PRESS RELEASE

Zebrafish Study Sheds Light on Potential Effect of Global Warming on Fish Populations

24 January 2017, Singapore – Temasek Life Sciences Laboratory (TLL) is pleased to announce an interesting discovery on how heat influences the genetic regulation of sexual development in fish. The findings provide insights into the interplay between genetic and environmental control of sex in zebrafish and indicate potential effects of global warming on natural fish populations and potentially other vertebrates.

The TLL team was led by Professor László Orbán and they conducted these studies in collaboration with the team of Professor Francesc Piferrer (Institute of Marine Sciences, Barcelona). Their findings are published today in the Proceedings of the National Academy of Sciences of the United States of America.

Using the zebrafish model, the researchers found that exposing juveniles to elevated temperature can alter their sex, resulting in a disproportionate number of males, since the heat treatment forces some of the genetic females to differentiate into males (neomales). Data from several families of zebrafish showed that the degree of masculinization as a response to elevated temperature is family-dependent. Among the heat-exposed zebrafish the scientists found individuals with female anatomy and ovary, but a testis-like gene expression profile. This showed the possibility of major reprogramming of gene expression while still maintaining the organ structure.

Evaluating the effects of temperature on sexual development is important for understanding the potential impact of environmental factors on vertebrate reproduction. The discovery of highly heat-sensitive zebrafish families and the presence of “undercover” males disguised as females means that we might need to rethink our strategy of how we assess the effects of elevated temperatures on fish sex in a scenario of climate change. If heat affects natural populations of zebrafish and possibly even other fish species in a similar manner, then we might be currently underestimating the effects of global warming.

Fish account for over half of the living vertebrate species and are well known for having a very plastic sexual development and exhibiting various forms of hermaphroditism. An example is the Asian seabass (*Lates calcarifer*), a tropical food fish cultured throughout the Asia-Pacific region, which is a protandrous hermaphrodite that first matures as a male, produces offspring with female partners for a period of time and then changes its sex to become a female. The regulation of this natural sex reversal is unknown but could also involve thermal effects. Prof Orbán’s team hopes to leverage on these findings to perform a detailed analysis of this process in the seabass.

Prof Orbán says, “With these data, we have opened up a window into an exciting research area. We hope that one day we will be able to utilize this knowledge for controlling the sex ratios of farmed fish stocks in a clean, hormone-less manner."

Mr Peter Chia, Chief Operating Officer of TLL says, “Rising temperature may cause climate pattern to change and this could have a direct and adverse impact on all of us. Some of our research programs at TLL are designed to find solutions to help mitigate the potential long-term effects of environmental change. In line with TLL’s mandate, this study will help to deepen our understanding on the environmental influences and their

effect on living organisms and could possibly provide better strategies to safeguard farm productivity leading to better food security."

About the Temasek Life Sciences Laboratory (TLL)

TLL, established in 2002, is a beneficiary of the Temasek Trust and affiliated to the National University of Singapore and Nanyang Technological University. The research institute focuses primarily on understanding the cellular mechanisms that underlie the development and physiology of plants, fungi and animals. Such research provides new understanding of how organisms function, and also provides foundation for biotechnology innovation. For more information, please visit www.tll.org.sg.

About the Institute of Marine Sciences (ICM)

The ICM, established in 1951 and located in Barcelona, is the largest marine research institute in Spain and one of the most important in the Mediterranean region of Europe. It belongs to the Spanish National Research Council (CSIC) and is entirely devoted to various aspects of the study of the oceans. With more than 200 specialists in different fields, it provides a broad vision of aquatic life and the marine ecosystem at different scales. The major focus of its research is on the assessment of changes and human impacts on the environment. For more information, please visit: www.icm.csic.es.

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