

# Origin of the Ciliate Macronucleus

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## SUMMARY

The macronucleus in ciliates has uniquely evolved, but no view or model reasonably explaining its origin has been proposed. All ciliates examined to date retain many micronucleus-specific DNA sequences, which are called internal eliminated sequences (IES). Those IESs are thought to have originated from certain transposons, suggesting that ancestral ciliates suffered from a large-scale of transposon invasion into their genome and faced a severe crisis in survival. A scenario of how ancestral ciliates evolved the macronucleus is presented herein. According to Orias's evolutionary model of ciliate cell structure (1976), the ancestral ciliates appear to have been multinucleate with homonuclei because ciliates might have evolved from colonial flagellates through cell fusion. To escape the crisis, ancestral ciliates might have excised the invaded transposons by transiently increasing transposase activity in some nuclei, with subsequent addition of telomeres to protect re-integration. This invariably led to fragmentation of chromosomes, engendering the loss of replication origin and centromere on each mini-chromosome. Such changes were prohibited in the remaining nuclei, resulting in maintenance of the capability of mitosis, but abandoning gene expression. The former nondividing nucleus corresponds to the karyorelictid macronucleus, although the latter inert nucleus corresponds to the typical ciliate micronucleus.