NEOTROPICAL CICHLIDS:

ADAPTIVE RADIATION VERSUS GENETIC CONSERVATION

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EXTENDED ABSTRACT ONLY – DO NOT CITE

Cichlids are amongst the most diverse group of fishes. Approximately 1400 species are found distributed across Africa, including Madagascar, South Asia, South and Central America, and the southern part of North America (Kullander & Nijssen, 1989). They are considered a monophyletic group and have been extensively studied because they constitute an outstanding example of adaptive radiation. Chromosome, enzyme (alozyme) and molecular studies have demonstrated a remarkably low level of genetic divergence (or genetic conservancy) in contrast with the high rate of speciation in the whole group of cichlids (Kornfield, 1984; Feldberg and Bertollo, 1985). Comparative studies suggest that neotropical riverine cichlids present faster molecular evolution than tropical lacustrine cichlids (Farias et al., 1999). On the other hand, both neotropical and tropical assemblages are described as plastic groups, adapted to particular niches resulting from fast evolutionary rates, differentiating them from other teleost groups (Kornfield, 1984; Stiassny, 1991).

The family Cichlidae is among the most advanced teleosts that occur in the Amazon basin. Their adaptive radiation includes strategies to perform aquatic surface respiration, which is an innate behavior that is easily observed in young specimens. Our studies have shown that some species reduce the number of incursions to water surface and increase their anaerobic glycolytic power during growth. This capacity is achieved because there is an increase in the mass specific LDH levels. Changes in the distribution of LDH isozymes in the brain and heart of several Amazon cichlid species help to improve their hypoxia survivorship. Such ability to regulate the enzyme (isozyme) expression has been explained as the result of gene regulation obtained by their phenotypic plasticity (reviewed in Almeida-Val et al., 1999).

Analysis of enzyme/isozyme tissue distribution has been an excellent tool to verify genetic heterogeneity among populations and to determine the amount of species variability. Molecular DNA sequence studies are also used to establish genetic similarities or divergences and have proved to be successful in the analysis of phylogenetic relationship among groups. The neutrality of natural polymorphism and their adaptive character still remain controversial. However, there is no doubt about the fact that evolutionary rates are measured based on nucleotide substitution rates. On the other hand, when studying a group evolution, one may consider that such nucleotide substitution rate may vary depending upon the gene (or group of genes) used to describe genetic divergence between species and so the amount of evolutionary rate suggested to that particular group. From literature, we know that genetic variation, obtained after alozymic studies, varies in number of polymorphic loci. For example, insects may reach 50% of genetic variability, while mammals retain only 20%. Fishes, amphibians and reptiles are all intermediate, and the lowest level is found in avian group with 15 % genetic variability. It is also clear that DNA substitution rates are different among mitochondrial and nuclear genes.
We have analyzed enzyme/alozyme distribution in 14 Amazon cichlid species belonging to different lineages: *Symphysodon discus*, *Heros sp*, *Uaru amphiacanthoides*, *Pterophylum scalare* (Heroines), *Cichlasoma amazonarum*, *Cichlasoma sp*, *Acaronia nassa* (Cichlasomines); *Satanoperca jurupari*, *Geophagus altifrons*, *Geophagus sp*, *Acarichthys heckelli* (Geophagines), and *Cichla monoculus*, *Astronotus ocellatus* and *A. crassipinis*,*(*these three are all related but do not fit in any lineage) (Farias et al., 1999) .
Our results can be summarized as follows:
lactate dehydrogenase (LDH) presented no polymorphism in all analyzed species and its tissue distribution is according to the distribution of this enzyme in advanced teleosts;
glucose phosphate isomerase (GPI) was polymorphic in 9 species;
alcohol dehydrogenase (ADH) did not present polimorphic loci; and

malate dehydrogenase (MDH) presented duplicated MDH-B* locus in all analysed enzymes.

Except by the GPI system, in which polymorphism levels are in accordance with the literature for teleosts, these data show a high level of structural gene conservancy, independent of polymerization number, which are considered to be another determining factor for polymorphism occurrence.
Even though these results are preliminary, such low genetic variability contrasts with the high speciation levels among riverine neotropical group and other molecular and enzyme analysis, which have suggested high evolutionary rates. Considering our previous results about gene regulation under environmental changes and the present data, we can suggest that, at least for Amazon cichlids, genetic variability in structural genes may not be considered a requirement for adaptive radiation, and that their specialization levels will depend upon regulatory mechanisms that allow them a high degree of phenotypic plasticity.

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