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Obtaining temperature data from the mid-Piacenzian warm period (mPWP) is of key importance in understanding the coming changes brought upon by anthropogenic climate change. The mPWP, a high-CO_2 world with a paleogeography similar to modern times, has been used to validate and improve climate model retrodictions. Validating climate models requires robust proxy data. Here, we increase the potential of this proxy database by showing that the extinct tellinid bivalve *Angulus benedeni benedeni* can be used for stable isotope-based temperature reconstructions. This species is found in the mid-Piacenzian sediments of the southern North Sea basin. Oxygen isotope and carbonate clumped isotope measurements on the shell of *A. benedeni benedeni* resulted in a mean annual temperature reconstruction of 13.5±3.8°C. This is 3.5°C warmer than the pre-industrial North Sea and in line with global Pliocene temperature estimates of +2-4°C above pre-industrial values. Oxygen isotope thermometry suggests summer and winter temperatures of 18.5±3.9°C and 6.4±3.9°C and a corresponding seasonal range of 12°C. This range should be regarded as a minimum. The preliminary clumped isotope dataset does not (yet) enable confident seasonality reconstructions, but we show that this is possible with a larger dataset. Sclerochronologic analysis showed that *A. benedeni benedeni* could live for up to a decade and likely experienced slower growth during winter. The pristine nature of the aragonitic shell material was verified through electron backscatter diffraction analysis (EBSD), X-ray diffraction and X-ray fluorescence. The various microstructures as obtained from the EBSD maps have been described, and they provide a template for pristine material against which potentially altered shells may be compared. The bivalve *A. benedeni benedeni* can be used to unravel marine conditions in the Pliocene North Sea basin at a seasonal scale, yielding enhanced insight into imminent western European climate conditions.