Understanding the mechanisms of regeneration using transgenic flatworms

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 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 the 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 in the 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 in transgenic methods available for these animals. I am using Macrostomum lignano, an alternative flatworm model, to test the function of genes shown to be involved in the positional control during growth and regeneration. M. lignano is a free-living flatworm capable of regenerating its whole body as long as the brain region remains uninjured. During my PhD I have established a robust transgenesis protocol for this worm, based on the microinjection of single cell eggs, making it the only regenerating flatworm with this technique available, and an ideal candidate to answer the biological questions regarding positional control of regeneration.

参考文献