PNAS LETTER

Reply to Peng et al.: Chicken tessellation requires more pieces

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In our PNAS article (1), we analyze the appearance and dispersal of chickens across Eurasia. Numerous factors complicate the confident dating, species determination, and domestic status assignment of archaeological bird remains. To minimize the likelihood of accepting spurious claims for early chickens, we applied strict, conservative criteria. The presence of chickens at the Thai Neolithic site of Ban Non Wat (1650–1250 BCE) thus represents a minimum bound.

In their letter, Peng et al. (2) describe additional Chinese sites with reported chickens. Unfortunately, none of these meet our criteria. At the Inner Mongolian Dadianzi tomb, an earthen-constructed site of the Lower Xiajiadian Culture abandoned by 1500 BCE (3), Yuan (4) attributed the remains to chickens, based on cooccurrence with dogs and pigs. Morphological confirmation and direct dating, however, have yet to be carried out. Similarly, descriptions of remains at Caiyuanzi are not available (5) and thus cannot be evaluated.

At Dadunzi, the single bone was described as "possibly domesticated" (6). Nonskeletal remains have also been excavated, and, although pottery and bronze art objects from Dadunzi and other sites suggest closer relationships between humans and birds resembling galliformes, their species identification and dating are uncertain. The bronze rooster from Sangxingdui is generally accepted, but the specific context of this find (Pit K2) is dated to ~1200 BCE (7). This places the artistic evidence just after our earliest confirmed chicken bones.

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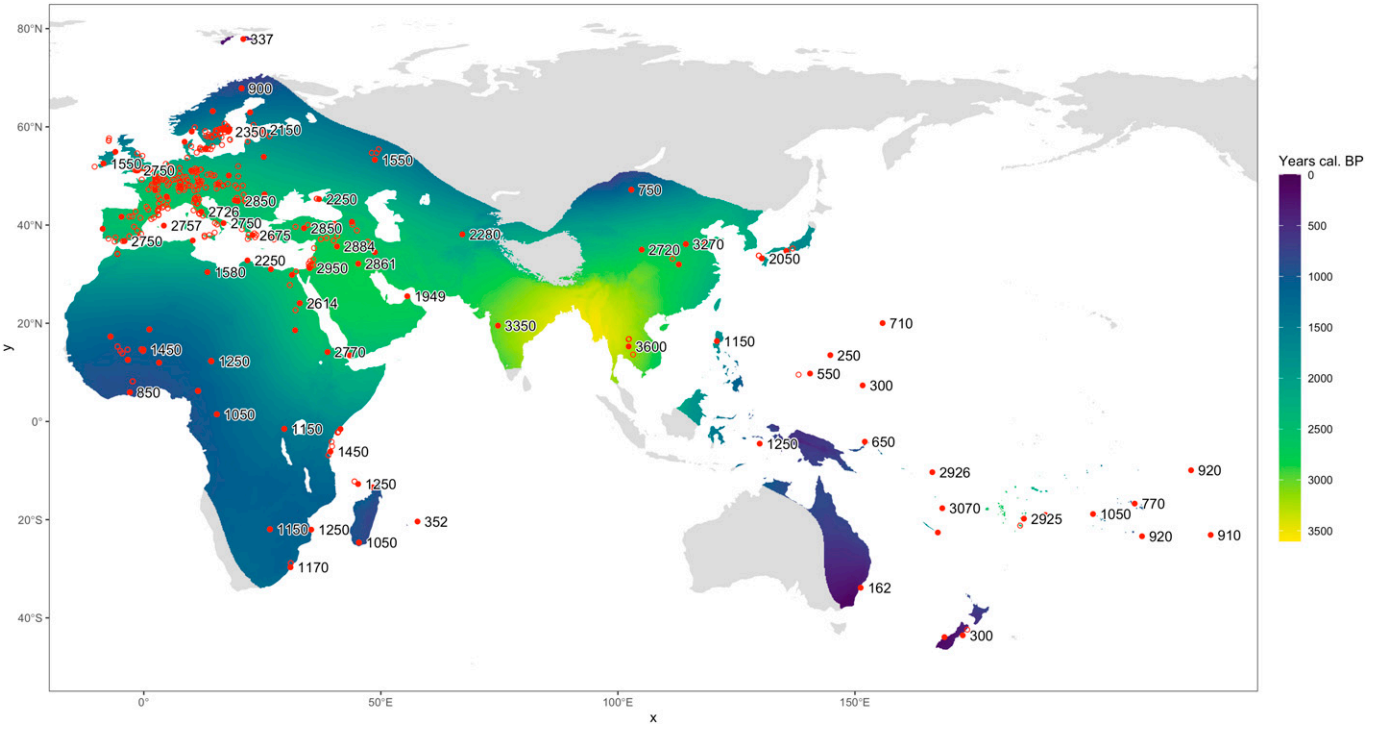

Fig. 1. A map depicting the earliest confidently assigned chicken remains across Eurasia, Africa, and Oceania alongside a spatial kriging interpolation of the timing of the arrival of chickens. The original map in our initial study (1) made use of the most recent end of the age ranges associated with the remains. This figure uses the oldest end of each age range, and this systematic inflation of the date estimates has no material effect on the interpolation.

Peng et al. (2) rightly point to Yunnan as a key region, since, as we note, the chicken ancestral subspecies *Gallus gallus spadiceus* is present. Agriculture was established here in 2600 BCE, based on a mixture of alluvial (wet) rice and rainfed millet (8). Based on our ecological coevolutionary model, the millet fallows would have provided potential commensal habitats for red junglefowl that wet rice did not. The predominance of wet rice over millet in Neolithic Yunnan datasets (8) therefore suggests that opportunities for these commensal pathways were present, but in a more limited fashion relative to peninsular Southeast Asia.

Lastly, Peng et al. (2) criticize our decision to use the lower limits of each chicken's age ranges on our map. A revised map using the upper limits of the age ranges (Fig. 1) does not materially affect the pattern of dispersal inferred in our spatial kriging analysis.

Earlier chicken remains will certainly be identified. As Peng et al. (2) suggest, that effort will be facilitated through simultaneous investigations of archaeology, anthropology, ecology, and evolutionary biology, and through international collaborations with experts from Southeast Asia and across the globe.

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