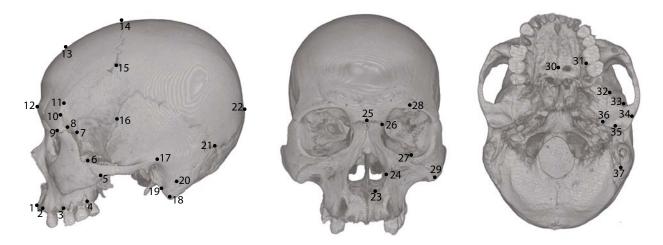
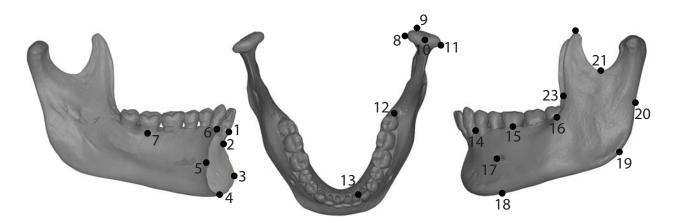
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Fig. S1. Cranial and mandibular landmarks. Starred ("*") landmarks are midline landmarks. All other landmarks are bilateral. While landmark data collection was bilateral, all analysis was performed on averaged hemiforms as a means to accommodate missing data. See Materials & Methods for details.



Cranial landmarks. 1 prosthion*; 2 external incisor margin; 3 premolar-molar margin; 4 M2-M3 margin (buccal); 5 zygotemporal inferior; 6 zygotemporal superior; 7 frontosphenomalare; 8 frontomalare temporale; 9 frontomalare orbitale; 10 temporalis anterior; 11 frontotemporale; 12 glabella*; 13 maximum glabella-bregma subtense*; 14 bregma*; 15 stephanion; 16 krotaphion; 17 radiculare; 18 inferior mastoid process; 19 anterior mastoid process; 20 lateral mastoid process; 21 asterion; 22 lambda*; 23 inferior nasal aperture; 24 alare; 25 nasion*; 26 nasomaxillare; 27 zygoorbitale; 28 orbital superior; 29 zygomaxillare; 30 palatomaxillary suture*; 31 M1-M2 margin (lingual); 32 sphenosquamosal suture; 33 temporal foramen posterior; 34 lateral mandibular fossa; 35 posterior mandibular fossa; 36 stenion; 37 posterior digastric groove.



Mandibular landmarks. 1 infradentale*; 2 incurvatio mandibularis*; 3 mental eminence*; 4 gnathion*; 5 mental spine*; 6 mandibular orale*; 7 lingual M2; 8 medial condyle; 9 posterior condyle; 10 condyle tip; 11 lateral condyle; 12 posterior molar; 13 I-C margin; 14 C-P3 margin; 15 buccal M1; 16 oblique line; 17 mental foramen; 18 inferior ramus; 19 gonion; 20 posterior ramus; 21 mandibular notch; 22 coronion; 23 anterior ramus.

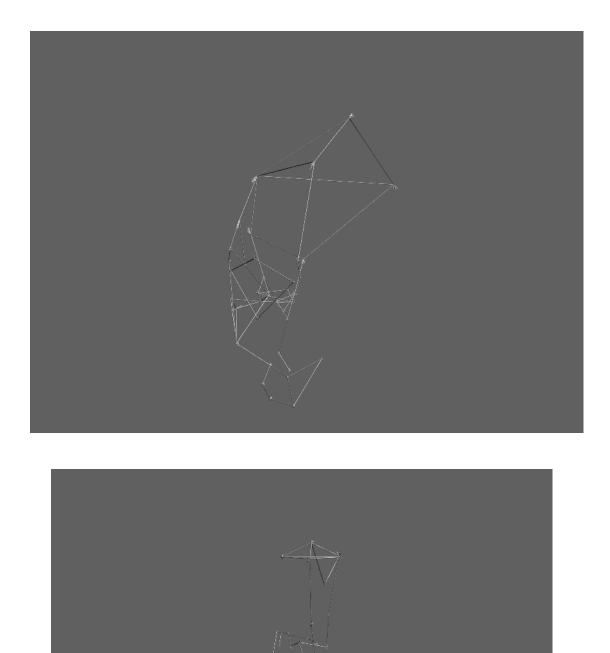
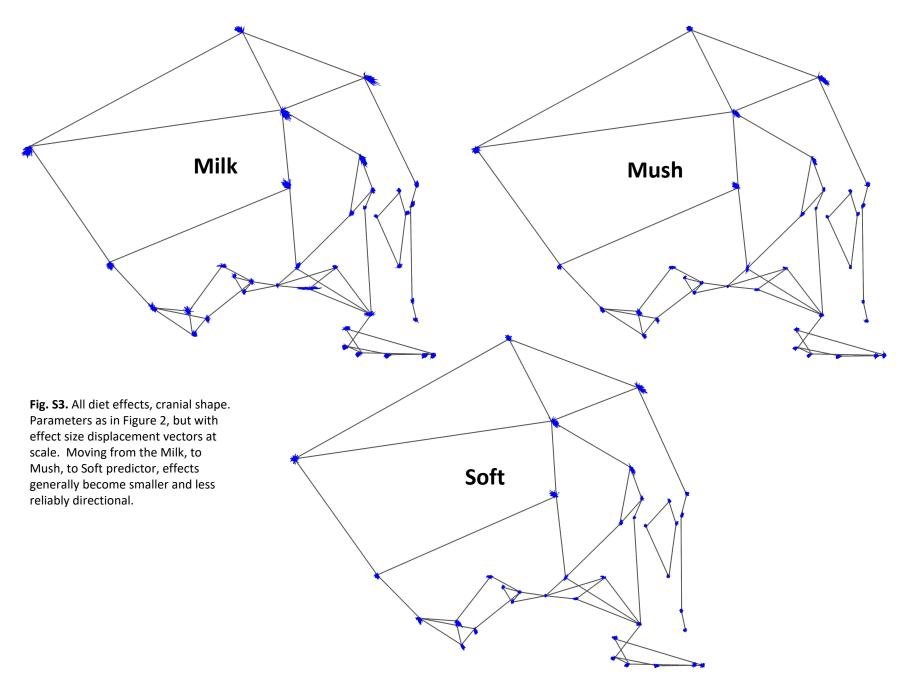
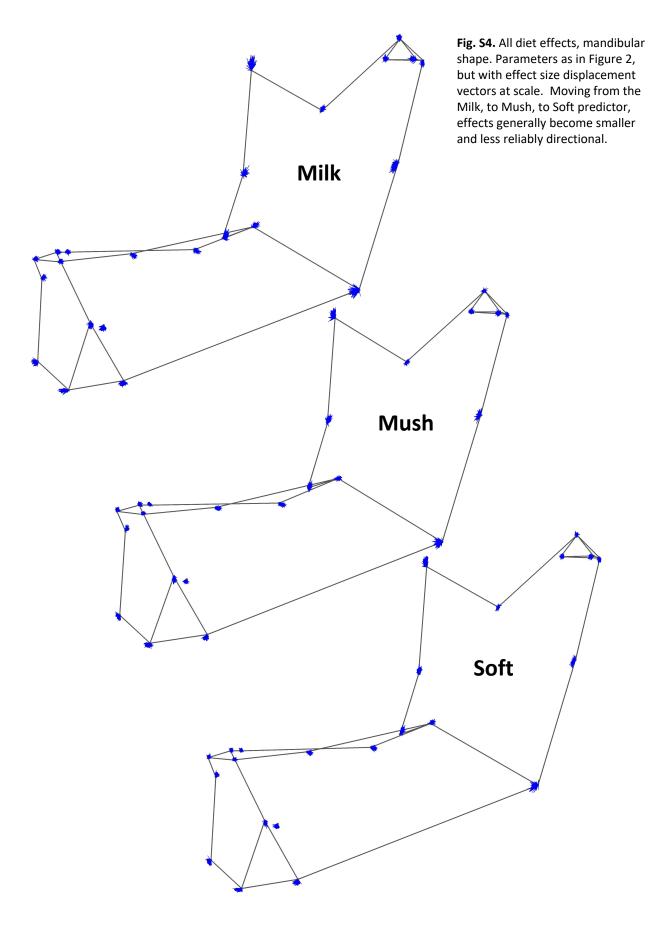


Fig. S2. Milk model diet effects, 3D shape. Landmark displacement vectors depict 50 realizations of the expected shape transformation across the agricultural transition, sampled with replacement from the posterior.

Wireframe and displacement vector thickness has been optimized for viewing in full screen mode. After activating scene, right click to select the full screen viewing option.





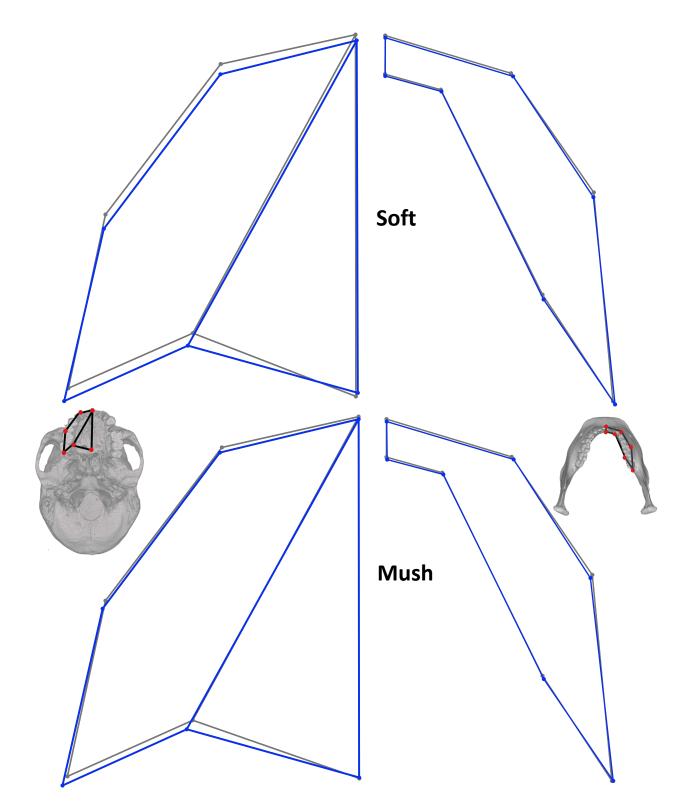


Fig. S5. Dental shape contrasts, Soft and Mush models. The reference shape is in gray; diet effect in blue.

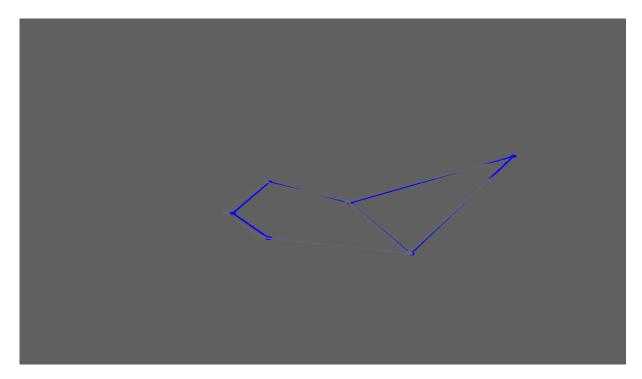


Fig. S6. Milk model maxillary dentition shape contrast, 3D. Reference (harder diet) configuration in gray; diet effect in blue. Wireframe and displacement vector thickness has been optimized for viewing in full screen mode. After activating scene, right click to select the full screen viewing option.

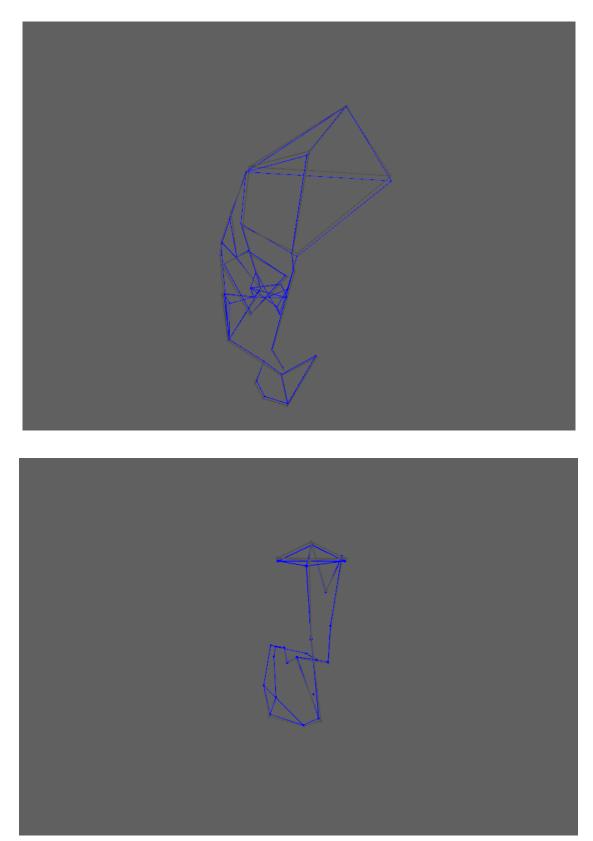


Fig. S7. Milk model mean contrasts, 3D form. After activating scene, right click to select the full screen viewing option. Reference (harder diet) in gray; diet effect in blue.

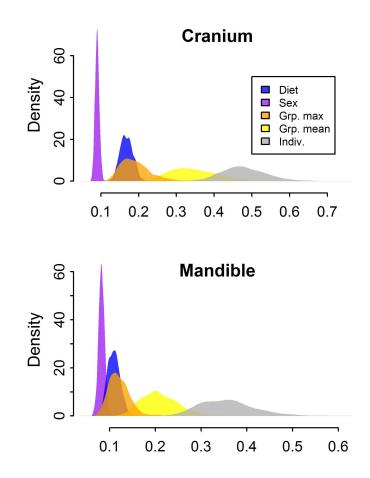
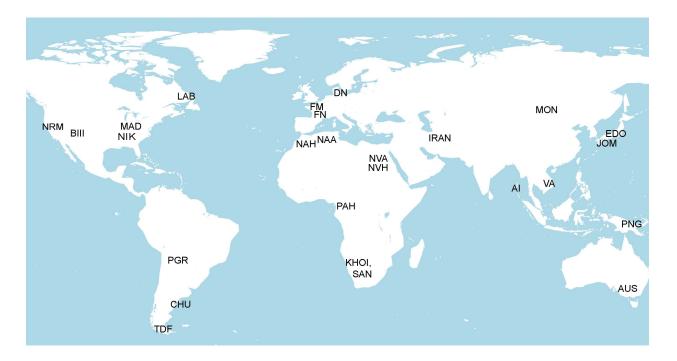


Fig. S8. Effect magnitude comparison, shape space. Densities are distributions of pairwise Euclidean distances for the Milk diet contrast, sex contrast, the contrast between two groups of average relatedness (approximately 0.5 for both the cranium and mandible) and between two groups of maximum relatedness (approximately 0.84), and the contrast between a pair of unrelated individuals from the same group. Each posterior sample contributes one contrast to each density.

5.93 22.89 6.97 12.96 11.02 14.82 12.37 7.51 12.67 12.41 13.88 16.07 8.84 7.26 16.33 15.84 12.61 15.82 14.36 11.01 21.63 9.85 23.74 26.15 11.38 30.45 15.68 8 30.16 13.57 25.79 28.99 26.28 28.65 21.49 15.91 13.82 21.66 27.38 27.73 14.14 7.24 24.93 13.47 26.24 21.34 26.54 30.84 24.33 -0.23 5.6 Ë 28.35 23.04 22.56 14.92 10.07 10.3 22.54 21.08 0.01 0.49 14.98 21.59 21.54 29.6 12.35 17.38 12.65 12.39 6.96 4.94 11.4417.21 9.28 8.87 1 20.43 -SAN 19.62 15.76 0.06 12.57 17.32 18.63 13.69 21.58 21.1 12.28 17.36 17.71 21.08 26.89 10.09 7.64 20.08 17.28 17.58 12.34 16.13 0.34 0.68 28.14 20.82 PNG 24.17 19.56 25.63 23.68 24.44 26.54 28.74 25.28 11.47 22.83 11.37 6.19 24.13 19.23 22.22 19.38 13.81 11.71 12.04 24.05 -0.13 0.08 28.05 0.77 PGR 0.3 9.27 18.74 18.26 7.25 18.24 10.68 13.08 8.09 7.25 7.14 12.91 10.62 6.89 16.78 4.96 0.15 ΗΛN 17.29 17.24 8.05 8.35 -0.22 0.48 0.71 25.3 0.63 10.31 18.37 10.26 7.14 17.87 16.93 16.87 6.77 12.54 17.89 6.78 16.41 24.94 7.69 12.71 7.99 7.73 7.61 9.68 0.84 0.23 0.49 0.16 0.64 ٨V 0.7 15.56 20.79 5.54 13.29 11.96 17.17 14.96 14.13 14.48 13.58 12.12 8.64 7.2 12.2 13.75 12.29 18.01 18.36 7.05 -16.87 19.28 0.46 NRM 16.9121.47 0.47 0.61 0.36 0.32 0.54 0.53 20.74 22.93 6.89 19.47 17.02 22.25 18.33 18.63 16.42 6.07 12.73 13.42 18.37 4.8 19.82 0.56 0.32 0.27 0.49 ХĬХ -0.77 0.42 0.41 0.63 12.26 4.91 8.71 26.88 9.63 14.66 9.93 9.67 7.9 10.62 20.32 -NAH 18.87 18.82 13.77 19.49 19.83 0.36 0.4 0.67 0.58 0.77 0.76 0.17 0.43 0.1 8.37 14.31 10.4 19.97 18.52 26.53 9.28 9.58 7.9 11.91 0.84 0.37 18.47 9.32 1 11.85 0.42 0.78 NAA 7.7 0.78 0.18 0.44 0.67 0.11 0.59 6.84 14.25 12.75 20.81 11.15 ~ 11.45 11.19 8.14 0.6 0.6 13.12 0.62 0.55 0.67 0.66 0.52 MAD MON 13.44 22.95 15.32 0.37 0.6 0.3 0.77 18.64 18.38 16.43 22.26 12.97 18.34 13.44 20.75 13.59 6.64 0.37 0.36 0.84 17.04 6.24 -0.55 0.27 0.55 0.49 0.77 0.42 0.41 0.62 0.32 23.43 14.08 15.06 18.83 13.93 19.13 18.87 21.24 16.92 0.54 0.34 22.75 7.93 0.78 0.35 0.78 0.72 0.39 0.55 0.25 0.48 0.47 ГAВ 8.64 17.52 0.4 0.3 17.6 20.64 13.44 13.74 15.4 13.5 4.79 13.48 10.37 0.78 12.58 -0.54 0.56 0.54 0.53 0.56 0.58 0.6 0.76 0.3 ΣoΓ 0.59 0.37 0.44 0.61 8.34 -IRAN 14.86 15.41 23.48 8.14 8.44 8.18 10.56 9.63 0.66 1 11.83 0.45 0.74 0.47 0.73 0.72 0.47 0.51 0.78 0.77 0.28 0.56 0.63 0.21 0.71 13.05 15.37 21.99 21.93 12.75 17.77 12.79 0.24 КНОІ 7.26 0.62 0.43 0.26 0.66 0.66 0.26 0.69 0.84 0.48 30 0.5 0.3 0.7 0.07 0.32 13.17 19.74 10.55 15.58 10.85 10.59 0.76 0.69 19.79 27.8 0.31 0.33 0.75 0.74 PAH -0.5 0.57 0.33 0.75 0.14 0.55 0.37 0.76 0.4 0.07 0.77 17.36 5.54 11.98 13.62 0.59 18.48 25.43 4.88 -0.73 0.69 0.66 0.15 0.6 0.56 0.39 0.4 0.64 0.7 0.4 0.45 0.75 0.74 0.22 0.44 0.6 ۲Ľ 17.63 13.88 12.24 25.69 18.74 5.46 -0.84 0.65 0.58 0.73 0.55 0.38 0.63 0.69 0.68 0.44 0.74 0.73 0.43 0.59 0.14 0.59 0.4 0.4 0.21 Ξ 8.88 13.74 12.42 20.49 13.58 0.56 0.58 0.55 0.49 0.66 0.55 0.52 0.56 0.59 0.76 0.42 0.84 0.56 0.77 0.54 0.61 0.38 0.59 0.44 0.31 EDO 25.39 11.94 17.33 0.82 0.6 18.44 0.56 0.82 0.66 0.59 0.74 0.39 0.41 0.69 0.45 0.75 0 4 0.6 0.15 0.56 0.64 0.7 0.41 0.74 0.22 Z 24.08 12.62 0.18 0.34 0.17 0.18 0.59 0.19 0.18 0.0 0.82 21.24 29.31 0.24 0.33 0.51 0.58 0.09 0.26 0.1 0.03 0.33 0.14 0.13 0.57 0.8 ЭHO 16.02 -0.59 0.44 0.36 0.29 0.59 0.74 0.43 0.5 0.8 0.59 0.39 0.82 0.45 0.44 0.35 0.56 0.52 BIII 0.6 0.44 0.4 0.8 0.63 0.3 11.26 0.56 0.31 0.05 0.55 0.39 0.36 0.29 0.52 0.56 0.26 0.28 0.39 0.28 0.33 0.45 0.44 0.09 0.75 0.02 0.64 AUS 0.4 0.4 0.4 0.3 0.48 0.57 0.73 0.72 0.43 0.45 0.74 0.6 0.45 0.65 0.26 0.67 0.19 0.61 0.5 0.5 0.67 0.51 0.22 0.61 0.6 0.63 0.71 0.61 0.81 ₹ MON MAD IRAN KHOI Mol NAA NAH NRM NVA NVH LAB PAH PGR PNG AI AUS BIII E ΒŪ ĬХ SAN ě Z Z 5

Table S1. Relationship matrix. The diagonal and lower triangle entries are the pairwise estimates of shared history between groups (elements of the relationship matrix, **A**). The upper triangle entries are estimates of pairwise delta-mu squared ($\delta\mu^2$) microsatellite distances. Population identifiers match those in Table 1.

Doc. S1. Sample Overview



Population	Region	ID	Milk M	lush	Soft	μ°C	C (f/m)	J (f/m)
San	Africa	SAN	0	0	0	20.1	15/13	12/9
Khoi Khoi	Africa	KHOI	ŏ	ŏ	ŏ	22.7	6/9	6/7
Gabonese Pahuin	Africa	PAH	Ō	Ō	Ō	26.5	13/8	2/1
Jebel Sahaba	Africa	NVH	Ō	Õ	8	26.2	0/0	10/10
Naqada & Qeneh	Africa	NVA				24.1	26/20	27/15
Afalou & Taforalt	Africa	NAH	Ō	Q	Ŏ	16.6	4/3	11/12
Protohistoric Maghreb	Africa	NAA		Ο		21.8	12/8	13/8
French Neolithic	Europe	FN				9.9	13/17	12/12
French Mesolithic	Europe	FM	0	0	0	11.3	2/0	6/3
Danish Neolithic	Europe	DN				7.7	13/16	10/14
Tepe Hissar, Hasanlu	Asia	IRAN				15.3	15/13	9/17
Andaman Islands	Asia	AI	Q	Õ	Õ	26.6	10/10	6/6
Man Bac	Asia	VA	Q	Q		24.2	_5/2	8/9
Edo	Asia	EDO	Q			15.1	15/14	15/12
Jomon	Asia	JOM	Q	õ	Õ	13.7	2/8	11/17
Mongolian	Asia	MON		Q		-1.1	14/15	11/14
Papua New Guinea	Oceania	PNG	Q	000	Q	25.9	13/14	14/14
Australian	Oceania	AUS	Q	Q	Q	14.3	13/14	13/13
Ryan Mound	N America	NRM	Q	Q	0000	15.1	11/16	14/18
Basketmaker III	N America	BIII	õ			5.5	14/9	11/11
Indian Knoll		NIK	Q	Q	Õ	13.6	12/14	10/16
Madisonville		MAD	Q			11.7	13/9 15/14	11/10
Labrador Inuit		LAB	Q	0	Õ	-1.1		12/13
Pampa Grande		PGR	õ			20.4 13.4	9/5 8/8	0/0
Chubut Valley		CHU TDF	8	8	Õ	3.6	0/0 15/12	0/0 11/8
ruegians	S America	IDF	0	U	U			
Total 288/271 265/269								

Diet variables are Milk, Mush, and Soft. Milk = dairying. Mush = cereal domestication. Soft = domesticated cereals and/or dairying. $\mu^{\circ}C$ = mean annual temperature. C (f/m) and J (f/m) are, respectively, crania and mandible samples sizes for females (f) and males (m). The remaining pages provide additional details about the sampled populations.

SUBSISTENCE PROFILES

The materials below provide a brief summary for the evidentiary basis for the subsistence variable assignments.

San

The San are a foraging culture from southern Africa. Subsistence varies among San groups, most prominently based on whether mongongo nuts are available in a respective region. Still, the proportion of animal protein in the diet is small and reasonably similar across San groups (1-3).

Khoi Khoi

The Khoi Khoi are coastal nomadic pastoralists who likely descended from San with the introduction of Middle Eastern livestock species by migrants or traders (2, 4). In summers, they largely subsist upon milk and butter from their herds (4). Foraging and hunting also contribute meaningfully to total caloric consumption (4, 5).

Gabonese Pahuin

There are few sources of data available on the subsistence of the Gabonese Pahuin. They are a Bantu speaking people. It appears most individuals maintain an agrarian lifestyle. Staple items are manioc, some maize, plaintains, yams, and groundnuts. Livestock is limited to small animals. However, the main protein source is bushmeat (6). Despite the presence of maize in the Pahuin diet, we have scored the population with a "0" in the cereals binary category (Mush). The diet appears to be highly diversified, not maize intensive.

Jebel Sahaba

The Jebel Sahaba skeletal population is considered to have been part of the Qadan culture, and dates to around 12,000 BP. The site is located just north of the Second Cataract of the Nile, on the eastern shore. More than half of the burials at the site show evidence of a violent death (7).

Late Paleolithic and Epipaleolithic subsistence along the Nile was based on hunting and foraging (8). Food items exploited included tubers and other plants, fish, shellfish, waterfowl, palm nuts, hartebeest, gazelle, wild cattle, and hippopotamus (8-13). Grindstones, sickle blades, and other tools suggesting extensive plant use are also present (7, 11, 12).

Naqada and Qeneh, Egypt

Naqada and Qeneh are both part of the predynastic Chalcolithic of Egypt (11, 14). The sites are just a few kilometers apart from each other on the Nile River in Upper Egypt, about 60 km north of Luxor (15, 16).

Naqada was inhabited for about from about 4400-3000 BCE. Aspects of subsistence and economy changed across these periods. However, throughout, diet included substantial inputs from domesticated plants, including cereals (wheat, barley, e.g.), domesticated animals (cows, pigs, goats, sheep), and wild plant and animal resources (11, 17, 18). Archaeological evidence for dairying is strong. However, isotopic data does not always support high levels of meat or dairy consumption (compare: 19, 20). It has been suggested that these isotope results may be peculiar to the animal samples and environmental conditions in the Nile Valley, rather than reflective of subsistence behavior, because a literal reading of the data would suggest that ancient Egyptians neither ate the livestock they raised nor drank the milk their livestock produced (19). This is extremely unlikely. Following the lead of others (19, 20), for purposes of this study, the Qeneh and Naqada skeletal sample is regarded as a dairying one.

Afalou & Taforalt

The sample is primarily from Afalou bou Rhummel and Taforalt, with small contributions from Aïn Dokkara, Aïn Meterchen, and Mechta el Arbi. These are Iberomaurusian and Capsian sites with a broad based hunting and foraging diet (21-23).

Neolithic and Protohistoric Maghreb

The sample is Neolithic and protohistoric from Algeria and Tunisia. Pastoralism is widespread in the region during this time (24, 25), including among the ancient Berber, which form part of the sample. While there is some evidence for cereal agriculture in the Mahgreb during this timeframe (26, 27), pastoralism supplemented by foraging appears to be the primary mode of subsistence (27, 28).

French Late Mesolithic

The remains come from four sites: Teviec, Hoedic, Montclus, and Gramat. Montclus is located on the Mediterranean Sea. The remaining sites are along the Atlantic coast. The Late Mesolithic animal resources consisted of a mix of larger mammals (red deer, boar, e.g.), smaller game, marine resources, and small package items like snails (29-31). The extent of plant exploitation is debated, with estimates ranging from diets that include as much as 80% vegetal matter to as little as little as 20% (31-33). Teviec and Hoedic appear to be marine intensive sites (34, 35).

French Neolithic

The remains come mostly from sites in Northern France. None appear to be from dates earlier than the Late Bandkeramik period (4500-4000 BC: 36), though dates could not be obtained in many cases. Animal protein was primarily derived from domesticated cow, pig, and caprids (37). Plant domesticates were present from the early Neolithic in France, though the number of cultivated species was low; major domesticates included cereals and pulses (38, 39). There is substantial evidence for intensive dairying, buttressed by high present-day frequencies of lactase persistence (40-42).

Danish Neolithic

The Danish Neolithic remains in this sample come from many sites, both inland and coastal. Not all of these sites could be confidently assigned to a specific culture or subculture. Much of the Danish Neolithic subsistence characterization below is based on evidence from the Funnel Beaker culture. However, for the diet categories considered in this study, diets from all periods appear to be consistent with one another.

Cow and pig were the chief domesticated animals of the Danish Neolithic. Cereals (wheat, emmer, einkorn) were intensively exploited (43). Dairy items were a subsistence staple (41, 44). Nevertheless, hunting and fishing continued in the Neolithic, perhaps on a seasonal basis (45-47). There is also evidence for continued exploitation of shellfish (48).

Tepe Hissar and Hasanlu, Iran

Tepe Hissar and Tepe Hasanlu are Bronze Age urban sites in northeastern Iran (49, 50). Much less is known of the subsistence economy at Hasanlu (51). Hissar was occupied as early as 7000 BP, with the Bronze Age period beginning after 5000 BP. Cereals make up the largest component of plant remains at Hissar, followed by legumes and fruits (52). Nuts (almonds and pistachios) also appear to have been an important part of the diet (51).

While zooarchaeological evidence for animal domestication at Hissar and Hasanlu is not dense, there are several reasons to suspect livestock and dairying were important parts of subsistence. The majority of zooarchaeological remains at Hissar are domesticates (53). Nomadic pastoralism (cattle, sheep, goats) was extremely important in the surrounding regions well before the Bronze Age (51, 54, 55). The presence of figurines and other cultural representations of domesticated animals (as well as wild animals) at Hissar and Hasanlu (53, 56) further supports the inference that these animals were important dietary resources. Animal domestication and dairying will therefore be inferred as components of the Hissar and Hasanlu subsistence economy.

Andaman Islands

The Andaman Islands are a small archipelago in the Bay of Bengal. Most Andaman Islands tribes had a diverse foraging subsistence that included roots, tubers, fruit, vegetables and a heavy reliance on maritime and intertidal resources (57, 58). While the Andamanese began to raise pigs after contact with seafaring traders around 2 ka, they did not adopt farming (59 p. 35). Pigs proliferated on the main island, and were hunted rather than raised (58).

Neolithic Vietnam

The skeletal materials come from the Man Bac site in Northern Vietnam, dated 3800-3500 BP. Man Bac is most likely a Neolithic-Bronze Age transitional site (60). The site provides extensive evidence for agriculture, as well as hunting and marine resource exploitation (60, 61). By far the most abundant mammal taxon in the faunal assemblage is pig, nearly all of which are thought to have been domesticated (62). Man Bac lacks direct evidence

for rice production (63). However, the estimated dates for Man Bac are subsequent to the spread of rice cultivation in Vietnam (64, 65). Further, cultural artefacts associated with the burial site have close affinities with the contemporary Phung Nguyen culture period, which strongly suggests rice domestication (63). Rice exploitation is therefore presumed for this study.

There is no evidence for dairying. Further, modern Vietnam has among the lowest frequencies of lactase persistence in the world (66).

Edo, Japan

The preindustrial Edo period ran from the 17th through the middle of the 19th century in Japan. All specimens in the sample are from the Ikenohata Shichikencho burial site, near Tokyo. Diets differed substantially among the social classes in the Edo period (67). Thanks to the assistance of K. Sakaue, we were able to limit the skeletal sample to the remains of townspeople (lower class). The food staples of Edo townspeople were soybeans, rice, and vegetables; meat was consumed in lower quantities or irregularly (67, 68). There is no evidence that dairy was an important part of the diet during this period.

Jomon

Jomon are Japanese aboriginal hunter-gatherers. Primary resources are medium-sized to large terrestrial herbivores, marine mammals, fish, nuts, seeds, fruits, roots, and green plant foods, and intertidal zone resources, most notably shellfish (69). After the early Jomon period, there is evidence for the exploitation of a few domesticated plants (rice, millet, e.g.), but not for extensive reliance on domesticates (70).

Mongolian

The Mongolian climate and landscape is not favorable for plant agriculture. Mongolian diets are largely dependent on traditional nomadic pastoralist animal products: meat, fat, entrails, dairy (71-73).

Tolai, New Britain

Tolai inhabited New Britain, part of Melanesia. The Tolai are part-time horticulturalists, raising coconuts, banana, yams, taro, sweet potatoes, and sugar cane, among other items (74). Fish and turtles were important for animal protein (74-76). There is no evidence for dairying or intensive exploitation of cereals.

Southern Australia

Foraged diets among the aborigines of South and southeastern Australia were diverse, including a range of fruits, vegetables, and terrestrial, aquatic and marine protein (77, 78).

Ryan Mound, California

Ryan Mound (CA-ALA-329) is a shellmound located on the southeastern shore of the San Francisco Bay. Radiocarbon dating indicates occupation of the site from about 2200-200 BP (79). Isotopic, artefactual, and zooarchaeological evidence support mixed marine and terrestrial foraging strategies (80, 81).

Basketmaker III, Colorado

Multiple lines of evidence, including coprolites (82), stable isotopes (83, 84), and large mano size (85), suggest a heavy reliance on maize agriculture. Estimates run from 50% maize diet (86), to upwards of 80% (83, 84). Basketmaker III groups continued to exploit wild growing plants (e.g., pinyon nuts, prickly pear cactus) and animals (87). There is no evidence for dairying.

Indian Knoll, Kentucky

Indian Knoll is an Archaic hunter-gatherer site in Kentucky. The primary subsistence items were deer, shellfish, nuts, and small game. Deer is by far the most heavily represented terrestrial mammal in the zooarchaeological materials (88). Exploitation of plant resources became much more pronounced in the Middle and Late Archaic, including nuts, squash, and seeds (89-92).

Madisonville Fort Ancient

The Madisonville, Ohio site is an agricultural group from the (Western) Fort Ancient period. Fort Ancient peoples primarily cultivated corn, but also beans, squash and other domesticates (93). Madisonville is a late Fort Ancient site. There is evidence that maize consumption was lower during this time period (94). Based on isotope data, it is likely that slightly more than 50% of dietary protein came from maize in the Madisonville diet (94, 95). For purposes of this study, that is sufficient to classify the Madisonville sample as reliant on domesticated cereals. There is no evidence for dairying.

Labrador Inuit

Atlantic coast nitrogen and carbon isotope values for North American north Atlantic coast huntergatherers support either marine top carnivore or terrestrial top carnivore, depending on group (34, 96). Arctic foragers consumed plant foods where available, particularly berries (97). However, animal protein and fat made up the vast majority of Arctic forager subsistence.

Pampa Grande, Argentina

The Pampa Grande sample comes from multiple sites in northwestern Argentina, all dating to around 1500 BP. The group was heavily dependent on high-carbohydrate domesticates for their subsistence (98 and citations therein). There is no evidence for dairying.

Chubut Valley, Argentina

Chubut Valley is a hunter-gatherer skeletal sample. The site dates to about 1500–200 years BP. The diet was heavily dependent on hunting guanaco and other animals as well as gathering some wild plants (98 and citations therein).

Tierra del Fuego

The several foraging groups that occupy the Fuegian archipelago will be regarded as a single population for this study. There are however, some differences in subsistence behavior and biology among the groups. The Ona intensively exploited guanaco, while the Yámana focused on maritime resources (99). The Ona are generally larger bodied that the Yámana (100). Nevertheless, all groups were heavily dependent on meat for survival.

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