

Science and Technology Group Annual Report FY2015

Garth Ilsley
Science and Technology Associate

1 Introduction

The past year has led to the completion and publication of modelling work in *Drosophila*, as well as the completion of single-cell RNA-seq analysis in *Ciona*. In addition, with the Luscombe Unit, we have established a stable culture of *Oikopleura dioica* at OIST.

2 Activities and Findings

1. Modelling transcriptional enhancer function in *Drosophila*

In collaboration with Justin Crocker and David Stern, we have completed and published our analysis of the regulatory function of *even-skipped* and *rhomboid* enhancers in *Drosophila*. We validated the results of model predictions of enhancer function with experimental perturbations, particularly those using transcription activator-like effectors fused to activators or repressors (TALEAs and TALERs).

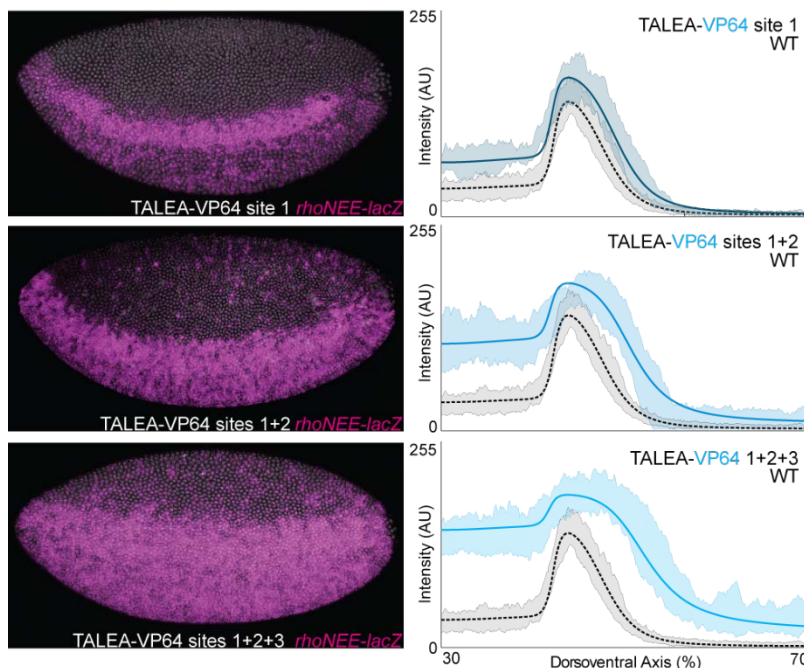


Figure 1: Comparison of experimental manipulation of the rhomboid enhancer (left and shaded areas on the right) with the modelling predictions (solid lines on the right). From Crocker, Ilsley and Stern. *Nature Genetics* (2016).

2. Single-cell measurements in *Ciona intestinalis*

It is important to have measurements of transcription factor levels and gene outputs at single-cell resolution. Spatially averaging transcription factor measurements obscures cellular state and hence limits the effectiveness of statistical studies of the regulatory inputs and outputs in the cell. Therefore, to understand gene regulation it is crucial to develop approaches for measuring gene expression at the single cell level.

I have finished RNA-seq analysis and generated a complete dataset of single-cell expression data at a specific stage of development in *Ciona*, a marine chordate. Experimental validation work by my collaborators in the Luscombe Lab is continuing.

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3. Establishment of *Oikopleura dioica* culture

Over the past few years, the Luscombe Unit has developed expertise and knowledge working with *Ciona*, an invertebrate marine chordate. Future experimental work will benefit from having an organism similar to *Ciona*, but with a shorter lifecycle. *Oikopleura dioica* is such an animal. With the help of the lab of Hiroki Nishida at Osaka University we have established a reliable culture of *Oikopleura dioica* at OIST.

3 Collaborations

Theme: Measuring gene expression with single-cell RNA-seq

Type of collaboration: Joint Research

Researchers: Luscombe Unit (OIST)

Theme: Establishing *Oikopleura dioica* culture at OIST in the Luscombe Lab

Type of collaboration: Assistance and guidance from experts in the field

Researchers: Takeshi Onuma, Tatsuya Omotezako and Hiroki Nishida (Osaka University)

Theme: Modelling transcriptional enhancer function in *Drosophila*

Type of collaboration: Joint Research

Researchers: Justin Crocker and David Stern (Janelia Research Campus, USA)

4 Publications and other output

Crocker, J., Ilsley, G. R. & Stern, D. L. Quantitatively predictable control of *Drosophila* transcriptional enhancers in vivo with engineered transcription factors. *Nat Genet* 48, 292–298 (2016).