LETTER

Statistical and archaeological errors invalidate the proposed chronology for the site of Ksar Akil

Bosch et al. (1) report on a series of radiocarbon dates from the site of Ksar Akil, which they model and interpret within a Bayesian statistical approach. They highlight as most significant aspects of this work the indirect dating of "Ethelruda" (>45,900 cal B.P.), the purportedly modern human maxilla found at the interface between Middle and Initial Upper Paleolithic layers, and that of a modern human child, "Egbert" (~43,000 cal B.P.), from the Early Ahmarian phase. Both estimates are older than those of previous work (2). Although the conventional ^{14}C determinations appear to be accurate, with identical dating methodologies used in the Groningen and Oxford laboratories, the improper application of Bayesian statistics and a poor understanding of the site's 23-m-long stratigraphy falsify the interpretation of these results and the overall conclusions these authors reach.

There are significant flaws in the constructed Bayesian models. These include (*i*) the lack of consistent boundaries between phases, which renders the age estimates for both fossils erroneous (see below); (*ii*) the use of incompatible approaches (agreement indices and outlier detection) to assess model robusticity; Bosch et al. (1) report 118.2% model agreement when ~40–50% of their data are conflicting and rejected as outliers; and (*iii*) manual down-weighting and elimination of certain results to decrease their impact. In the final, highly sensitive model, 6 out of 12 determinations from critical levels XVIII−XVI were excluded manually and deemed as 100% outliers.

In a Bayesian age model, so-called boundaries are used to separate discrete phases (geological/archaeological strata, specific contexts). In most parts of the Bosch et al. (1) models, no boundaries were included, resulting in unrealistic posterior distributions. The most pronounced example is the omission of a start boundary at the base of model 1 (Bosch et al.'s figure 1). This renders the calculated age for Ethelruda a statistical artifact, a meaningless probability distribution grossly skewed back in time.

Bosch et al. (1) overlook the difficulties in correlating the 1930s and 1940s excavations at Ksar Akil. Instead, they merge results from all seasons in a single Bayesian sequence. In an archival section drawing (Peabody Museum), the excavators note clearly that Layer XVII of 1947 corresponds approximately to Layer XIX, or older, of the 1937–1938 seasons; hence the two sequences cannot be combined. Not surprisingly, all determinations from 1947 material (GrA-57599, GrA-54847, GrA-57598) appear older when compared to other dates from the same context. Instead of excluding them altogether, Bosch et al. favor these dates, while picking as "contaminated" and manually rejecting the five relevant determinations above and below Egbert. This practice, along with the lack of boundaries in this part of the sequence, too, pushes back the calculated age for Egbert by 3,000–4,000 y.

The estimated ages that Bosch et al. (1) present for Ethelruda, Egbert, and their associated layers are not reliable. Had these authors included all other available chronometric data (2) within a properly constructed and adequately informed Bayesian framework, these estimates would have been dramatically different.

Eminent prehistorian Francis Hours, described Ksar Akil as "the site where everything published is true." His words are all the more relevant today and reflect the sad reality surrounding the site and recent publications, such as ref. 1, centered around it. A simple reading of a complex sequence is unjustifiable when relying on secondary sources. Instead a comprehensive, integrating, and cautious approach is advisable.

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1 Bosch MD, et al. (2015) New chronology for Ksâr 'Akil (Lebanon) supports Levantine route of modern human dispersal into Europe. *Proc Natl Acad Sci USA* 112(25):7683–7688.
2 Douka K, Bergman CA, Hedges REM, Wesselingh FP, Higham TFG (2013) Chronology of Ksar Akil (Lebanon) and implications for the colonization of Europe by anatomically modern humans. *PLoS One* 8(9):e72931.

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