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Temporal changes in diet: a stable isotope analysis of late Iron Age and Roman Dorset, Britain

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ABSTRACT

This study investigates the relationship between diet and cultural change in late Iron Age and Romano-British populations from Dorset, England (1st century BC to the early 5th century AD). Dorset was the only region in Britain to exhibit continuity in inhumation burial rites through these periods and a wide array of environmental, archaeological and material culture evidence is available there. A sample of $N = 77$ human adult and $N = 17$ faunal rib samples were utilized for carbon and nitrogen stable isotope analysis to test the hypothesis that Romanization of the diet would result in greater dietary variation.

The results of this study indicate that the late Iron Age sample did not show any sex-related differences in diet and consumed a diet that was heavily reliant on terrestrial resources. In contrast, the Romano-British population exhibited enriched isotopic values, though the data did not indicate a widespread increase in the use of marine resources across all sex and age cohorts. Instead, the data suggest that it was females rather than males who had a small component of enriched ^{13}C food in their diet.

1. Introduction

In this study, carbon and nitrogen stable isotope analysis was applied to human and animal skeletal material recovered from funerary and settlement contexts in Dorset County, England (Fig. 1) to test the hypothesis that Romanization resulted in greater dietary variation, as evidenced though changing stable isotope profiles. Romanization, as a concept, has a long history (cf., Freeman, 1997). Of particular interest to modern scholars is the nature of social change during the Roman period, as Roman Britain is now understood to have been a negotiated landscape within which regional variation, discrepant experience and indigenous resistance were present (Alcock, 2001; Carr, 2003; Lucas, 2002; Mattingly, 2004; Terrenato, 1998; Webster, 2001). Use of the term Romanization has, in fact, become controversial – with some scholars suggesting its replacement with more neutral designators such as "creolization" (Carr, 2003; Hawkes, 2001; Webster, 2001), "cross-culturalisation" (Crowe, 2001) or "globalization" (Hingley, 2005). In light of the hybrid nature of Roman Britain and its evidentiary material culture, the authors of this study follow Terrenato (1998:20) in applying the term "… in its weakest sense, as a convenient denomination covering the events involved in the creation of Roman [Britain], with no cultural implications taken for granted."

The materials on which this study were based (Table 1) were recovered in the vicinity of Dorchester, southwest England, in the former territory of the Durotriges, who had likely occupied the region since the early Iron Age (9th–7th centuries BC) (Cunliffe, 2004:52–53; Gale, 2003:98). By the late Iron Age (LIA) (1st century BC to 1st century AD), the Durotriges were a close-knit tribal confederacy centered upon modern Dorset. The Durotrigian confederacy consisted of ethnically similar tribal groups, each of which had a hillfort or hillforts that served as trading or manufacturing centres, as central storage facilities for grain reserves, and as centres for community defence in times of crisis (Gale, 2003:124). These tribal units were represented by a common currency, had an extensive trade system for items of Durotrigian manufacture (both for regional use and export), and likely banded together in defence of the confederacy's territory (Cunliffe, 2005:159–170).

The present-day county of Dorset was one of the regions conquered early by the Romans in the 1st century AD (circa AD 43/44) and Dorchester – Roman *Durnovaria* – was established circa AD 65–70 as the *civitas peregrina* (native capital) of the Durotriges (Royal Commission on the Historical Monuments of England (RCHME) 1970:534; Sharples, 1991:126; Woodward et al., 1993:361). This granting of administrative independence likely

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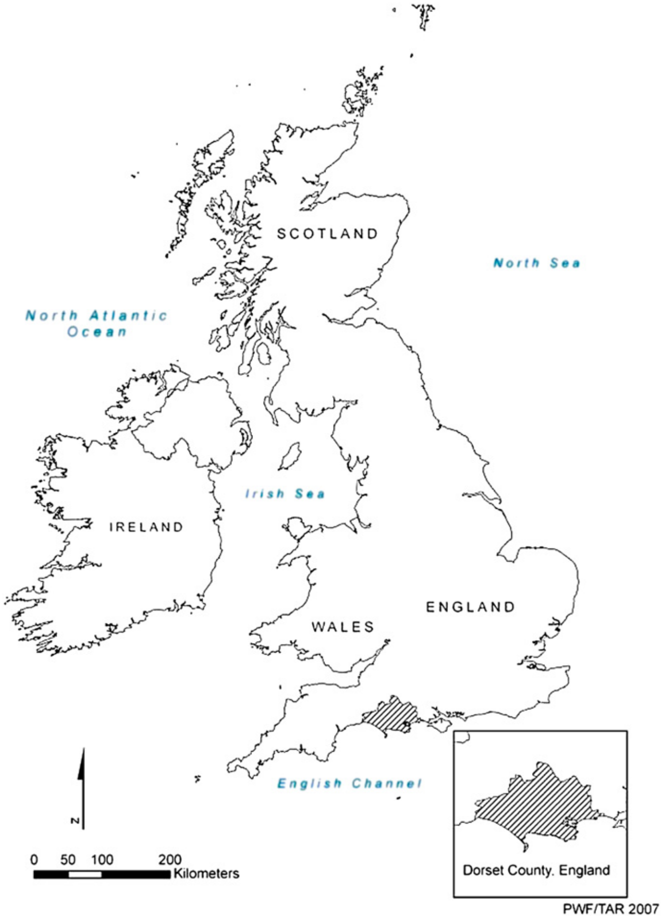

Fig. 1. Location of Dorset County, England. (Map: P. Fantle and T. Revane).

coincided with the consolidation of Roman control in southern England (Sharples, 1991:126). There are no Classical reports alluding to a need for Romans to quell further dissent in the area, nor is there osteological evidence indicative of large-scale violence in the region (Redfern, 2006). That *Durnovaria* was a "Roman-style town" is indicated by the presence of an aqueduct, which provided water both to a *castellum divisiorum* (public fountain), and a large public bath complex (Putnam, 2007). Also present were an amphitheatre – a Roman remodeling of the Neolithic Maumbury Ring henge monument – and a defensive wall that encircled the town (RCHME 1970:534–535). A Roman-style street grid ordered the *civitas*, which contained *insulae*, town houses and a forum (Woodward et al., 1993:3). Outside *Durnovaria*, the evidence for Romanization is more varied. Roundhouses continued to be built and occupied across Dorset, with Roman-style rectangular buildings later added in some outlying settlements (Hingley, 1989:116; Putnam, 2007:85). Archaeological evidence indicates that *Durnovaria* prospered over time, with early timber-frame buildings later replaced by more substantial brick and stone structures (Putnam, 2007:37). A testament to the eventual wealth of the town is the number of mosaics – around 50 – of 3rd and 4th century date, with a 'school' of mosaicists (the Durnovarian Group) conjectured to have been based in or near Dorchester (RCHME 1970:535–536). The construction of villas in Dorset follows the pattern of urban growth, with the 3rd and 4th centuries AD a time both of increasing villa numbers and architectural opulence. These farm complexes, of which some 16 have been identified in the Dorchester area to date, were likely home to *civitas* administrators and other functionaries, both native and Roman (Putnam, 2007:84). Villas functioned as links between the town and the outlying farms and settlements (Hingley, 1989:116; Putnam, 2007:85), and numismatic evidence suggests those near *Durnovaria* were part of a currency-based trading system (Putnam, 2007:85).

Table 1
Site type, location and date.[a]

Site name	Type	Location	Period of use
1. Albert Road	Cemetery: urban	Dorchester	RB
2. Alington Avenue	Cemetery: rural	Southeast of Dorchester	LIA-RB
3. Flagstones (Dorchester bypass)	Cemetery: rural	Southwest of Dorchester	LIA
4. Fordington Bottom (Dorchester bypass)	Cemetery: rural	Northwest of Dorchester	LIA-RB
5. Gussage All Saints	Settlement: rural	Northeast Dorset	LIA-RB
6. Manor Farm	Cemetery: rural	Southwest Dorset	LIA
7. Maiden Castle Road (Dorchester bypass)	Cemetery: rural	Southwest of Dorchester	RBP
8. Newfoundland Wood	Settlement: rural	South Dorset	LIA
9. Old Vicarage	Cemetery: urban	Dorchester	RB
10. Poundbury Camp	Cemetery: rural/urban	Northwest of Dorchester	LIA-RB
11. Poundbury Pipeline	Cemetery: rural/urban	Northwest of Dorchester	RB
12. Tolpuddle Ball	Cemetery: rural	East Dorset	LIA-RB
13. Whitcombe Farm	Cemetery: rural	Southeast Dorset	LIA

1. Stacey (1987); 2. Davies et al. (2002); 3,4,7 Smith et al. (1997); 5. Wainwright (1979); 6. Valentin (2004); 8. Toms (1970); 9. Startin (1982); 10. Farwell and Molleson (1993); 11. Davies and Grieve (1986); 12. Hearne and Birbeck (1993); 13. Aitken and Aitken (1991).

[a] Late Iron Age (LIA), Romano-British period (RB)

The discussion of 'rural' and 'urban' in the Dorset context necessitates a clarification of terminology. These terms are used to reflect settlement patterns, rather than geographical designators. Prior to the Roman conquest, hillfort communities such as Maiden Castle and Poundbury Camp were the largest human aggregates. These sites were largely depopulated after the middle Iron Age (5th to early 1st centuries BC), with a return to a landscape dotted with family farmsteads and small settlements (Sharples, 1991:116). LIA Dorset was, then, wholly rural. With the Romans came the introduction of an urban centre, *Durnovaria*. Settlements outside the *civitas* walls, however, maintained their rural aspects – even those, like Alington Avenue, which were quite close to the town. The degree to which these communities were "Romanized" was not a simple reflection of their proximity to the *civitas*, but involved a broad range of variables (Hamlin, 2007). The term rural is thus used here to describe sites with clear evidence for an agricultural and/or animal husbandry use ('farmsteads'), whatever their proximity to the *civitas*.

2. Diet in Iron Age and Roman Britain

The LIA communities of Britain initiated the first macro-agricultural landscapes, thereby intensifying agrarian activity and increasing food production (Albarella, 2007; Roberts, 1989). Evidence for crop husbandry suggests that they practiced autumn and spring sowing, particularly of emmer and spelt wheat (Jones, 1981). The faunal evidence indicates that chickens and pigs were kept for food in small numbers, with cattle and sheep herds managed for dairy, meat and wool production. Arabella (2007:389-392) suggests that in the LIA the emphasis of herd management was upon sheep. The remains of birds and non-domesticated animals occur in small numbers, but analysis suggests that wild resources formed only a small part of the diet

(Albarella, 2007; Hambleton, 1999; Maltby, 1981; Serjeantson, 2007). The material culture supports the storage, preparation and cooking of these foods, with the presence of quern stones for processing cereals and evidence for salt production, which enabled the curing and long-term storage of food (Cunliffe, 2005; Haselgrove, 1999).

The low frequency or absence of water-dwelling species (aquatic mammals, fish and shellfish) recovered from Iron Age sites cannot be explained by poor recovery methods or a lack of environmental sampling, as evidenced by Dobney and Ervynck's (2007) review of fish consumption in England, Belgium and the Netherlands. Their analysis of 116 sites from England found that only 10% had fish remains present, with the numbers recovered very small and from a limited range of species. The small contribution of marine and freshwater species in the diet is supported by stable isotope data of human diet across Britain (Cummings, 2008; Jay, 2008; Jay and Richards, 2006). This trend may reflect a religious interdiction against food obtained from water sources, as Green (1997) notes such locations were sacred due to their liminality, with the finds of metalwork and probable victims of ritual murder ('bog bodies') attesting to this belief.

In the Romano-British period (RB) (late 1st to early 5th centuries AD), management of the landscape improved and agriculture continued to intensify, though these changes would not have been immediate (Dark and Dark, 1998; Grant, 2007). The agricultural economy was revolutionised by the use of new technologies, such as the more efficient iron plough coulter, and by developments in livestock size and management (Albarella et al., 2008; O'Connor and van der Veen, 1998). The consumption of cattle, sheep and pigs continued but the range of species in the diet increased to include more wild game, fish and shellfish (Grant, 2007; Locker, 2007). The emphasis of herd management shifted to cattle post-conquest, indicating their use as draft animals and for provisioning the Roman army, as well as a cultural liking for beef (Albarella, 2007). Plant remains indicate the introduction of new species while innovation in meat processing and cookery techniques are evident in new vessel types (Cool, 2006; Grant, 2007; van der Veen et al., 2007, 2008). Environmental and material culture evidence demonstrates that considerable variation existed between rural, military and urban settlements, reflecting a number of factors. These include differences in community tradition, location, environment and economy; the influence of the Roman army; available imports; and access to urban markets (Albarella, 2007; Cool, 2006; Dobney and Ervynck, 2007; Grant, 2007; Hurst, 1999; King, 1999; van der Veen et al., 2008). For example, urban areas had greater food diversity, particularly of imported resources and foods not related to the farming calendar. Environmental evidence supports the presence of market gardens and pig breeding in many towns, including Dorchester (Grant, 2007). As Cool (2006:172) states, "there was no more a single Roman way of doing things, any more than there was a single native way".

An increase in fish consumption is supported by a rise in the amphora used to ship fish sauce (*garum*) that peaks in the mid 2nd century AD, particularly on military and urban sites. The range of freshwater and marine species being exploited increased, with evidence indicating these were derived both from local and imported sources. Their high frequency within newer settlements, rather than in older rural sites (Grant, 2007), suggests that the Iron Age taboos were eroded or subsumed by the trends in more Romanized communities.

There is ample LIA and RB dietary evidence specific to Dorset. The Durotriges had extensive trade networks both within Britain and Europe. Excavation at Hengistbury Head has shown that wine from Italy and perishables such as figs, corn and chamomile were imported, and imported pottery types recovered from Poundbury Camp hillfort are believed to have once contained olive oil, most probably for elite consumption (Darvill, 1995; Gale, 2003; Sparey Green, 1987:143). The evidence for cereal crops includes hulled barley, emmer wheat and oats (Hinton, 1999; Jones, 1981). A range of wild and domesticated animals, such as wood pigeons, curlew, red/roe deer, hares, geese, chickens and goats were exploited at this time (Harcourt, 1979; Wyles, 1997). Pottery residue analyses support the emphasis upon a dairy economy, with the majority of samples having dairy fats present (Copley et al., 2004).

In the Romano-British period, food imports increased and new food-stuffs were introduced; these included cherries, grapes, hazelnuts, cabbage and peas/beans. The range of cereals exploited shows continuity from the LIA but evidence from grain driers indicates barley, oats and bread wheat were now grown (Bryant, 1990; Ede, 1993). The faunal evidence continues to show an emphasis upon dairy farming, though evidence for the breeding of pigs and egg production in Dorchester has also been found (Hamilton-Dyer, 1999; Maltby, 1993; Sidell, 2001).

Hathaway's (2005) research has demonstrated that both Iron Age and Romano-British communities in Dorset exploited the estuaries and natural harbours to produce salt, which was used in the curing and storing of food. The level of freshwater and marine resources increased in the Romano-British period, and the species identified – periwinkles, cockles, limpets, eel, bass, sea-bream and chub – were most probably caught from the local coast and rivers (Allen, 1993a,b; Hamliton-Dyer, 1993, 1999). A deposit of herring and sprat bones from Dorchester has been identified as the discarded residue from the manufacturing of *allec* – a sauce with bones produced by the fermentation of very small fish. Shoals of herring are common in the coastal waters of Dorset in the winter and early spring. The probability of shellfish consumption is further supported by the discovery of a double-ended two-pronged cutlery item that may have been used to eat molluscs (Hamilton-Dyer, 2001). Amphorae from Poundbury Camp, as noted earlier, also show that *garum* was imported to the town, although not in large quantities (Sparey Green, 1987:143).

Given the abundant evidence for food production, importation and preparation in Dorset, the area was deemed ideal for the investigation of resource consumption patterning through stable isotope analysis (^{13}C and ^{15}N). We first assume that an increase in marine and freshwater food exploitation in Dorset sites during the RB period will be indicated by significant enrichments in δ^{13}C and δ^{15}N over LIA levels. We also test the hypothesis that, given the varying degrees of Romanization of the RB populations due to a broad range of variables (Hamlin, 2007), intra-site dietary variation will exist in the RB period to a greater extent than in LIA populations.

3. Principles of stable isotope dietary analysis

Stable isotope analysis is a well-established method of investigating ancient diet (cf., DeNiro and Epstein, 1978, 1981; Jay and Richards, 2006; Richards et al., 1998; Schoeninger et al., 1983; Sillen et al., 1989). Assessing what consumer isotope values indicate about diet requires observed or estimated isotope value ranges for source environments (e.g. terrestrial versus marine) and region-specific datasets (Beavan Athfield et al., 2008; Hobson et al., 1994), as local minimum and maximum values for isotope ratios in specific food webs can deviate from global mean values (Ambrose, 1993:83) and are an important consideration for dietary analysis (Milner et al., 2004).

Carbon (δ^{13}C) and nitrogen (δ^{15}N) are two of the isotopes most frequently used in dietary analysis. δ^{13}C can be derived from protein, carbohydrate or lipid diet fractions (Ambrose and Norr, 1993). Although some protein and non-protein components in a mixed diet could make $\delta^{13}C$ isotope values poorly correlated with the whole diet (Ambrose and Norr, 1993), in a relatively balanced diet, $\delta^{13}C$ values reflect dietary protein sources rather than the whole diet, theoretically due to the "routing" of dietary protein via essential amino acids (Ambrose, 1993, 2000; Ambrose and Norr, 1993; Ambrose et al., 1997; Krueger and Sullivan, 1984; Schwarcz, 1991). $\delta^{15}N$ also indicates the trophic level of the diet. Nitrogen is enriched progressively up the food chain from plants to meat sources (e.g. a poorer protein source such as vegetation versus terrestrial animals). $\delta^{15}N$ can also identify terrestrial versus freshwater or marine sources (e.g. animal protein versus fish) as marine environments tend to be enriched in ^{15}N relative to terrestrial environments, due to longer food chains in aquatic environments, resulting in additional levels of trophic enrichment in fish. Nitrogen values cannot, however, isotopically distinguish the consumption of secondary animal products (e.g. milk, cheese, eggs) from consumption of flesh of the primary producer (O'Connell and Hedges, 1999.)

Bone protein $\delta^{13}C$ and $\delta^{15}N$ values reflect the average isotopic composition of the consumer's dietary protein over time (Fry and Sherr, 1984; Stenhouse and Baxter, 1979) and are the result of an isotopic mass balance of overall isotopic contributions from food sources, including foods at the distal-ends (highly enriched or depleted) of the carbon and nitrogen value ranges. However, minute proportions of isotopically enriched protein sources in a largely terrestrial diet may induce only minimal change to, or be overwhelmed by, the isotopic signature of the largely terrestrial portion of the diet. In a mainly terrestrial diet dominated by C_3 plant foods (i.e., $\delta^{13}C$ depleted), and assuming a complete mixing of carbon in the diet, even a 20% contribution of marine protein would not shift consumer isotopic signature from $-21‰$ (Hedges, 2004.)

The appropriate trophic enrichment factor to use for Dorset diet analysis also needs to be considered. Isotopic enrichment occurs at each successive step in a food chain via metabolic fraction during amino acid synthesis, with retention of the isotopically heavier isotope (^{13}C, ^{15}N) and the excretion of isotopically lighter isotopes of ^{12}C through respiration and ^{14}N in nitrogenous waste (Checkley and Entzeroth, 1985; Checkley and Miller, 1989; Macko et al., 1986; Yudkin and Offord, 1973:379–383). The per mille (‰) amount of trophic enrichment for $\delta^{13}C$ and $\delta^{15}N$ is debated in the literature with respect to various factors (e.g. species, tissue type, proportion of protein in the diet; Bocherens and Drucker, 2003; Koch Paul, 1998; Hare et al., 1991; Hildebrand et al., 1996), but the few studies on trophic shift in humans have only analysed hair (O'Connell and Hedges, 1999; Minagawa, 1992; Minagawa et al., 1986; Schoeller et al., 1986). Most research has been based on faunal species $\delta^{13}C$ trophic shift, which various sources cite as between +1 and +5‰ (Ambrose and Norr, 1993; Bocherens and Drucker, 2003; DeNiro and Epstein, 1981; Hare et al., 1991; Tieszen and Fagre, 1993). For $\delta^{15}N$ trophic shift, a review by Hedges and Reynard (2007) cited twelve publications on British sites which reported enrichment values ranging from +2.8‰ to ~+5‰. Gauging a relevant estimation of trophic shift for a particular study is important, for as McCutchan et al. (2003) point out, "small errors in estimates of trophic shift can result in large errors in estimates of the contribution of sources to consumers or in estimates of trophic position". In our examination of diet in LIA and RB Dorset, we used local faunal values and the difference in mean $\delta^{13}C$ and $\delta^{15}N$ between faunal and human values in the Dorset LIA data to arrive at a reasonable trophic shift factor for these sites. We discuss this method further in Section 5.1.1.

We also use Dorset faunal isotopic data from LIA and RB sites, as well as supplemental data from previously published values for freshwater fish, eels, salmonids and marine fish to provide observed ranges for terrestrial, freshwater and marine food sources from British sites, and created a proxy for humans on a purely vegan diet from the minimum and maximum ranges from the isotopic ranges of herbivores (c.f., O'Connell and Hedges, 1999). We used the assembled faunal isotope ranges to plot the distribution of human isotope values relative to ranges for possible food sources. A description of the method employed is given in Section 5.1.1.

4. Materials and methods

A total of 77 human rib samples were taken from 40 LIA and 37 RB adult individuals (Table 1) who were aged over 20 years old (Tables 2 and 3a and b) and the bone protein extracted for stable isotope analysis.

Statistical methods for analysis of the resulting stable isotope data used Shapiro Wilk normality tests to determine the use of unpaired *t*-tests, Welch's *t*-test for comparisons of two normally distributed populations with unequal variance (Ruxton, 2006) or the Mann–Whitney *U* test for comparisons of data which were not normally distributed, using Prism 5.0 (GraphPad Software, San Diego California USA, www.graphpad.com). or PAST PAlaeontological STatistics (Hammer et al. 2001).

The LIA population consisted of 20 females, 17 males and 3 ambiguous sex individuals, and the RB population of 13 females, 22 males and 2 ambiguous sex individuals. Assessment of adult biological sex was achieved by scoring the morphology of the skull and innominate using the methods stated in Buikstra and Ubelaker (1994). Adult age-at-death was determined using methods based upon degeneration of the pubic symphysis and auricular surface following the methods stated in Buikstra and Ubelaker (1994). Age-related changes in sternal rib end morphology were also scored using the methods published by İşcan and Loth (1986a,b). A separate analysis of age-related variability in diet of the Dorset sample is preparation (Redfern and Hamlin in prep).

Faunal samples were grouped into subsets by period (LIA $N = 10$, and RB $N = 7$; Table 4a). The datasets contain four herbivore species (horse, cow, sheep and red deer) and three omnivore species (dog, pig and chicken).

4.1. Bone collagen extraction and isotopic analysis procedures

The human and faunal bone samples were prepared by the Rafter Radiocarbon Laboratory, where they were physically examined for fine root inclusions and burial matrix (soil). All surfaces were either mechanically abraded with a Dremmel™ drill or pared with a scalpel to remove bone surfaces that had contact with the burial environment and/or appeared degraded. Each sample was then pulverised in a Retch mill to <450 μm and chemically treated with 0.5 M HCl while stirred at room temperature until fully demineralised. Insoluble collagen was filtered from the solution, rinsed and dried in a vacuum oven at 40 °C. Up to 80 mgs of collagen was gelatinised with 0.01 M HCl in a nitrogen atmosphere at 90 °C for 16 h. The soluble gelatine was then double-filtered through Whatman™ GF/C and 0.45 μm Acrodisc™ filters, and lyophilised to weigh yields.

The carbon and nitrogen isotopic and % elemental content were measured using a Europa Geo 20–20 isotope ratio mass spectrometer, interfaced to an ANCA-SL elemental analyser in

Table 2
Number of Late Iron Age and Romano-British sexed adult individuals used in the study.

Sex	Late Iron Age	Romano-British
Male	19	22
Female	18	10
Totals	37	32

Table 3a
List of Late Iron Age human samples used in the study. Data given by site name, period, sex and isotope value.

Site name	Sample ID	Sex	δ^{15}N	δ^{13}C	Atomic C/N
Alington Ave	AA287	Male	10.1	−19.1	3.1
Alington Ave	AA761	Female	10.3	−20.5	3.2
Alington Ave	AA796	Female	9.8	−19.0	3.3
Alington Ave	AA823	Male	9.5	−19.3	3.3
Alington Ave	AA831	Female	9.6	−19.8	3.3
Alington Ave	AA1083	Female	10.0	−19.9	3.3
Fordington Bottom	FB2756	Male	9.4	−19.9	3.3
Fordington Bottom	FB3030	Male	9.0	−19.9	3.3
Fordington Bottom	FB4042	Male	9.5	−19.6	3.2
Fordington Bottom	FB4360	Female	9.1	−19.9	3.3
Fordington Bottom	FB4391	Male	9.2	−19.6	3.3
Fordington Bottom	FB4395	Female	8.7	−19.4	3.3
Fordington Bottom	FB4402	Female	8.8	−20.1	3.4
Fordington Bottom	FB4406	Female	9.5	−20.0	3.3
Fordington Bottom	FB4408	Female	9.5	−20.0	3.3
Fordington Bottom	FB4425	Male	9.0	−19.9	3.3
Flagstones	FL72	Female	9.7	−19.9	3.3
Flagstones	FL74	Male	8.7	−20.1	3.3
Gussage All Saints	GAS62.7	Female	9.0	−20.6	3.3
Gussage All Saints	GAS139.3	Female	8.9	−20.2	3.4
Gussage All Saints	GAS285.3	Male	9.0	−20.3	3.3
Gussage All Saints	GAS359.4	Male	8.7	−20.2	3.3
Gussage All Saints	GAS410.6	Female	8.3	−20.2	3.3
Manor Farm	MF85	Male	9.6	−19.0	3.2
Manor Farm	MF94	Male	8.7	−19.9	3.3
Manor Farm	MF133	Male	9.3	−20.2	3.3
Manor Farm	MF502	Female	9.3	−19.7	3.3
Newfoundland Wood	NFW1	Male	9.6	−20.6	3.4
Poundbury Camp	PC1391	Male	11.9	−19.8	3.3
Tolpuddle Ball	TB1348	Female	9.7	−20.1	3.3
Tolpuddle Ball	TB1541	Female	9.7	−20.3	3.3
Whitcombe Farm	WF1	Female	9.7	−20.0	3.3
Whitcombe Farm	WF2	Male	9.7	−20.0	3.3
Whitcombe Farm	WF3	Female	9.6	−20.2	3.3
Whitcombe Farm	WF5	Male	9.4	−19.8	3.4
Whitcombe Farm	WF6	Male	9.9	−20.0	3.3
Whitcombe Farm	WF7	Male	9.7	−20.0	3.4
Whitcombe Farm	WF9	Male	9.4	−20.0	3.3
		Mean	9.4	−19.9	3.3
		Sd	0.61	0.39	0.05
		Var	0.369	0.149	0.002

Table 3b
List of Romano-British human samples used in the study. Data given by site name, period, sex and isotope value.

Site name	Sample ID	Sex	δ^{15}N	δ^{13}C	Atomic C/N
Alington Ave	AA210	Male	8.8	−19.1	3.2
Alington Ave	AA268	Male	10.8	−19.0	3.1
Alington Ave	AA577	Male	10.2	−19.0	3.1
Alington Ave	AA617	Male	8.9	−19.9	3.2
Alington Ave	AA710	Female	11.4	−19.0	3.2
Alington Ave	AA728	Female	11.4	−18.8	3.2
Alington Ave	AA766	Female	9.5	−19.4	3.2
Alington Ave	AA794	Male	11.0	−17.7	3.3
Alington Ave	AA827	Male	9.1	−19.6	3.2
Alington Ave	AA852	Male	10.0	−18.8	3.2
Alington Ave	AA962	Male	9.1	−19.8	3.3
Alington Ave	AA1178	Female	7.9	−19.5	3.2
Albert Road	AR9	Female	8.9	−18.7	3.2
Albert Road	AR10	Male	10.0	−19.6	3.2
Albert Road	AR32	Male	10.3	−19.6	3.3
Albert Road	AR39	Male	10.2	−20.3	3.3
Albert Road	AR49	Male	8.8	−19.0	3.3
Fordington Bottom	FB2189	Male	8.2		2.1
Gussage All Saints	GAS815.3	Male	8.9	−20.1	3.3
Maiden Castle Road	MCR16	Male	8.7	−19.5	3.4
Maiden Castle Road	MCR36	Male	9.1	−20.3	3.3
Maiden Castle Road	MCR41	Female	8.5	−19.5	3.2
Maiden Castle Road	MCR117	Female	9.6	−19.8	3.3
Maiden Castle Road	MCR1400	Male	9.0	−20.1	3.3
Old Vicarage	OV1	Male	9.8	−18.8	3.2
Old Vicarage	OV4	Male	9.1	−19.8	3.3
Old Vicarage	OV7	Male	9.9	−19.7	3.3
Old Vicarage	OV10	Female	9.5	−19.3	3.3
Old Vicarage	OV17	Female	10.0	−19.1	3.3
Old Vicarage	OV18	Male	9.8	−18.6	3.3
Poundbury Camp	PC1193	Male	8.6	−20.6	3.4
Tolpuddle Ball	TB802	Male	7.8	−19.4	3.3
Tolpuddle Ball	TB908	Female	8.7	−19.4	3.3
		Mean	9.4	−19.4	3.2
		Sd	0.92	0.59	0.22
		Var	0.845	0.346	0.047

continuous flow mode (EA-IRMS). Approximately 1.5 mg of freeze-dried gelatine was weighed in duplicate into tin capsules for automated combustion. The carbon dioxide and nitrogen gases were resolved using gas chromatographic separation on a column at 60 °C and analysed simultaneously for isotopic abundance as well as total organic carbon and nitrogen. Standards and blanks were included during the run for internal calibration. All results are reported with respect to VPDB and N-Air, normalized to internal standards of Leucine (−22.7‰ for δ^{13}C, 1.8‰ for δ^{15}N), GNS Bone Collagen (−20.85‰ for δ^{13}C, 9.41‰ for δ^{15}N) and EDTA (−30.6‰ for δ^{13}C, 0.4‰ for δ^{15}N). The typical analytical precision for these measurements are ±0.1‰ for δ^{13}C and ±0.3‰ for δ^{15}N. The precision for the analysis of the Dorset project runs were ±0.04 for carbon and ±0.08 for nitrogen, indicating a precision better than the typical analytical precision.

5. Results

5.1. Stable isotope variation in Iron Age and Roman Dorset populations

5.1.1. Dietary base: fauna and fish

Faunal data from Dorset (Table 4a) and additional marine and freshwater fish data from previous British archaeological studies (Table 4b) provided an isotopic baseline of animal protein available to Dorset communities. Herbivore isotopic ranges (cow, sheep, horse; LIA and RB Dorset faunal data) were used as a proxy for human vegan diets.

Mean and standard deviation values for Dorset terrestrial faunal remains from the LIA were δ^{13}C −21.4 ± 0.6‰; and δ^{15}N 6.3 ± 1.7‰, and in the RB period were δ^{13}C −21.0 ± 0.8‰ and δ^{15}N 6.0 ± 2.4‰. These values are quite similar to previously published faunal data values (fowl, cattle, pig, sheep/goat) from other Iron Age and Romano-British sites (δ^{13}C −21.6 ± 0.5‰; δ^{15}N 6.0 ± 1.4‰; Jay and Richards, 2006; Müldner, 2005).

Two vertebral centrums of Iron Age date from *Salmo trutta* species were found at Maiden Castle hillfort (Sharples, 1991:148) but these were not available for isotopic analysis, and no other marine or freshwater faunal samples were available for testing from other Dorset sites. We assembled supplemental data from previously published values for freshwater fish, eels, and salmonids ($\bar{x}$ δ^{15}N 12.2‰, sd. 2.9‰; $\bar{x}$ δ^{13}C −20.9‰, sd. 4.0‰) and marine fish ($\bar{x}$ δ^{15}N 13.5‰, sd.1.9‰; $\bar{x}$ δ^{13}C −13.1‰, sd. 1.1‰) from mainland British Iron Age to Late Medieval archaeological sites (Müldner, 2005; Müldner and Richards, 2005, 2007).

We arrived at a trophic enrichment value ($\Delta_{\text{diet-bone collagen}}$) for the Dorset sites by calculating the Δ for carbon and nitrogen from mean human bone and faunal isotope values from the LIA, a period where it is less likely that fish have contributed to apparent enrichment factors. LIA humans were enriched over LIA faunal samples in δ^{13}C by +1.4‰ and in δ^{15}N by +3.1‰, providing us with an estimated Δ^{13}C $_{\text{diet-bone collagen}}$ of 1.4‰ and Δ^{15}N $_{\text{diet-bone collagen}}$ of 3.1‰.

Table 4a
Isotope values of the faunal samples (‰). The precision for the analytical analysis was ±0.04 for carbon and ±0.08 for nitrogen.

Site	Site ID	Species	Period	δ^{15}N	δ^{13}C	Atomic CN
Alington Avenue	W98 3213 (774)	Chicken	Late Iron Age	8.6	−20.5	3.4
Fordington Bottom	W221 233	Cow	Late Iron Age	4.4	−21.3	3.3
Tolpuddle Ball	TP93- 856	Sheep	Late Iron Age	4.6	−21.2	3.3
Manor Farm	MF85 SF45	Sheep	Late Iron Age	7.5	−22.3	3.4
Manor Farm	MF85 SF45	Pig	Late Iron Age	6.7	−20.8	3.4
Manor Farm	MF502 noSF	Pig	Late Iron Age	6.2	−21.3	3.4
Tolpuddle Ball	TP-93	Pig	Late Iron Age	7.4	−21.5	3.3
Tolpuddle Ball	TP-93 789	Horse	Late Iron Age	5.4	−22.4	3.2
Tolpuddle Ball	TP-93 1066	Red Deer	Late Iron Age	4.1	−21.7	3.3
Tolpuddle Ball	TP-93 1239	Dog	Late Iron Age	8.5	−20.7	3.3
		N = 10	**Mean**	**6.3**	**−21.4**	
			Std dev	**1.7**	**0.6**	
Alington Avenue	W98 2626	Chicken	Romano-British	2.7	−21.1	3.4
Alington Avenue	W98 2626	Pig	Romano-British	9.9	−20.3	3.3
Fordington Bottom	W221 387	Horse	Romano-British	4.8	−22.2	3.5
Maiden Castle Road	W185 2370	Dog	Romano-British	8.3	−20.0	3.3
Maiden Castle Road	W1852388	Cow	Romano-British	6.2	−21.4	3.3
Maiden Castle Road	W185 2388	Sheep	Romano-British	4.9	−20.3	3.4
Poundbury Pipeline	W123 114	Horse	Romano-British	5.1	−21.3	3.3
		N = 7	**Mean**	**6.0**	**−21.0**	
			Std dev	**2.4**	**0.8**	

In Fig. 2, bracketed ranges for LIA and RB human consumer values were created from the minimum and maximum values for the assembled faunal, marine fish and freshwater fish data, and included the estimated trophic enrichment discussed above. Error bars on bracketed ranges are the standard deviation of mean faunal and fish values. The bracketed ranges illustrate the area in which human consumer isotopic values may sit given the possible diet source isotopic ranges. Human δ^{13}C and δ^{15}N values are also shown in the figure, illustrating how human isotope values relate to period-specific food sources.

Table 4b
Isotope value of supplementary fish species data.

Freshwater and androminous species	δ^{13}C	δ^{15}N	Marine species	δ^{13}C	δ^{15}N
^{1}Salmonid	−15.1	13.9	^{2}Flatfish	−13.2	11.7
^{1}Salmonid	−15.3	8.6	^{2}Flatfish	−12.4	13.7
^{1}Salmonid	−14.7	12.9	^{2}Gadidae sp	−12.6	13.8
^{1}Salmonid	−15.6	8.8	^{2}Gadidae sp	−11.8	16.9
^{1}Salmonid	−15.5	9.6	^{2}Gadidae sp	−12.9	11.3
^{1}Salmonid	−14	13.6	^{2}Gadidae sp	−14.1	14.4
^{2}Cyprinid	−18.6	10.2	^{2}Gadidae sp	−12.7	14.8
^{2}Pike	−24.5	23.4	^{2}Haddock	−13	12.6
^{2}Pike	−23.4	16.7	^{2}Haddock	−13.2	13.3
^{1}Pike	−22.7	12.5	^{2}Herring	−16.1	10.1
^{1}Pike	−25.4	12.3	^{2}Herring	−14.2	10.4
^{1}Pike	−22	14.9	^{2}Herring	−15.4	11.5
^{1}Pike	−23.4	11.6	^{2}Ling	−12.4	17.2
^{1}Cyprinid	−14.2	13.2	^{2}Ray	−12	14.7
^{1}Cyprinid	−22.7	13.5	^{2}Whiting	−12	12.7
^{1}Cyprinid	−18.5	11.2	^{2}Whiting	−13.6	14.5
^{1}Cyprinid	−23.6	11	^{2}Whiting	−12.4	14.4
^{2}Eel	−17.6	10.6	^{2}Whiting	−12.4	14.2
^{2}Eel	−22.7	12.8	^{2}Whiting	−12.9	14.3
^{2}Eel	−22.9	11	**Mean**	**−13.1**	**13.5**
^{2}Eel	−21.7	11.7	**Std dev.**	**1.1**	**1.9**
^{2}Eel	−23.5	11.8			
^{2}Eel	−24.9	11.9			
^{1}Eel	−25.2	12.7			
^{1}Eel	−24.5	9			
^{1}Eel	−21.1	11.4			
^{1}Eel	−25.7	11.5			
^{1}Eel	−25	8.8			
Mean	**−20.9**	**12.2**			
Std dev.	**4.0**	**2.9**			

LIA and RB humans fit well with the predicted values based on terrestrial faunal values from their respective periods. There is a positive drift in the RB period towards more enriched isotopic values, but these do not enter the region of freshwater or marine fish consumers. The plotted values suggest that the tendency for some RB human data points to move towards enriched diet sources may be due to minor inclusions of those foods in human diet.

5.1.2. *Humans*

As illustrated in Fig. 2a and b, LIA human isotopic values sit within the predicted consumer isotope ranges based on LIA faunal values. In the RB period, most human values sit well within the predicted consumer isotope ranges based on the RB faunal values, with a slight trend in several individuals towards isotope values predicted for marine sourced diets.

In the statistical analysis we observed that median δ^{13}C in the RB period (−19.5‰) was significantly enriched over the median of the LIA (−20.0‰; Δ^{13}C = 0.55‰; Mann–Whitney $U = 267.5$, $p < 0.001$). However, there was no significant difference in δ^{15}N between the periods, as might be expected from increased fish consumption (LIA median 9.5‰; RB median 9.2‰, Δ^{15}N = 0.3‰, $U = 616$, $p = 0.90$).

When the LIA and RB data were examined by sex, it was of great interest that for both males and females the RB individuals were significantly enriched in carbon over LIA individuals (unpaired t-tests with Welch's correction, males, Δ^{13}C = 0.59, $t = 2.33$, $p = 0.026$, females Δ^{13}C = 0.41‰; $t = 5.29$, $p < 0.0001$) but nitrogen differences by sex between the two periods were not significant (males Δ^{15}N = 0.37‰; Mann–Whitney $U = 224.5$, $p = 0.903$, females Δ^{15}N = 0.06‰, unpaired t-test with Welch's correction, $t = 0.36$, $p = 0.723$).

We also investigated intra- and inter-site variance in both the LIA and RB period. Within the wholly rural LIA, sites with $N = >4$ individuals included Fordington Bottom, Whitcombe Farm, Manor Farm, Alington Avenue and Gussage All Saints. While there were larger spreads in carbon and nitrogen within certain sites (Alington Avenue Δ^{13}C = 1.5‰; Manor Farm Δ^{15}N = 0.9‰) the variations did not create distinct clustering of groups within the sampled populations (Fig. 3a–e).

Inter-site isotopic variation in the LIA showed the site of Alington Avenue to have highest median of δ^{13}C (−19.6‰) and δ^{15}N (9.9‰), suggestive of an enriched diet source – possibly small amounts of fish. Gussage All Saints had the most depleted median δ^{13}C (−20.2‰) and δ^{15}N (8.9‰), which fits well with an overall

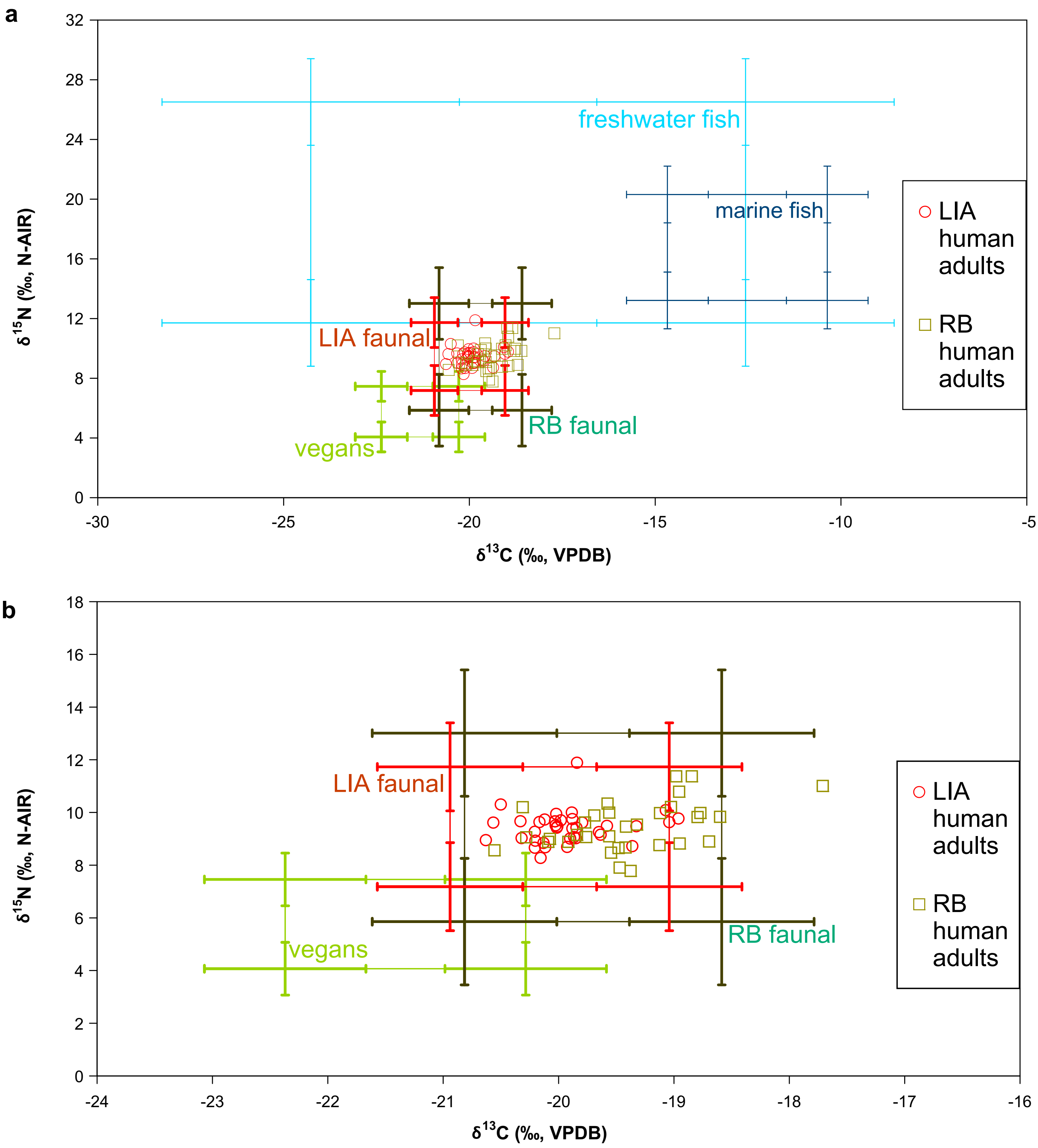

Fig. 2. a. Human isotope values for the late Iron Age (LIA) (red circles) and Romano-British period (RB) (green squares) plotted against faunal and fish isotope ranges for foods. Brackets are created from minimum and maximum values for herbivores (a proxy for human vegans), and other faunal data from Dorset sites in the LIA and RB, as well as supplemental freshwater fish and marine fish data (Müldner, 2005; Müldner and Richards, 2005). Isotope ranges for foods are adjusted by a trophic enrichment of +1.4‰ for δ^{13}C and +3.1‰ for δ^{15}N, based upon enrichment of LIA human over LIA faunal values. Error bars on food-range brackets are the standard deviation of isotope values for the food group. b. Human isotope values for the late Iron Age (LIA) (red circles) and Romano-British period (RB) (green squares) plotted against Dorset faunal isotope ranges for foods. A proxy for human vegans was created from minimum and maximum values for herbivores. Brackets are created from minimum and maximum values for specific faunal sources. Isotope ranges for foods are then given a trophic enrichment of +1.4‰ for δ^{13}C and +3.1‰ for δ^{15}N. Error bars on food-range brackets are the standard deviation of isotope values for the food group. Uncertainties (not shown) for human values are 0.04‰ for δ^{13}C and 0.08‰ for δ^{15}N, based upon analytical errors reported for the isotope analysis.

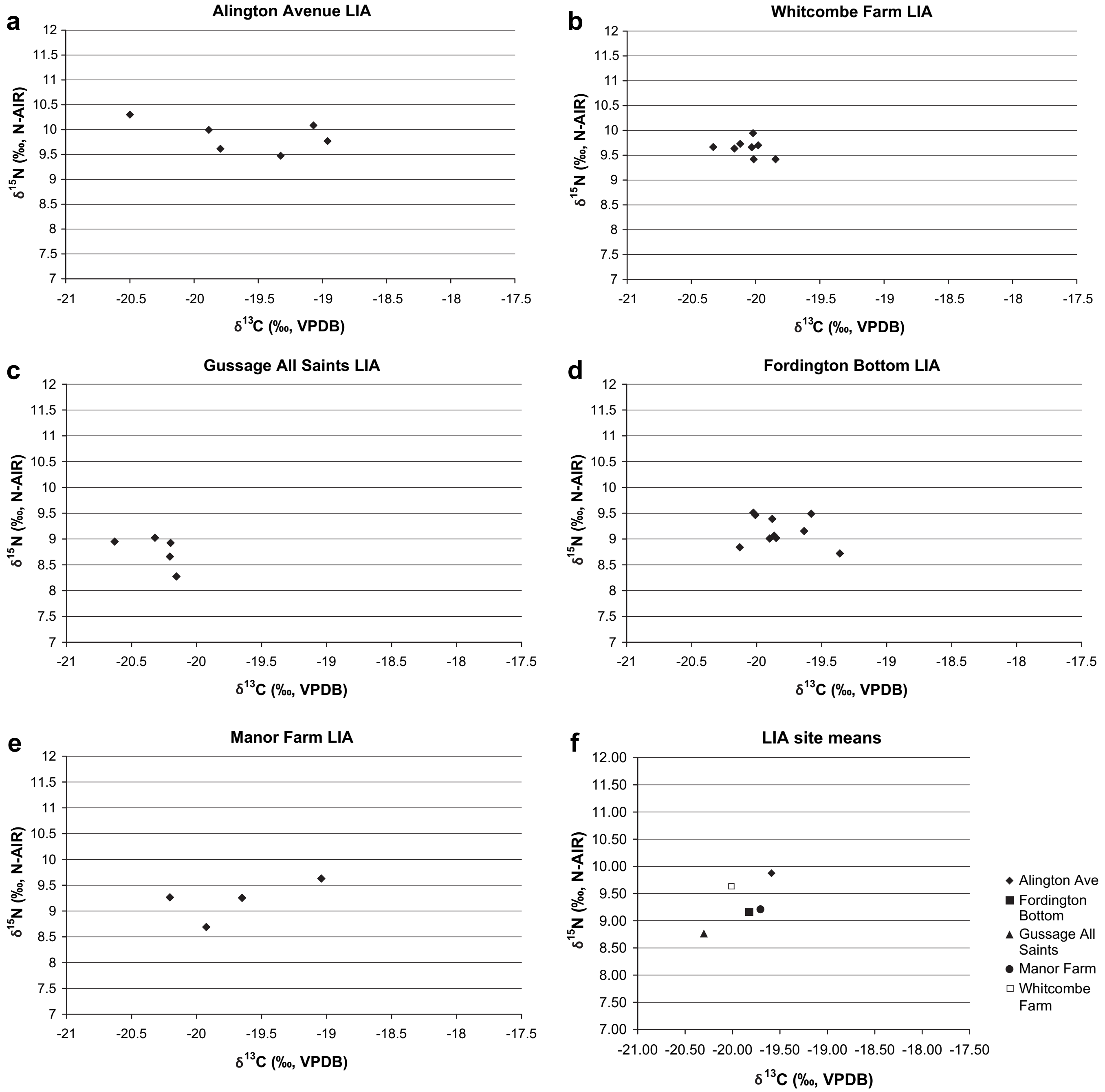

Fig. 3. (a–f). Intra-site diet signatures of populations in Dorset LIA at a) Alington Avenue, b) Whitcombe Farm, c) Gussage All Saints, d) Fordington Bottom, and e) Manor Farm. In Fig. 3(f), mean carbon and nitrogen for the sites show inter-site variation of up to 1.1‰ for δ^{15}N and 0.7‰ for δ^{13}C between least and most enriched sites. Uncertainties (not shown) for human isotope values in Fig. 3a–f are 0.04‰ for δ^{13}C and 0.08‰ for δ^{15}N, based upon analytical errors reported for the isotope analysis.

terrestrial diet. The Δ^{15}N of 1.0‰ and Δ^{13}C of 0.6‰ from most enriched (Alington Avenue) and the most depleted site (Gussage All Saints) requires further examination of the underlying reasons for diet variation between these sites (Redfern and Hamlin in prep).

In the RB period, we anticipated dietary enrichment over the LIA results but also assumed that "Romanization" of diet may not have been consistent within populations because of unequal access to introduced foods and/or personal preferences. Differences were also considered to be reflective of status, as suggested in intra-site variation observed among burial types in Roman individuals studied by Richards et al. (1998) from Poundbury Camp (Dorset), and Roman Imperial period populations from Italy (Craig et al., in press). These relationships are being explored in current research (Redfern and Hamlin in prep).

Intra-site differences within the RB period were examined in four sites that provided $N = >4$ individuals for statistical purposes: the rural sites of Alington Avenue and Maiden Castle Road, and the urban sites of Albert Road and Old Vicarage (Fig. 4a–d). All four sites date to the 3–4th centuries AD. These results suggest that intra-site dietary differences were present, but they do not clearly support the hypothesis that increased fish consumption would be the basis for intra-site dietary differences.

At the rural RB site of Alington Avenue, two isotopic clusters appeared: Group 1 (G_1 $N = 5$) and Group 2 (G_2 $N = 6$). These clusters

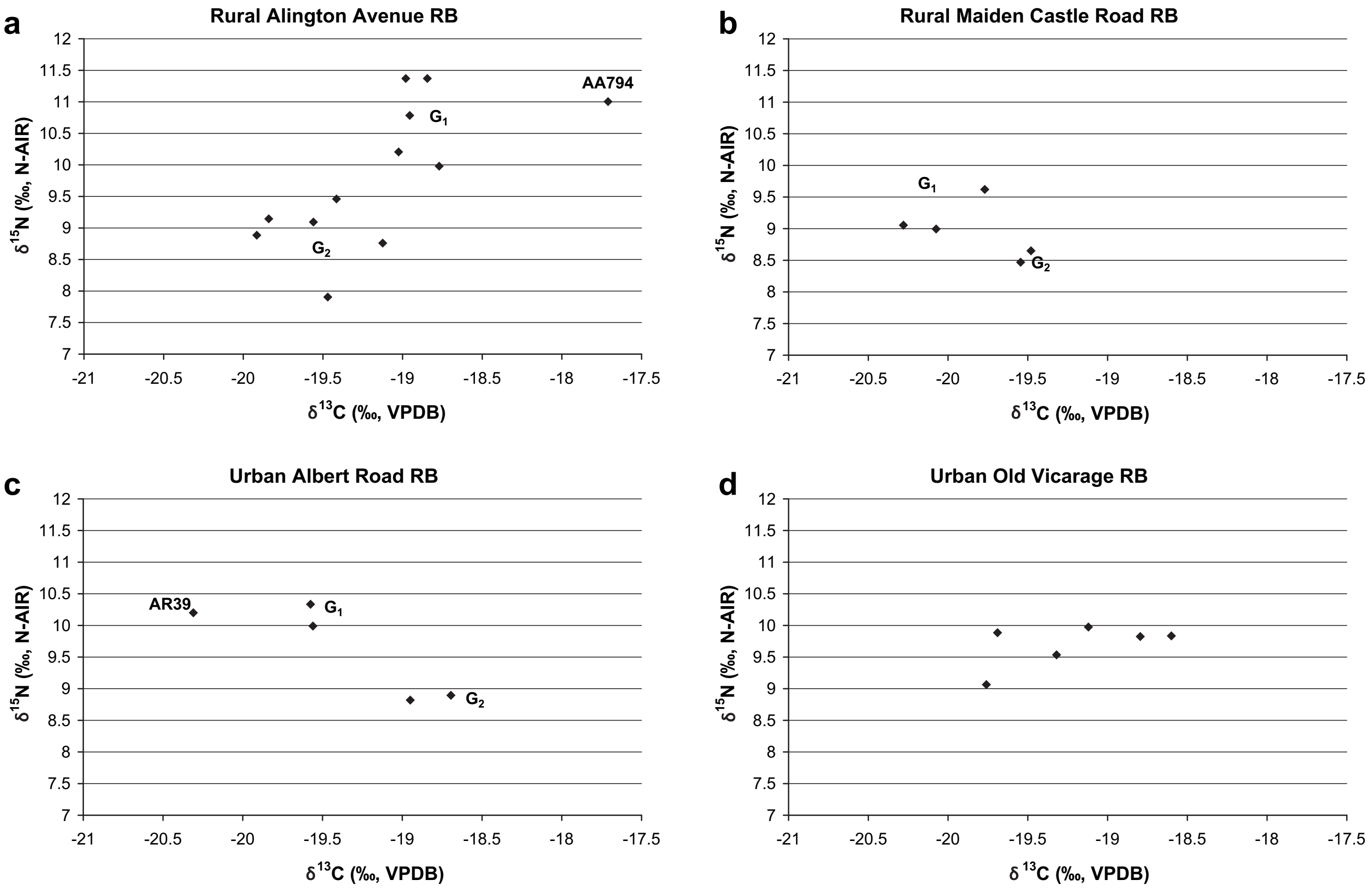

Fig. 4. (a–d). Intra-site variation in Dorset Roman Britain sites. Group 1 (G$_1$) and Group 2 (G$_2$) are shown in a) Alington Avenue, b) Maiden Castle Road, and c) Albert Road. In d) Old Vicarage carbon values vary by 1.2‰, but are similar in nitrogen. Uncertainties (not shown) for human isotope values are 0.04‰ for δ^{13}C and 0.08‰ for δ^{15}N, based upon analytical errors reported for the isotope analysis.

had significant differences in group median for δ^{15}N (G$_1$, 10.8‰; G$_2$, 9.0‰; Δ^{15}N $= 1.8$‰) and for δ^{13}C (G$_1$, −19.0‰; G$_2$, −19.5‰, Δ^{13}C $= 0.5$‰; Mann–Whitney $U = 0.0$, $P = 0.008$ for both). Additionally, one male (AA794) had a statistically significant carbon outlier value (δ^{13}C −17.7‰) relative to carbon values in Group 2 (Grubb's test, $n = 5$, $Z = 1.71$, $P < 0.05$). This site provides clear evidence for at least two groups, an additional carbon enriched outlier, and dietary variation within the population. The enrichment of both C and N in Group 1 and the individual AA794 suggests that preferences for marine resources underlie this variation (Fig. 4a).

In the rural site of Maiden Castle Road there appeared to be two clusters (G$_1$ $N = 3$; G$_2$ $N = 2$; Fig. 4b), but the dataset is too small to undertake statistical analyses.

A test of inter-site variation between Alington Avenue ($N = 12$) and Maiden Castle Road ($N = 5$) found that the Alington Avenue median value for carbon was significantly enriched over Maiden Castle Road, but not for nitrogen (Δ^{15}N $= 0.7$; Δ^{13}C $= 0.7$‰; Mann–Whitney $U = 15$, $p = 0.126$ for nitrogen and $U = 8.5$, $p = 0.027$ for carbon). During the Romano-British period both sites were rural but Alington Avenue was situated nearer to the *civitas*, close to the town's defensive walls, whereas Maiden Castle Road was located within 2.1 km of *Durnovaria* (Smith et al., 1997:xii). However, its longstanding agricultural identity and proximity to an urban centre (Davies et al., 2002:8) could have afforded its inhabitants greater opportunities for trading, better access to imported food and, possibly, greater influence by Romanized diet preferences.

The urban site of Albert Road (Fig. 4c) comprises four males and one female. One male (AR39) is separated by a 0.7‰ depletion in δ^{13}C, but has a similar δ^{15}N as the G$_1$ set ($n = 2$, $\bar{x}$ 10.2‰). The dataset is too small to undertake statistical analysis with the two pairs but we can observe that while the G$_1$ pair's nitrogen is enriched over G$_2$ by +1.3‰, it is depleted in δ^{13}C by −0.75‰ with respect to G$_2$. The negative trend of enriched δ^{15}N and depleted δ^{13}C is more suggestive of terrestrial diet with a trend towards higher animal protein in Group 1 and the individual AR39.

At the urban Old Vicarage site (Fig. 4d), minimum and maximum values within the group have a Δ^{13}C of 1.2‰ and Δ^{15}N of 0.9‰, but no distinctive isotopic clustering was observed. There appears to be a positive tendency towards enriched isotope values of δ^{13}C (−19.8‰ to −18.6‰) but less δ^{15}N variation (9.1–10.0‰) that may suggest slight contributions of marine foods in individual diets. As Old Vicarage was situated within 130 m of the eastern town walls of *Durnovaria* (Startin, 1982:43), this trend may have been caused by low proportions of aquatic animal protein in the diet; the use of fish-based condiments could perhaps provide the observed increase in δ^{13}C values. However, an inter-site comparison of Albert Road and Old Vicarage failed to find significant differences in their median isotope values. Due to the small size of groups in the Albert Road sample and the absence of clusters in Old Vicarage, we considered the entire dataset for each. The median isotope values of Albert Road (δ^{15}N 10.0‰; δ^{13}C −19.6‰) were not significantly different from those of Old Vicarage (δ^{15}N 9.8‰; δ^{13}C −19.2‰) but the depleted carbon, paired with the enriched nitrogen in the Albert Road data, conforms to a terrestrial diet; whilst the Old Vicarage data is suggestive of a wider dietary mix, including the possibility that enriched carbon sources were consumed (Fig. 4c and d). These observations will be further investigated in future research (Redfern and Hamlin in prep).

6. Discussion

Results from LIA sites in Dorset, for the most part, confirm the findings of other British studies, with the populations fitting well within the range of a terrestrial diet (Jay, 2008; Jay and Richards, 2006). Alington Avenue is the exception to this generalisation. Its six individuals exhibited a broader range of δ^{13}C (-20.5 to -19.0) than other comparative LIA sites in Dorset, suggesting that within the sampled population a variety of dietary preferences existed that included terrestrial and possibly aquatic protein resources.

The overall RB isotopic data is somewhat at odds with historical or environmental evidence for the increased exploitation of freshwater and marine resources, and the introduction of new foods such as the import and manufacture of fish-based sauces *garum* and *allec*, in the Romano-British period (Allen, 1993a,b; Hamliton-Dyer, 1993, 1999, 2001; Sparey Green, 1987:143).

The RB sites' δ^{13}C values were significantly enriched by just $+0.55‰$ over the LIA and had no significant differences in δ^{15}N. The RB enrichment in δ^{13}C was not restricted to one sex. The lack of significant changes in nitrogen did not provide strong evidence for greater consumption of freshwater fish in this period. However, the presence of freshwater fish could be masked if taken in relatively small quantities, as lower end freshwater ^{15}N isotope values and standard deviations overlap with both RB and LIA faunal isotope ranges. Likewise, though marine fish-based condiments would have an enriched isotopic signature, *garum* and *allec* would theoretically form a relatively small proportion of an individual's diet. Nonetheless, there was no clear isotopic evidence in the human population's consumption of marine fish, given the less than 1.0‰ enrichment for δ^{13}C values and little appreciable enrichment in δ^{15}N values.

The one clear exception to this observation once again comes from Alington Avenue, where a cluster of values are distinguished by median δ^{15}N and δ^{13}C of 10.7‰ and $-18.9‰$, respectively. An additional individual (male AA794) provides δ^{15}N of $+11.0‰$ and δ^{13}C of $-17.7‰$, suggesting that a portion of the population here had dietary preferences which included marine fish.

Carbon but not nitrogen values in the RB rural sample from Alington Avenue were also significantly enriched over those from rural Maiden Castle Road. The apparent difference in diet between the two rural sites may be due to Alington Avenue's longevity as an agricultural site and its proximity to the new town (Davies et al., 2002; Sharples, 1991:125–126), which would suggest that the *Durnovaria* area had a longstanding involvement in regional trade, affording greater opportunity for interaction with Romanized influences.

Though the median δ^{15}N and δ^{13}C values from the urban site of Albert Road were not significantly different from those at the urban site of Old Vicarage, the depleted carbon and nitrogen in the Albert Road data suggest that the individuals buried there had a range of dietary choices based on terrestrial-range foods whereas individuals from Old Vicarage appear to have a slight tendency towards carbon enriched diets which may provide some evidence for the limited consumption of small marine-based foods.

The results from both periods raise new questions about changes in regional diets over time, as well as intra- and inter-site differences in food-ways. Importantly, they contribute to the growing body of evidence for strong regional variation within Britain during the late Iron Age and Romano-British period (Cummings, 2008; Cunliffe, 2005; King, 1999; Redfern, 2006, 2008; van der Veen et al., 2007, 2008). This study had expected urban RB period sites to have greater dietary variation compared to their rural counterparts; this, however, was not the case, as Alington Avenue shows. It appears that the degree to which communities were 'Romanized' was not reliant on their proximity to *civitas* but was a highly complex development influenced by social differentiation (cf., Hamlin, 2007), access to food and to new and existing dietary patterns. For example, van der Veen et al.'s (2008:25) multivariate analysis of archaeobotanical records from Roman Britain and their relationship to expressions of cultural diversity concluded that site classification (i.e., rural, urban, military) was not directly relevant to the types of food consumed and that access to new foods in a number of rural and minor town sites was not limited to elite groups. In Dorset, we have been able to show that within an urban population, a range of food-ways existed – some wholly terrestrial (e.g. Albert Road); others, with a slight tendency to δ^{13}C enriched diets (e.g. Old Vicarage) but with little clear indication if this was derived from marine food sources.

One consideration for the poor isotopic resolution of aquatic food contributions in these diets is that the relatively small proportions of isotopically enriched protein may be overwhelmed by the isotopic signature of the largely terrestrial portion of the diet. Modelling the likely proportions of various foods in individual diets may help to identify such dietary inclusions and offer better resolution of dietary variation within these sites. The analysis would be well served by a robust isotopic concentration-dependent modelling (Phillips and Gregg, 2003; Phillips et al., 2005), which has been successfully applied in other archaeological settings (cf., Beavan Athfield et al., 2008; Newsome et al., 2004). These models work best when a comprehensive isotopic database for all available foods exists for the locality, but they do not require knowledge of elemental concentrations as in the model of Phillips and Koch (2002). Further development of a faunal isotopic database for the region will be a focus of our future work as additional faunal and fish data become accessible. The resulting data for individual diet components and likely proportions could then be correlated with individual age, sex and funerary data to develop a rigorous examination of social differentiation within sites and across Dorset in the LIA to RB periods (Redfern and Hamlin in prep).

7. Conclusions

Stable isotope data have shown the LIA tribe of Dorset ate a mainly terrestrial diet, based upon their position within the predicted range of values for consumers of terrestrial faunal for the period. However, the data from Alington Avenue suggests that the diet of sampled individuals from this site may have contained small amounts of fish.

In comparison with their LIA counterparts, the overall RB period population exhibited slightly enriched δ^{13}C values, but carbon enrichments were not complemented by a significant increase in ^{15}N. Only in a few site-specific examinations could we identify enriched carbon and nitrogen signatures that implied aquatic or marine dietary preferences.

The application of a population-based approach to diet in the LIA and RB period indicates that within one region there may be less dietary variation within and between periods than has hitherto been expected, based on the archaeological and biochemical evidence for dietary preferences and food imports of migrants to Roman Dorset and Britain. The example of an apparent intra-site dietary discrimination at Alington Avenue also suggests that there may be other factors associated with these variations concerning settlement type, social status, gender and age (Redfern and Hamlin in prep).

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