Consuming food, embodying places. Dietary and social resources in the Holocene Acacus Mountains (Libyan Sahara)

Mary Anne Tafuri, Alex Bentley, Giorgio Manzi, Savino di Lernia

maryanne.tafuri@uniroma1.it

This work is part of a wider project on isotope study of human and faunal skeletal remains found during the past 10-15 years of activity of the Italian-Libyan Archaeological Mission in the Acacus and Messak. The scope of this project is to understand the interaction between living species and a ‘changing’ environment, through the application of Strontium and Carbon isotope analysis.
The region of study, is the Fezzan, which corresponds to the south-western corner of the Libyan desert (a satellite image of the area in concession to the Archaeological Mission is visible)
What we know about this part of the world is that, at the end of the Pleistocene, the northward shift of the African monsoon brings rainfall in the central part of the Sahara, after many millennia of extreme aridity (Cremaschi and di Lernia, 2001). Around 12,000 ago, the Sahara becomes wetter, so that wild cereals are collected, and local livestock gradually begins to be managed.

During the earliest part of the Holocene a series of alternations from wet to dry phases create an environmental discontinuity that might not have had effect on a generation level, but seem to culturally and socially characterize human groups inhabiting this region. At around 5000 BP a severe dry spell triggers the process of formation of what is nowadays desert. Climate changes that created the expansion and contraction of wet and fertile areas might have corresponded to profound changes in the lifeways of the people living in this region during that times, especially in terms of economic strategies and social issues.

The archaeology of the Fezzan produces a picture of human adaptation to this particular environment that is mainly reconstructed through the observation of economic strategies.
In an oversimplified synthesis of the archaeology of the region, we can recognize different phases characterized by different subsistence strategies and related food security. These are well represented by the extraordinary rock art of this region, a UNESCO world heritage site since 1985.

During the Early and Late Acacus phases, radiocarbon dated between 10000 and 7200 uncal years bp, hunter-gatherers mainly relied on foraging over partially restricted territories (Cremaschi and di Lernia, 1999).
Early and Middle Pastoral groups, between 7000 and 5000 years bp, found in the wetter climate the conditions for the husbandry of cattle (di Lernia, 1999).
Increasing aridity characterizes later phases, so that Late and Final Pastoral groups shift to the husbandry of sheep and or goat better adapted to drier climate (di Lernia, 1999).
The Garamantes and the oasis system
ca. 2500 – 1900 uncal bp

The onset of present-day desert conditions has its outcome in the formation of the oasis system of the Garamantes (Liverani, 2000).
Aside a traditional archaeological approach, the question of environmental changes and subsequent human response – at least in terms of economic strategies – arises a series of questions that might be interesting to approach through isotopic studies.

- Carbon, and particularly δ13C values can be used for their ability to distinguish between different plants, in accordance to their photosynthethic pathway. Generally, plants that can tolerate arid environments use the C4 pathway as opposed to C3 plants that better adapt to wetter conditions. Carbon isotopic values in the bone of human and animal species could offer an insight of the type of plant resources used.

- Nitrogen isotopic values, instead, are able to discriminate between terrestrial and marine and/or freshwater fish diet, through the value of δ15N. The presence of lacustrine deposits in many parts of our study area could have translated in fish-based diet, which might be detected in the isotopic signal of human and animal bone.

- Oxygen isotopic values are mainly linked to the coordinates of the place of residence and are able to express variation in rainfall as the heavier fraction of oxygen falls in precipitation. Also diet can affect oxygen values in the tissues. Although for this, we need a sound map of oxygen isotopic variation for the area.

- Finally, Strontium isotopes could represent an indirect evidence of climate changes, in the way they can describe human mobility. Sr ratio is linked to the geology of given regions and is reflected in bone composition of mobile vs. settled people.
In this perspective, we have analysed human and animal bone remains from 9 different sites in southwestern Fezzan.
They well represent the diverse geomorphological settings of this area, which include lowlands and wadi systems, mountain areas and upland plateaux.
The sites are in the Wadi Tanezzuft (In Aghelachem, site 96/129, and those of the Tanezzuft Transect), the rockshelters of the Acacus Massif (Uan Afuda, Uan Muhuggiag, Takarkori, Imenennaden), the open sites of the Messak plateau, as well as the sites from the Edeyen of Murzuq (MT).
### The (human and animal) skeletal sample

<table>
<thead>
<tr>
<th>Site</th>
<th>phase</th>
<th>14C age (uncal yrs bp)</th>
<th>males</th>
<th>females</th>
<th>indet.</th>
<th>juveniles</th>
<th>fauna</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uan Afuda</td>
<td>Late Acacus</td>
<td>8000</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>Uan Muhuggag</td>
<td>Late Acacus</td>
<td>8000</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Takarkori</td>
<td>Late Acacus Early, Middle, Late Pastoral</td>
<td>7500-4500</td>
<td>1(?)</td>
<td>4</td>
<td>-</td>
<td>3 caprovids</td>
<td>-</td>
</tr>
<tr>
<td>Imenennaden</td>
<td>Early Pastoral</td>
<td>6800</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>In Aghelachem</td>
<td>Late Garamantian</td>
<td>1600</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Tanezzuft Transect</td>
<td>Late, Final Pastoral Garamantian</td>
<td>3300</td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>96/129</td>
<td>Late, Final Pastoral</td>
<td>3800-2900</td>
<td>5</td>
<td>6</td>
<td>-</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>MT</td>
<td>Middle Pastoral</td>
<td>5600</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>cattle</td>
</tr>
<tr>
<td>MSRS</td>
<td>Middle Pastoral</td>
<td>5500</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>cattle</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td>12</td>
<td>11</td>
<td>3</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

Various archaeological phases are represented, ranging from Late Acacus sites to Pastoral as well as Garamantian contexts; a rough indication of corresponding chronological dates is provided in the table. Nearly 40 individuals were analysed from the various sites; probably the largest human skeletal dataset for the area. In addition to humans, faunal samples of different species, where selected, when available and with a firm chronological attribution.
Two lines of investigations are followed:

- On the one side, we have undertaken a study on Sr isotopes on human bone and teeth samples in order to detect patterns of mobility of the prehistoric groups of this region in relation to social and economic issues (Tafuri et al., 2006).

- A second aspect of our project is based on C and N stable isotope analysis on human and animal bones in order to reconstruct prehistoric dietary patterns in this changing environment.

Sr signature was tested against our understanding of the different economic strategies adopted by the prehistoric groups of the Fezzan over the millennia, in accordance with climatic changes that characterized the region. The greater resistance of enamel to diagenetic effects has driven our choice of using mainly teeth values, which reflect elemental composition built-up during childhood, but a few samples of bone were selected from each site to have an indication of the local signature during adult life.

Our theoretical premise lies in the belief that the progressive desertification of the Fezzan, over several millennia, carried different pattern of human economic strategies. This could have translated into differential patterns of mobility of the various groups that came to be based on the movement of people and resources, so that mobility became a 'resource' in itself.
When looking at the Sr values for each archaeological phase, earlier and later periods show a wider range of Sr signatures. This is somehow expected for the Garamantian, where highly heterogeneous groups may provide this type of signal, while is less easily explained for earlier contexts. The relatively restricted signal of the Pastoral groups, instead, is well explained by their highly specialized subsistence strategy, which might have translated in a specialized use of the environment, through localized, targeted mobility.
When looking at individual values the best perspective is offered by data from Takarkori and site 96/129, where we are able to apply a comparative approach within a ‘population’ (although it should be borne in mind that there are chronological gaps). It is interesting to observe how individuals from the Pastoral site of Takarkori show extremely homogeneous signatures, which speak in favour of a tight community, where mobility was likely to involve every member. Such a picture is not discordant from that of a group of herders, probably moving seasonally to recurrent areas.

Unlike at Takarkori, individuals from the various tumuli of site 96/129 show extremely heterogeneous signals that find the only exception for cases with clear evidence of kinship relations (tested through DNA analyses). This set of data seems to reflect a ‘dynamic’ community building up through the mixture of people of different origin. This could well be the case for the people at site 96/129, that during the later phases of the Pastoral, when increased aridity is affirmed, might have needed to rely on different economic as well as social resources, and increased mobility.
C and N isotope analysis is partly still in progress, and so far we are able only to present preliminary results, and are still testing different methods to extract collagen from these extremely depleted specimens.

In general, we find less problems with C analysis, for which we can match our data with those from the labs providing C14 dating. We are able to present a rather significant set of δ13C values from human and various animal samples coming from the different sites of the Fezzan. We are still at a very exploratory phase but some results are quite interesting, although our interpretation still speculative.

When trying to obtain once again a diachronic picture of possible variation in the diet, in accordance with climatic changes across time, it is quite interesting to observe how there seems to be a shift in C values. The earlier phases (namely Late Acacus and Early Pastoral) that in terms of climate are characterized by generally wetter conditions and occasional aridity, yield values that seem to indicate the reliance of human and animal species on a variety of sources. Carbon signature is somehow at the threshold between C3 and C4 values, as if the earlier foragers relied on various food resources, not necessarily favouring specific types of crops. This is somehow expected, however, slightly later phases (namely Middle and Late Pastoral), instead seem to provide δ13C values that are more in line with a dietary reliance on C4 plants, those better adapted to extremely dry conditions.

These values do not meet our expectations: in fact, especially during the Middle Pastoral, the climate is fairly humid and we were not ready to find Carbon signatures that refer to the consumption of plants well adapted to drier conditions. One way to interpret this result is by looking at the animals which
In conclusion, although at a preliminary stage, the results of our isotope study on human and animal remains from Southwestern Libya, have revealed in some cases a good correspondence between archaeological expectations and bone chemistry, while providing new evidence which call for further archaeological debate.

We have observed how different economic systems translated into differential mobility and use of the lived-in environment. Similarly, climate changes seem to be reflected in the reliance on food resources of the prehistoric people of the Fezzan.

We need, however, a stronger database in terms of number of samples, both human and animal, and further analytical progresses; for example, we are hoping to be able to identify N values in these extremely depleted bones.

There is still much to do, but I believe these first results add relevant information to our knowledge of ancient Saharan societies in terms of food security and social organization.
Selected Bibliography


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