



LATEST NEWS

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MULTIPLE SEX CHROMOSOMES IN FISH ATTRACT THE SCIENTISTS' ATTENTION

Last year's publication of an updated list of fish sex chromosomes describing the huge variation in different types of sex determination in fish has captured notable attention of the biology and biochemistry community. The work showed that the most well-known XY sex-determination systems, involved also in the determination of sex in humans, and their derivatives have a lower rate of degeneration than the ZW systems. They are therefore more malleable and leave more room for evolutionary processes. The database, created by the scientists from the Institute of Animal Physiology and Genetics CAS in collaboration with colleagues from the University of São Carlos in Brazil, provides fundamental information in the field of evolutionary biology that can be used in conservation genetics and aquaculture as well.

Fish as champions in various types of sex determination

Fish belong to the group of vertebrates with the widest range of sex determination mechanisms, from genetic to environmental factors. "We have put together an updated system of all fish with sex chromosomes and noticed that the number of multiple sex chromosomes, where males have a unique Y sex chromosome that is absent in females, is significantly higher than the number of those, where females have a unique W sex chromosome that is absent in males," describes Alexandr Sember from the Institute of Animal Physiology and Genetics CAS his study results. "In addition, we have found that XY sex-determination systems or their derivatives have a lower rate of degeneration than ZW sex-determination systems, which, on the other hand, degenerate rapidly and are therefore less likely to switch to another system," adds Alexandr Sember. Thus, it seems that the XY systems are more variable and capable of leaving more room for evolutionary processes that can lead to the development of new sex-determination mechanisms and result in the emergence of new species as well as entire evolutionary lineages.

Why knowing the mechanism of sex determination proves to be of importance?

Genes can determine whether an offspring will be male or female, most often due to the presence of sex chromosomes or certain environmental factors such as the water temperature during gonad maturation in embryos. A detailed description and understanding of how different fish species determine sex can help us with wildlife conservation. As a matter of fact, climate change challenges and other effects can drastically impact the survival of certain fish species. The knowledge of sex determination is likewise used in aquaculture. *“It is therefore quite clear that this research area is receiving close worldwide attention and, in addition to our direct outputs, our updated data on fish sex chromosomes can serve as ideal benchmark data for numerous future studies in this area,”* says Alexandr Sember, explaining the importance of the study.

“The diverse range of sex-determination types in fish includes also 75 cases of multiple sex chromosomes.”

We humans are only familiar with the genetic system of sex determination by XY chromosomes, with males having a different Y chromosome. However, this is not the case in many animals and plants, where the unique sex chromosome is instead found in females. This constitutes the ZW system, that determines the sex of offspring in birds and most butterflies, for example. *“Fish have an unprecedented ability to create new sex chromosome systems, including those with more than two sex chromosomes in the system,”* says the Head of Laboratory of Fish Genetics Petr Ráb. That is the reason behind a huge variety of ways in which sex is determined in fish, even at the level of closely related species or populations of the same species. *“It is therefore important to comprehend the ways in which sex chromosomes can evolve in fish and how this affects, for example, the ability of individuals from different populations to reproduce. It is the different number of sex chromosomes that can prevent reproduction between populations of the same species, purely because they do not fit together, just like a lock does not open with a wrong key,”* says Petr Ráb of the need to understand the role of sex chromosomes in nature.

The publication appeared in the prestigious scientific journal *Philosophical Transactions of the Royal Society B Biological Sciences* and received close attention from the scientific community in its very first of publication. The article was named Hot Paper in the Web of Science, the most famous database of scientific publications, identifying it as a key work of impact on the future direction of research in the field of biosciences. Only the top 0,1% of all publications in a given field receive this designation.

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Photo gallery:

Fig. 1: The *Nothobranchius* killifish represent a group of fish with the highest number of multiple sex chromosomes. Whereas *N. lourensi* (pictured) boasts multiple X_1X_2Y sex chromosomes, another species in this group, a well-known model species in research of aging (turquoise killifish, *N. furzeri*), has an XY sex chromosome system. Photo: M. Reichard.



Fig. 2. Karyotype of *Nothobranchius lourensi* killifish with multiple X_1X_2Y sex chromosomes. Photo: A. Sember.

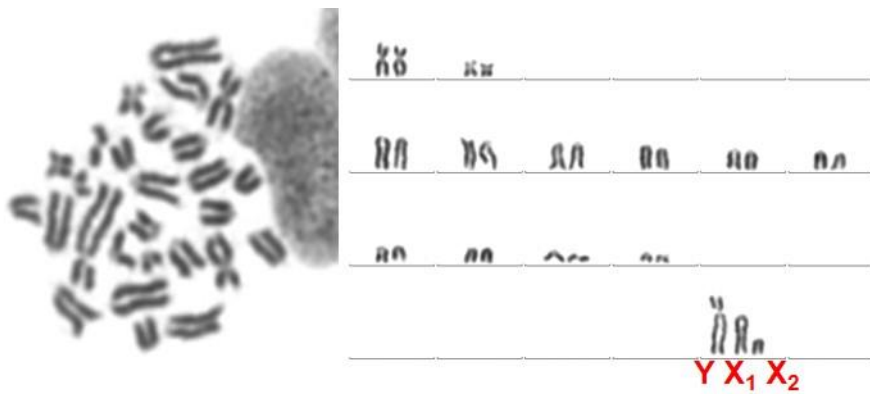


Fig. 3 Infographics

