The Role of Ethnobotany in Stable Isotope Studies of Human Skeletal Remains, Baja California Sur

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Abstract

Reconstructions of human diet via stable isotopes of carbon ($^{13}C/^{12}C$) and nitrogen ($^{15}N/^{14}N$) in human tissues benefit by collaborations with researchers in ethnobotany, and its subdiscipline of archaeobotany. Archaeobotanists examine the surviving plant record to suggest past subsistence, although such reconstructions lack information on important aspects of ancient life, such as diet breadth and relative reliance on specific foods. Short-lived plants within the archaeobotanical record are appropriate for radiocarbon dating to establish chronology of site occupation. Researchers with botanical backgrounds attach scientific names to plant resources referred to in historic literature only by description, or by common or indigenous name. The combined archaeobotanical and historical records of foods for a region help direct which plants should be included in modern stable isotope studies, in order to establish a local baseline against which isotopes in ancient human tissues can be compared. As field collaborators, ethnobotanists develop vouchered herbarium collections, and document both landform preferences and season of availability of plant resources, to more fully understand human movements for plant collecting on a specific landscape, and to suggest seasons when specific resources can be acquired. Ethnobotanical contributions to reconstructing prehistoric diet via stable isotopes for The Las Palmas Archaeology and Bioarchaeology Project of Baja California Sur are outlined in this paper.

Abstracto

Las reconstrucciones de la dieta humana vía isótopos estables de los tejidos finos humanos de carbono($^{13}C/^{12}C$) y nitrogeno($^{15}N/^{14}N$) benefician por colaboraciones con los investigadores en etnobotania, y su subdisciplina de arqueobotania. Las arqueobotanistas examina el expediente de la planta el sobrevivir para sugerir más allá de subsistencia, aunque tales reconstrucciones faltan la información sobre aspectos importantes de la vida antigua, tales como anchura de la dieta y confianza relativa en los alimentos específicos. Las plantas de breve duración dentro del expediente arqueobotanical son apropiadas para la fecha del radiocarbono para establecer la cronología de la ocupación del sitio. Los investigadores con sus educaciones botánicos asocian nombres científicos a los recursos de las plantas mencionadas en la literatura histórica solamente por la descripción, o por nombre común o indígena. Los expedientes combinados de arqueobotanistas e históricos de los alimentos para una región ayuda a ordenar cuales plantas se deben incluir en los estudios estables y modernos del isótopo, para establecer una línea de fondo local contra la cual los isótopos en tejidos de humanos antiguos puedan ser comparados. Como colaboradores del campo, las etnobotanistas se convierten unas colecciónes garantizadas de los herbarios, y documentan las preferencias de la tierra y la estación de la disponibilidad de los recursos de la plantas, a entienden más completamente los movimientos humanos para cosechar las plantas en un paisaje específico, y sugerir las estaciones cuando los recursos específicos pueden ser adquiridos. Las contribuciones de las etnobotanistas a la reconstrucción a la dieta prehistorica vía los isótopos estables para el proyecto de la argueologia de Las Palmas y el proyecto de bioarqueologia de Baja California Sur se contornean en este papel.

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Introduction

Ethnobotany, including the sub-discipline of archaeobotany, contributes more than one type of data relevant to reconstructing diet via stable isotopes of carbon and nitrogen preserved in ancient skeletal tissues. Archaeobotanists identify and interpret plant parts from archaeological sites to reconstruct subsistence, and locate annuals or other short-lived plants useful in establishing chronology via radiocarbon dating. Historic literature of a region requires botanical expertise to determine the identities of historic dietary staples that may reflect long-standing subsistence resources and choices. Modern plant reconnaissance, as illustrated here by the Las Palmas Archaeology and Bioarchaeology Project of Baja California Sur, helps provide sound, geographically specific baseline data on the stable isotope signatures of important plant foods. At the same time, such modern reconnaissance acquires distributional and phenological (seasonality) information helpful in understanding geographic and seasonal timing aspects of plant gathering by ancient groups. The research reported here pertains to the Cape region of Baja California Sur.

Plant Parts from Archaeological Sites

The archaeobotanical plant record offers an important glimpse into ancient foods, fuels, and plants serving everyday needs. *Macrofossils*, or the larger plant parts recognized by archaeologists during excavation, often complement *microfossils* such as minute seeds, pollen grains, charcoal fragments, opal phytoliths, and starch granules that preserve as very small particles in site sediments routinely taken for water or chemical processing. The two size classes of materials can provide independent or complementary information relevant to understanding past plant use. Archaeobotanists must consider issues related to sampling, identification, and quantification of parts recovered, prior to offering interpretations.

There is a wide variety of constraints on the archaeobotanical record that make it very difficult to estimate or comment on the specifics of human diets. One can sometimes recover those plant resources that happen to leave sturdy reproductive parts behind during accidents of food processing, but often missing are: a) resources that have fragile parts (e.g. leafy greens or fleshy fruit), b) foods not accidentally burned during preparation, c) foods hard to identify via anatomical structure (e.g. roots and other underground organs), and d) foods normally sought and eaten away from habitations. Human coprolites, so critical for documenting at least short episodes of food consumption, rarely preserve. Occasionally food residues (e.g. proteins, starch granules, phytoliths) remaining on stone tools suggest some past foods. Generally, however, the archaeobotanical record offers a muted view of past human subsistence, providing at best a partial list of foodstuffs to the physical anthropologist studying ancient diet via stable isotopes preserved in human bone.

Materials for Radiocarbon Dating

Archaeobotanists are often asked to search through site soil to help identify ancient plant resources with a short life span, such as the remains of seeds or fruit gathered from annual plants, to provide material for radiocarbon dating. This is especially critical in the southern Baja California Sur area, where the ocean serves as a reservoir for old carbon, and where human diets drawing upon Pacific Ocean and Gulf of California marine resources incorporate unknown portions of this old carbon into skeletal elements, making accurate dating of the skeletons themselves extremely difficult (Molto et al. 1997). Since establishing a sound chronology is one of the first tasks of an archaeologist, archaeobotanists help identify and recommend appropriate specimens to date archaeological site occupation.

Historic Ethnographic Literature

Literature written in post-contact times provides a reservoir of information on human knowledge of and choices of plants on a given landscape. Sometimes botanical scholars find it difficult to attach a modern taxonomic name to a very old description of a plant. There are still plants in historic literature to which names haven't been attached, and some of them may have been very important, perhaps even semi-domesticates or once-managed plants, now lost to human history. As helpful as they are, it is unlikely that these historic records reveal complete details on subsistence or diet, or that they reflect unchanging subsistence regimes over the centuries. Also, independent paleo-environmental records, such as the materials in packrat middens or pollen assemblages deposited in wetlands, often reveal changes in plant communities of the past, likely the result of both natural and anthropogenic forces. Despite these complications, it is reasonable to assume that some of the major food resources presently available in a region may have some continuity of human use through time, even if their relative representation on a landscape, and/or the relative reliance on them by people, has changed.

Baja California Sur Literature

Valuable sources of information on Colonial era indigenous groups in Baja California Sur include a number of translations of written letters or reports made by 18th century Jesuit missionaries (Aschmann 1986). Homer Aschmann (1966) served as translator and editor of a manuscript written in 1765 by Padre Norberto Ducrue, after the Padre had lived on the peninsula for 28 years. The writings of Padre Fernando Consag, another resident of Baja California Sur in the mid-1700's (Aschmann 1966), are also available. At roughly the same time, Miguel del Barco (1980, 1981) spent 30 years in Mission San José de Javier, 50 km west of Loreto, and wrote extensively on plant use. Some of this literature was synthesized by William Massey in his doctoral work (1955). Just to the north, in the Central Desert region of Baja California, Homer Aschmann (1959) provided an important review of plant uses by former inhabitants of this particularly arid region. More recently, Reygadas and Velázquez (1983) have presented an overview of the prehistoric and historic occupants of southern Baja California Sur, outlining a subsistence model extending over the calendar year.

From the above literature, it appears that the Baja California Sur groups were entirely dependent on their hunting and gathering efforts, which included marine resources. The Padres reported no plant domesticates, no pottery containers for food preparation, and that indigenous groups moved frequently to find enough to eat. The Padres revealed that occasionally people swallowed and retrieved the same piece of meat tied to a string, possibly in a ritual context or to insure that more people shared scarce protein; they also practiced the "second harvest," which is retrieval of seeds that have previously passed through the human digestive tract. Miguel del Barco (1981) reports that the Baja California Sur occupants divided their year into six parts that started with a time called *meyibo*, which was the season of *pitaya dulce* (*Stenocereus thurberi*) fruit harvest from mid-June through mid-August, and ended with a season of great hunger from April to early-June

Potential Major Food Products

Because of the efforts of these historians and researchers, there is a reasonable list of some of the wild plants considered important during the 18th century Mission period. At least five species of *mezcal* (*Agave aurea, A. capensis, A. datylio, A. promontorii* and *A. sobrina*) grow in Baja California Sur (Gentry 1982; Lenz 1992:5-6), and historical accounts have stressed that *Agave* provided the "daily bread" of native peoples (Aschmann 1959:79). *Agave* hearts offer both food and beverage, and the leaves are a useful source of fibers. Two valued columnar cacti were *pitahaya* (*Stenocereus thurberi*), also known as *pitaya dulce*, a large cactus with sweet fruits covered with spines, and its relative *pitaya agria* (*S. gummosus*) having somewhat sour-tasting fruit. Other foods included oil-rich *jojoba* (*Simmondsia chinensis*) seeds and *San Miguel (Antigonon leptopus*) seeds, whose value as a food seems high since mature fruits can cling to plants for months, into the most food-stressed time (May) of the year. Dependable *mesquite* (*Prosopis* sp.) pods, and fruits of many other legumes, were also gathered. Other foods included: annual plants such as *verdolaga* (*Portulaca sp)., Chenopodium* spp., and *Amaranthus* spp., all offering abundant leafy greens (*quelites*) and seed harvests; fruit and seeds of *nopal* (*Opuntia* spp.), *cholla* (*Opuntia* spp.), *biznaga* (*Ferocactus townsendianus*) and *cardón (Pachycereus pringlei)* cacti; fruit of *dátil* (*Yucca* sp.) and *ciruelo* (*Crytocarpa edulis*); *encino* (*Quercus* spp.) acorns; *piñon (Pinus lagunae*) nuts; and *higos* (*Ficus palmeri*) fruit (all taxonomy according to Lenz 1992).

Las Palmas Archaeology and Bioarchaeology Project

Armed with this background from historic literature, the "modern studies team" of the Las Palmas Archaeology and Bioarchaeology Project, led by Theresa Schober, spent two weeks on the arid landscape collecting specimens of as many of the historically reported important resources as possible, plus any additional cacti present (Table 1). Plant tissue samples are

Table 1. Plants collected in transects of this study. Taxonomy according to Lenz (1992)

Spanish Name	Scientific Name
pitaya dulce	*Stenocereus thurberi* (Engelm.) Buxbaum.
pitaya agria	*Stenocereus gummosus* Engelm.
cardón	*Pachycereus pringlei* (S. Wats.) Britt. & Rose
garambullo	*Lophocereus schottii (*Engelm.) Britt. & Rose
nopal	*Opuntia* spp.
cholla	*Opuntia* spp.
biznaga	*Ferocactus townsendianus* Britt. & Rose
viejito	*Mammillaria* spp.
mezcal	*Agave* spp.
jojoba	*Simmondsia chinensis* (Link.) C.K.Schneider
San Miguel	*Antigonon leptopus* Hook. & Arn.

backed by 138 herbarium voucher specimens, and each collecting stop was located via a G.P.S. (global positioning system). The collection of vouchers is especially important because, long isolated from the mainland and further cut off to the north by the arid central desert region of Baja California, the Cape region of Baja California Sur has developed a high proportion of endemism in its flora (Luz et al. 1995), making plant identification especially challenging. The modern studies team also documented landform preferences and phenology (seasonality) of the plants; information on geographic distribution and the calendrical timing of resource availability allows a better informed reconstruction of seasonal gathering rounds.

Collection efforts concentrated on establishing baseline plant population data on variability of stable carbon and nitrogen isotopes in plant tissues, and on revealing any differences in isotopic signatures due to elevation and/or proximity to either the Pacific Ocean or the Gulf of California. Ratios of stable carbon and nitrogen isotopes in human bone are potential indicators of past human diet (Ambrose 1993; Schoeninger and Moore 1992). As for carbon, differences in stable carbon isotope ratios of consumers begin ultimately at the level of plant photosynthetic processes. Plants can represent one of three photosynthetic strategies, e.g. C3, C4 and CAM (Crassulacean Acid Metabolism) pathways (Smith 1972; Smith and Epstein 1971; Mooney et al. 1974), each pathway fixing differing proportions of $^{13}C/^{12}C$. Many plants in temperate regions utilize the C3 pathway, for example Baja California Sur species of *encino, piñon, mesquite* and *jojoba*. Grasses and other plants of interest to humans, such as species of *Amaranthus, Chenopodium* and *Portulaca*, use the C4 pathway. The CAM strategy is common among cacti and other succulent taxa. As for the stable nitrogen isotopes $^{15}N/^{14}N$, it has been suggested that soil salinity, climate and vegetation can affect the ratios (Karamanos et al. 1981), as can saline sea spray incorporated into soil of plants growing adjacent to oceans (Heaton 1987).

The team concentrated on two transects across Baja California Sur, one on the Pacific Ocean side located between Todos Santos and Cabo San Lucas, and the other transect located on the Gulf of California side near Cabo Pulmo. Prehistoric human burial caves are located within the vicinity of each of these transects, so it is reasonable to assume that plants in these two areas were of interest to prehistoric groups. Each transect was intended to encompass a range of elevations. Each transect also included collection stops near and far from oceanic salt water spray, to document differences in nitrogen isotope signatures linked to soil salinity affected by salinity and temperature differences between the Pacific Ocean and the Gulf of California, or due to other soil chemistry variables. Project results are forthcoming.

Summary

Ethnobotany can contribute to stable isotope analysis of ancient human remains in more than one way. Via preserved plant parts in ancient sites, archaeobotanists offer insights into prehistoric subsistence. They can also identify short-lived materials appropriate for radiocarbon dating, especially important in the Cape region of Baja California Sur, where human bone and archaeological remains of marine origin are currently poor candidates for such attempts. For the Las Palmas Archaeology and Bioarchaeology Project, an ethnobotanist on the modern studies team helped establish modern baseline data on the stable carbon and nitrogen isotope signatures of a number of historically important plant foods, especially cacti. This work was supported by a collection of 138 plant voucher specimens, especially important in the study region where a high degree of plant endemism has been fostered by long-term isolation of the peninsula from the mainland. The list of plants studied was suggested by the rich 18th century literature of Baja California Sur, some of it translated and interpreted by scholars with botanical backgrounds. Ethnobotanists and archaeobotanists offer more than one means to enhance efforts to reconstruct human diet via stable isotope analysis.

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