LABORATORY OF BIOLOGICAL DIVERSITY

WUDARSKI Group

Specially Appointed Assistant Professor:
WUDARSKI, Jakub

Understanding the mechanisms of regeneration using transgenic flatworms and IR-LEGO

Regeneration is the process of restoring lost or damaged tissues and organs. Flatworms have long been considered as model organisms for studying regeneration; some species of planarian flatworms can even restore all their body parts from small pieces. In my research, I am using the new powerful flatworm model organism, *Macrostomum lignano*, to study how stem cells differentiate into various cell types during regeneration and how body patterning is established. The main advantage of *M. lignano* is the availability of transgenesis methods which I have developed during my PhD. It enables tracking specific cells and their progenitors during development and regeneration.

Positional control of regeneration in flatworms

Flatworms have remarkable regeneration capabilities. They are able to regrow their whole body after amputation, including their reproductive organs. They can do this thanks to a population of adult stem cells, collectively called neoblasts. One of the fascinating aspects of flatworm regeneration is the positional control of the process along the anterior-posterior axis (head-tail). How cells know where specific body parts need to be reconstructed is a question that still lacks a full answer. Our current state of knowledge is that Wnt pathway and the mitogen-activated protein kinase (MAPK)/extracellular signal-related kinase (ERK) signaling play major role in this process. However, most of the research done on flatworms is based on information inferred from experiments on gene knock-down via RNA interference (RNAi). Gene activation and overexpression studies are absent in planarians, the more common flatworm model organisms, because of the lack of transgenic methods available for these animals. I am trying to use the ERK-KTR biosensor in *Macrostomum lignano* (Fig. 1), to track ERK signaling and test the function of genes shown to be involved in positional control during growth and regeneration. I am also adapting the infrared laser evoked gene operator (IR-LEGO) technology to use with the previously established HSP20 promoter (Fig. 2). This will enable me to track the cell fate in vivo and overexpress selected genes even on a single cell level.

The research is financed by the Mistubishi Foundation grant.

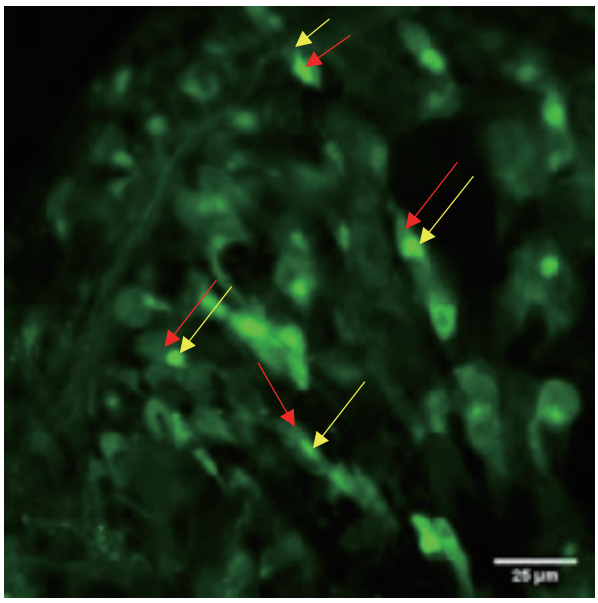

Figure 1. ERK-KTR biosensor in *Macrostomum lignano* red arrow points at the cytoplasm and yellow at the nucleus.

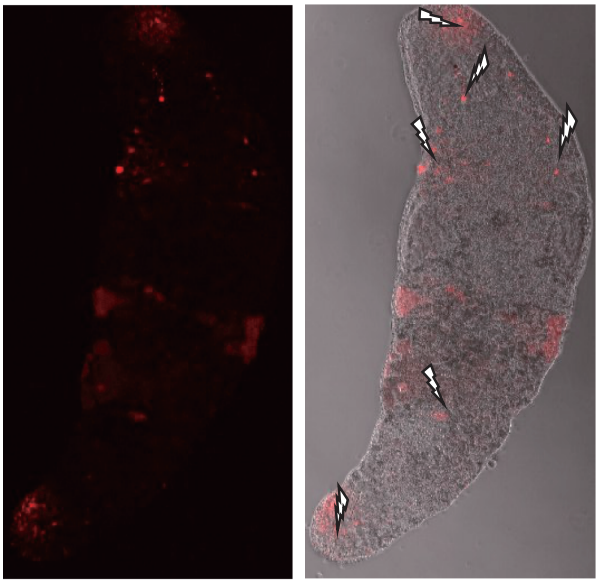

Figure 2. Expression of mScarlet under the HSP20 promoter 24 hours after induction using IR-LEGO. The lightning bolts point at the targeted sites.

Publication List:

〔Original paper〕

● Ustyantsev, K., Wudarski, J., Sukhikh, I., Reinoite, F., Mouton, S., and Berezikov, E. (2021). Proof of principle for piggyBac-mediated transgenesis in the flatworm *Macrostomum lignano*. Genetics *218*, iyab076. DOI: 10.1093/genetics/iyab076