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Axel Meyer - Fish keep the secrets of evolution

Axel Meyer, biology professor at Constance University, has an unusual namesake: A rare frog that lives in Madagascar. This did not happen by chance: Former colleagues named the species "Boophis axelmeyeri" after Axel Meyer in appreciation of the productive and friendly atmosphere in Meyer's laboratory. Meyer works with fish in order to unleash the secrets of evolution.

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Meyer's laboratory at Constance University is packed with fish kept in an aquarium and there are one hundred additional aquariums in the animal research facility. Meyer, who is now 47, owned his first aquarium when he was 10 years old. "I have always liked fish," said Meyer who went on to study biology and do his doctorate in Berkeley on the differences between fish living in a Nicaraguan crater lake. He did his postdoctoral training in biochemistry at the University of Berkeley, before accepting a position as professor of evolutionary biology in New York. In 1997, 15 years later, Meyer returned to Germany where he became a professor at Constance University. His interest in fish persisted.

Meyer quickly became research manager and team coordinator of his new laboratory, working with 20 scientists from up to eight countries. There are two new scientists currently expected at Meyer's laboratory – one from Canada and one from Finland. One of his assistants is from Japan. Meyer has been extremely successful in his field, evident from the framed front pages of renowned journals such as Science and Nature on his office wall. Once a year, Meyer heads off on an expedition either to Lake Victoria in Africa to catch cichlids, to Nicaragua or to some other exotic location where fish can be found.


Prof. Dr. Axel Meyer (Photo: Frank van Bebber)

"Fish are an important evolutionary model system," said Meyer who is interested in the evolution of the genome, the organisation of the genome and functional changes of genes. The fish genome is no simpler than that of land animals. Meyer uses DNA sequencing and DNA chip technology to decipher the fish genome, to prepare genomic maps of fish that provide information on the genes that give a fish its golden colour or its stripes.

Lake Victoria as evolutionary playground

Fish have many advantages for biologists: for Meyer and his team, the lakes are nature's own oversized test tubes. Many animals have been cut off in such lakes for thousands of years and have thus been protected from the influence and fresh genes of other species. The evolutionary trees can be traced back to other river and lake systems. The precise evolutionary trees of cichlids from Lake Victoria are what led to Meyer, one of his former colleagues, Walter Salzburger, and two Belgian colleagues being on the sought-after Science front page.

"In the large East African lakes, the development of a new species happens very fast," said Meyer explaining that something that otherwise takes millions of years to develop only takes a few thousand years in these lakes. The researchers are enthusiastic about Lake Victoria with its 500 different cichlid species, calling it the "playground of evolution". Geologists previously thought that the lake had dried out 15,000 years ago. If this had been the case, the manifold species would have developed within this narrow timeframe. But in fact this turned out to be an incorrect assumption as biologists subsequently found that the genome of the cichlids from Lake Victoria had similarities with that of Lake Kivu fish from which the first Lake Victoria fish originated approximately 100,000 years ago.

Evolution of a species in less than 10,000 years

Such findings not only contribute to basic knowledge, but are also of practical importance. It is now clear that Lake Kivu is an important site of genetic heritage. The people living at Lake Victoria were very surprised to see strange European men interested in small fin segments rather than in the tasty flavour of the fish. The fin segments were taken to Constance where they were used for further DNA analyses.


A crater lake in Nicaragua (Photo: Axel Meyer)

The Meyer laboratory regularly publishes important news: In the case of a crater lake in Nicaragua, where Meyer had already collected material for his PhD thesis, DNA analyses showed that new species were able to develop in a confined habitat – even though all the fish were in contact with each other. Without separation and in less than 10,000 years a new species developed in the five-kilometre-wide lake. Species normally develop as a result of geographic isolation, as was reported last year in the journal Nature.

While the Nicaraguan and African cichlids revealed their secrets through genetic analysis, Meyer and his colleagues discovered another secret of evolution in Mexican swordtails. They found that a new species developed from the fact that swordtail females preferred males with the longest swords. This meant that even females belonging to swordless species preferred the sword-bearing males of other species. The evolutionary tree showed that approximately two million years ago the crossing of two species led to a new one. So females from the swordless species and males from the attractive sword-bearing fish produced progeny that eventually led to a new species with swords. This is an example of what is known as hybridisation, which has previously been regarded as of minor importance in the development of new species.

Meyer is convinced that there are many evolutionary puzzles to solve and is planning his next expedition to Nicaragua in November.

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