The integration of sedimentary facies analysis, ichnology and benthic mollusc quantitative paleoecology allowed to interpret factors controlling deposition of the Altavilla Milicia alluvial to marine succession, near Palermo, Sicily. Two major composite units are recognised, separated by an angular unconformity and internally subdivided into elementary depositional sequences. Calcareous nannoplankton biostratigraphy allowed to recognize the upper Pliocene and lower Pleistocene, a time interval that covers the onset of the Quaternary glaciation. The main asset of the succession is driven by tectonic compression and accommodation by transpressional faults, a regime that led to a change in the direction of fluvial sediment delivery, from axial to transverse with respect to the basin elongation. High-frequency eustatic changes have driven the formation of elementary depositional sequences. The upper Piacenzian is characterised by marine bioclastic strata, deposited during maximum flooding intervals of the two large composite units. Mixed carbonate-siliciclastic lithosomes show a good correlation with shallow marine shell-rich detrital carbonates of Northern and Southern Italy and with Mediterranean deep-water sapropel clusters, suggesting common climatic forcing. Some tropical species previously thought to disappear from the Mediterranean at around 3.0 Ma, are instead present in the upper Piacenzian of Sicily. The study suggests that the Pliocene macrobenthos with tropical affinities disappeared from different sectors of the Mediterranean at different times.