveness. *Integr. Comp. Biol.* 60: 267-274.

Gatzmann, F., Falckenhayn, C., Gutekunst, J., Hanna, K., Raddatz, G., Coutinho Carneiro, V., and Lyko, F. (2018). The methylome of the marbled crayfish links gene body methylation to stable expression of poorly accessible genes. *Epigenetics Chromatin* 11: 57.

Gutekunst, J., Andriantsoa, R., Falckenhayn, C., Hanna, K., Stein, W., Rasamy, J., and Lyko, F. (2018). Clonal genome evolution and rapid invasive spread of the marbled crayfish. *Nat. Ecol. Evol.* 2: 567-573.

Description of existing or sought Chinese collaboration partner institute (max. half page):

Freshwater crayfish are an emerging source of nutritional protein, particularly in China. We are seeking a Chinese collaboration partner with a background in crayfish aquaculture and genetics. Crayfish research in China is predominantly focused on the red swamp crayfish, *P. clarkii*. As *P. virginalis* is closely related to *P. clarkii*, but also shows fundamentally different biological differences (e.g. sexual vs. asexual reproduction), comparative analyses will be particularly interesting and provide an excellent opportunity for a sustained, long-term collaboration.

The Key Lab of Freshwater Animal Breeding (Wuhan) and Nanjing Agricultural University are two institutions that pursue active research along these lines.

Required qualification of the postdoc:

-
- PhD in natural sciences
 - Experience with molecular biology, molecular genetics
 - Additional skills in animal culture, computational biology
 - Excellent English communication skills