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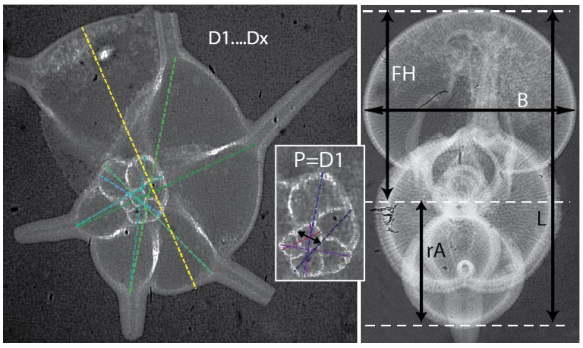

Plankton life-history reveals adaptions to Cenozoic climate change

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The life history of an organism, including birth, growth and life span, is critical for optimizing survival and reproduction in the face of ecological challenges and, thus, is central to evolution and adaptation. The fossil record repeatedly documents evolution prompted by environmental and climate disruption. However, capturing relevant parameters for documenting life history evolution is more problematic because a fossil typically represents a static snapshot rather than an individual's journey through life. If the environment an individual experiences changes, we might expect those individual life histories to respond. Modern imaging technologies enable such comparisons in deep time. Here we leverage such advances and the fossil record of planktonic foraminifera to investigate how life history responded to the mid Eocene Climatic Optimum, a transient warming event, and the subsequent resumption of the dominant climatic cooling trend that culminated in widespread glaciation of Antarctica 34 million years ago. We show how embryonic life stages, represented by the proloculus (first formed chamber of a multichambered shell), in the prominent Eocene lineage *Hantkenina*, doubled in size from the warmer to the cooler climate state while relative growth rate decreased yielding no detectable change in overall size. Migration from a mesopelagic to mixed layer thermal niche preceded the morphological changes, suggesting climate-forced pelagic restructuring drove the evolutionary changes in life history. We apply a similar approach to a Pleistocene case. Preliminary results for the *Turborotalita quinqueloba*-plexus from Marine Isotope Stage 11, find a significantly larger proloculus size (embryonic-stage), tied to invasion of the group into the Central Arctic Ocean during a prolonged interglacial. Our results emphasize the benefits of identifying appropriate study groups and using technology to capture relevant parameters for life history evolution at micro and macro-scales. This will provide benchmarks for the capacity organisms have to adjust their life history in the face of climatic upheaval.