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EVOLUTION

A fishy tale of adaptive radiation

The accrual of genetic variation in periods of relaxed constraint has permitted the rapid evolutionary diversification of African cichlids by various evolutionary mechanisms, report the authors of a new study. More than 2,000 species of morphologically diverse cichlid fish exist in a variety of ecological niches, with most of these species found in the East African lakes. Cichlids are known to have undergone species radiation, whereby a single lineage diversifies into many species in a relatively short period of time. In an effort to elucidate the genetic mechanisms that underlie this extensive diversity, Brawand *et al.* sequenced the genomes and transcriptomes of five lineages of cichlids, including the Nile tilapia (*Oreochromis niloticus*; the ancestral lineage) and four species from the East African lineage.

The genomes provide evidence for a burst of gene duplications in

the East African lineages, and many of the duplicate genes had altered tissue-specific expression that provides support for a gain of new functions in these species. Furthermore, there is evidence from the sequenced genomes for the accelerated evolution of protein-coding genes. For example, genes that encode proteins involved in colour vision and the bone morphogenetic protein (BMP) signalling pathway (which has been linked to jaw development) showed an increased number of nonsynonymous versus synonymous variants, indicative of accelerated evolution.

The researchers also investigated mechanisms involved in gene regulation. Transposable elements (TEs) constitute almost 20% of East African cichlid genomes, and the insertion of such elements throughout the genome was found to have occurred over three waves of TE insertion events. Insertions near 5' untranslated regions (UTRs)

were associated with increased gene expression in all tissues, whereas TE insertions in 3'UTRs were associated with increased expression in all tissues apart from brain and skeletal muscle tissues. Interestingly, 40 new microRNA-encoding genes were also identified with very similar patterns of expression to the genes they are thought to regulate.

Sequence data from six closely related species in Lake Victoria show that selection occurred frequently on ancient variants. The researchers hypothesize that the variety of changes might be linked to a time of relaxed constraint that occurred prior to the radiation process, which allowed the accumulation of genetic variants, therefore highlighting the importance of standing variation in charging genomes for rapid adaptive radiation.

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ORIGINAL RESEARCH PAPER Brawand, D. *et al.* The genomic substrate for adaptive radiation in African cichlid fish. *Nature* <http://dx.doi.org/10.1038/nature13726> (2014)

WEB SITE

Ole Seehausen's web site: http://www.fishecolology.ch/index_EN