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Revision of morphological trends and mechanisms in the evolution of the *Zaphrentis delanouei* group of the Vale of Glamorgan, South Wales, UK.

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Species of rugose coral in the *Zaphrentis delanouei* group have been logged along the coastline of the Vale of Glamorgan in South Wales, UK. Data are collated, relating to their geographic distribution and stratigraphic occurrence, within the Friars Point formation of the Black Rock group in the Lower Carboniferous limestone series.

Evolutionary trends in the *Z. delanouei* group are examined using a range of mathematical methods, that include Markov Chain analysis and Branching Processes with immigration modelling and statistical methods including Z-test, T-test, and hypothesis testing. The palaeontological methods involve detailed morphological examination, morphometrics, three-dimensional tomography, and subsequent reconstructions.

Results show that several morphological changes are related to evolutionary mechanisms and by extension to the evolutionary trends that are both consecutive and concurrent and reveal a new phylogenetic tree of maximum parsimony. Although many morphological features are homologous, there remain two distinct branches in the phylogenetic tree with an analogous change in cardinal fossulae.

From these geostatistical and geobiological results, a few different conclusions were reached. Firstly, the shape of the cardinal fossulae remain either open or closed from an early stage in the morphological development of a Zaphrentis corallite and made independent emergences at a late stage in the evolutionary tree. This is possibly due to the development of the corallite, macroevolution, and environmental parameters and natural selection. Secondly, the coexistence of multiple species within the *Z. delanouei* group weighs heavily against previous hypotheses of consecutive only evolution because of the presence of at least one concurrent biozone logged across the Vale coast.

Finally, it is intended to construct monographs and morphometric schemes that document the three-dimensional structure of the group, to further understand the ontogeny, phylogeny and evolution of the *Z. delanouei* group with the view to understand fully the geobiological mechanisms that moulded their shape and yet ultimately caused their demise.