SHORT REPORTS

Stable Isotopic Analysis of Indigenous Skeletal Remains from Blanchetown Bridge, South Australia

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Introduction

In 1998 a replacement bridge over the Murray River at Blanchetown, South Australia, was completed (see Figure 1 for a map showing the location of Blanchetown). During its construction human skeletal remains were uncovered when the company began excavating for footings to be positioned. The remains were located approximately one metre below the original surface and 15-20m from the edge of the western bank (Walshe 1998). The bank at this point is approximately 30-40m above water level and is composed of typically hard limestone.

We would like to respectfully acknowledge here that in this region Aboriginal people may use terms such as the ‘old people’ and ‘merrily bones’ or ‘merildi bones’ to refer to human remains in different contexts (see Roberts et al. 2005 and Amy Roberts personal observation). The uncovering of the remains was of great concern to the Aboriginal community and all efforts were made by them to mitigate the events given the difficult circumstances. Indeed, subsequent to the discovery of the remains the community requested that the removed soil be sieved to recover any bone fragments and that they be placed back in their original location. The community also stipulated that analyses be conducted in relation to some of the remains still in situ given that once the bridge was fully constructed access to the remains would be restricted for an indefinite time into the future. As such, it was due to the unfortunate...
circumstances of the unearthing of the remains that this research took place.

![Map showing location of Blanchetown on the Murray River in South Australia as well as places referred to in this article and other towns in the region (adapted from Government of South Australia 2009).]

**Figure 1** Map showing location of Blanchetown on the Murray River in South Australia as well as places referred to in this article and other towns in the region (adapted from Government of South Australia 2009).

As a result of the community’s directions radiocarbon dating and bone collagen stable carbon and nitrogen isotopic analyses were conducted as a means of providing context for the remains and in order to address past dietary composition and habitat use. As has been demonstrated, stable isotopic analyses of bones and teeth recovered from archaeological sites are now accepted methods used to independently assess past diet and
the related use of the landscape (see Katzenberg 2000; Larsen 1997; Pate 1994, 1997, 2008). This paper summarises these results and discusses them in relation to research previously conducted at comparative sites (Roonka Flat and Swanport – see Figure 1).

Charcoal associated with the Blanchetown Bridge sample was also submitted to the Radiocarbon Dating Laboratory, CSIRO Land and Water, Adelaide and dated to 7210 ± 230 BP (Walshe 1998). Radiocarbon dates for the comparative skeletal remains discussed in this paper similarly fall within the Holocene (although it is noted that Pleistocene burials [between 16 and 20 ka] have been reported nearby on the bank opposite to Roonka Flat at a site referred to as the East Bank – see Robertson and Prescott 2006). The Roonka Flat sample spans the 7500 BP - ca. AD 1840 period (Pate 1998b; Walshe 2009) and ages were determined on human bone collagen and associated charcoal (Pate 1998b; Pretty 1977, 1986). Whilst the Swanport burials date between 2790 ± 40 BP and 420 ± 40 BP and were dated directly by AMS radiocarbon employing bone collagen extracts (Pate et al. 2003).

Materials and Methods

In relation to the stable isotope analysis, a 1-1.5g cortical bone specimen was taken from each individual. The Blanchetown Bridge sample size consisted of 7 individuals. Sample preparation involved ultrasonic cleaning of the bone pieces, demineralisation and sodium hydroxide treatment. Bone fragments were demineralised in dilute HCl according to the methods of Sealy (1986). Humic acids and other base-soluble contaminants were removed using a 0.125 M NaOH solution. Extracts were soaked and washed thoroughly following acid and base treatments in order to remove dissolved contaminants. The remaining organic component was oven dried at 35°C and carbon and nitrogen concentrations were determined using an ANCA SL elemental analyser. Stable carbon and nitrogen isotope values were determined by mass spectrometry. Analytical precision was better than ± 0.1‰ for carbon and ± 0.3‰ for nitrogen.

Controls for post-mortem organic decomposition were implemented by excluding samples with: 1) less than 5%
collagen yield from the bone specimens; or 2) less than 5% carbon yield from collagen; or 3) less than 0.5% nitrogen yield from collagen (Ambrose 1990; Pate 1997; Schoeninger et al. 1989). When collagen yields were less than 5% upon initial demineralisation, additional bone samples were taken and demineralised until a specimen with adequate collagen yield was obtained. C/N ratios for all samples were within the range of that reported for modern collagen (Ambrose 1990; DeNiro 1985).

Estimates of marine-terrestrial and C₃-C₄ dietary percentages were calculated using bone collagen δ¹³C values of -22.5‰ for a 100% C₃ terrestrial diet (koala – Phascolarctos cinereus), -7.0‰ for a 100% C₄ terrestrial diet (see van der Merwe et al. 1988) and -13.5‰ for a 100% marine diet (sea lion – Neophoca cinerea).

In addition, bone collagen δ¹⁵N variability related to marine and terrestrial diet was assessed using baseline values of 15.9‰ (sea lion – Neophoca cinerea), 5.5‰ and 8.8‰ (western grey kangaroo – Macropus fuliginosus from the riverine Blanchetown [250mm-300mm] and Morgan [200-300mm]) areas, respectively, and 11.1‰ (red kangaroo – Macropus rufus from the semi-arid Plumbago [200-250mm] region to the north of the Murray River – see Pate 1998a).

A detailed summary of isotopic values for marine, riverine and terrestrial foods for the region is provided in Pate (1998a) and Pate and Schoeninger (1993). Some example faunal data is also plotted in Figure 2 to provide additional context. Stable isotope results from the Blanchetown Bridge site were compared with previous isotopic results for the Roonka Flat (Pate 1998a) and Swanport (Hobson and Collier 1984; Owen 2004) sites (see Table 1 and Figure 2).
Table 1 Summary of human bone collagen stable carbon and nitrogen isotope results for archaeological sites in the lower Murray River Valley, South Australia.

<table>
<thead>
<tr>
<th>Site</th>
<th>n</th>
<th>δ&lt;sup&gt;13&lt;/sup&gt;C (‰)</th>
<th>Range</th>
<th>δ&lt;sup&gt;15&lt;/sup&gt;N (‰)</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blanchetown</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bridge&lt;sup&gt;a&lt;/sup&gt;</td>
<td>7</td>
<td>-19.1 ± 0.7</td>
<td>-20.4, -18.3</td>
<td>11.2 ± 0.3</td>
<td>10.9, 11.7</td>
</tr>
<tr>
<td>Roonka Flat&lt;sup&gt;b&lt;/sup&gt;</td>
<td>32</td>
<td>-20.1 ± 1.2</td>
<td>-22.9, -18.4</td>
<td>13.4 ± 1.2</td>
<td>10.9, 16.0</td>
</tr>
<tr>
<td>Swanport&lt;sup&gt;c&lt;/sup&gt;</td>
<td>110</td>
<td>-20.0 ± 0.8</td>
<td>-21.6, -18.1</td>
<td>10.1 ± 1.1</td>
<td>6.6, 12.3</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>-16.1 ± 1.3</td>
<td>-17.9, -14.4</td>
<td>12.5 ± 0.9</td>
<td>11.0, 13.7</td>
</tr>
<tr>
<td>Swanport&lt;sup&gt;d&lt;/sup&gt;</td>
<td>7</td>
<td>-20.1 ± 0.8</td>
<td>-21.5, -19.3</td>
<td>no data</td>
<td>no data</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>N/A</td>
<td>-16.0</td>
<td>no data</td>
<td>no data</td>
</tr>
</tbody>
</table>

<sup>a</sup> This research
<sup>b</sup> Pate 1998b
<sup>c</sup> Owen 2004
<sup>d</sup> Hobson and Collier 1984

Results and Discussion

Carbon isotope values for the Blanchetown Bridge individuals reveal a diet consisting predominantly of terrestrial and riverine resources derived from the vicinity of the Murray River (see Table 1 and Figure 2). Likewise, the high δ<sup>15</sup>N values in individuals from this region reveal the inclusion of fauna from the semi-arid plains in the hinterland beyond the Murray River valley.

Comparative results from Roonka Flat and Swanport also largely suggest diets consisting predominantly of terrestrial and riverine resources derived from the vicinity of the Murray River and nearby hinterland. Although it should be noted that a small number of individuals from Swanport (n=11 from a sample size of 121) show δ<sup>13</sup>C and δ<sup>15</sup>N values (when plotted together – see
Figure 2) indicative of a largely marine-based diet. In this case, the use of both carbon and nitrogen isotope values improves the information that can be derived about past diet.

Key

▲ Blanchetown Bridge humans (n=7)
- Roonka Flat humans (n=32)
■ Swanport humans (n=110)
♦ Swanport humans (n=11)
+ Koala (Kangaroo Island)
○ Freshwater mussel (Blanchetown)
△ Western grey kangaroo (Blanchetown – 250-300mm)
× Western grey kangaroo (Morgan – 200-300mm)
□ Red kangaroo (Plumbago – 200-250mm)
◊ Murray cod (Swan Reach)
◊ Sea lion (coastal Adelaide region)

Figure 2 Carbon and nitrogen isotopic composition of average human dietary protein at Blanchetown Bridge, Roonka Flat and Swanport with example faunal data values plotted to provide context. Example faunal data were plotted according to Pate (1998a), Pate and Scheoninger (1993) and some previously unpublished data. Isotopic values for freshwater mussel meat were employed to calculate expected bone collagen values in human bone using a diet-bone fractionation of +3‰ for δ¹⁵N and +5‰ for δ¹³C.
The more minimal variation between the Blanchetown Bridge and Roonka Flat samples can potentially be explained by the small Blanchetown Bridge sample size used to create the $\delta^{13}$C and $\delta^{15}$N averages (see Table 1). The more positive $\delta^{15}$N averages observed at Roonka Flat most likely relate to the consumption of arid land mammals.

Whilst we have dates for all three of the samples compared in this paper any discussion of more precise temporal variability is restricted given the small sample size at the Blanchetown Bridge site. Additional direct dating of bone samples by the AMS radiocarbon method for the lower Murray region would assist in assessing whether there is any temporal variability in access to food sources by past Indigenous peoples in this region.

**Conclusions**

The stable isotope results for these populations show that the majority of individuals had a diet consisting predominantly of terrestrial and riverine resources derived from the vicinity of the Murray River and nearby hinterland. Indeed, when individuals from all three sites are compared only a small number of individuals (n=11 from Swanport) can be considered as having outlying isotope values suggesting that they were either individuals from areas closer to marine resources or were individuals who had consistent access to such resources.

Thus, the isotopic data from the Blanchetown Bridge site provide additional support for arguments regarding limited access to marine foods by Indigenous populations occupying the lower Murray region during the Holocene (cf. Pate 1997, 1998a, 2000, 2006). Indeed, foods from coastal marine and non-local terrestrial areas are not being consumed by the majority of lower Murray people in any significant quantities. Thus, it can be stated that in general non-local foods are not moving to the lower Murray and lower Murray people are not spending lengthy periods of time in coastal marine and non-local terrestrial areas. These isotopic dietary reconstructions suggest that Indigenous populations inhabiting the lower Murray River region of South Australia had relatively sedentary lifeways.
throughout the mid-late Holocene. Additional chronometric dating of Indigenous burial populations will be required to improve the chronology in relation to bioarchaeological research in this region of Australia and to allow more detailed assessments regarding temporal variability.

Acknowledgements

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