

## Aquisition of extreme performance: adaptive mechanisms and evolutionary patterns

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One of the aspects of biology that intrigued Karl Liem was that of energy transfer in biological systems, where evolutionary transformations mould existing designs into efficient machines with highly specialised feeding structures. The core function of these structures is to obtain nutritional mass to generate that energy with minimal energy expenditure. It is thus not a surprise that evolution of heterotrophe lineages is largely characterised by changes in the cranial system (for food uptake) and postcranial system (for catching food or avoiding to becoming food). One of the paradoxes studied by Karl Liem was that of evolutionary specialisations which allow the occupation of unoccupied niches, but which at the same time may constrain ecological versatility (and hence make organisms vulnerable to extinction). That this does not necessarily constrain functional and hence ecological versatility had been demonstrated in cichlid fishes by Liem (and more recently other biologists). However, one aspect that remains intriguing is that of extreme morphologies. The cranial system in vertebrates seems to be susceptible to far reaching morphological transformations, assumed to be related to extreme but constrained functional performances. In this presentation, this hypothesis, and some associated ones, is tested using some examples derived from the recent literature. What becomes clear is that the favourite topic of Karl Liem, *i.e.* the craniate trophic system, is a very suitable system to test hypotheses related to extreme performance. Yet, the relation with extreme morphologies is not as clear as might be assumed a priori.