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MIDDEN AND COPROLITE DERIVED SUBSISTENCE EVIDENCE: AN ANALYSIS OF DATA FROM THE LA QUINTA SITE, SALTON BASIN, CALIFORNIA

MARK Q. SUTTON
Department of Sociology and Anthropology
California State University, Bakersfield
9001 Stockdale Highway
Bakersfield, CA 93311-1099

ABSTRACT.—An analysis of resource constituent remains recovered in coprolites from sites in the Salton Basin, California, reveals several patterns of food availability, preference, and utilization. Specific combinations of foods are noted, indicating possible "meals." The coprolite data, combined with traditional faunal and floral analyses, form a more comprehensive view of subsistence. It is recommended that noncoprolite data be integrated into coprolite studies.

RESUMEN.—Un análisis de los restos de los materiales constitutivos recuperados en coprolitos encontrados en algunos sitios de la cuenca del lago Salton, en California, muestran varios patrones de disponibilidad, preferencia, y utilización de alimentos. Se notan combinaciones específicas de alimentos, indicando posibles "comidas." Los datos derivados de los coprolitos, combinados con los análisis tradicionales de fauna y de flora, proporcionan una visión más completa de la subsistencia. Se recomienda que a los estudios sobre coprolitos se integren datos no derivados de los coprolitos mismos.

RÉSUMÉ.—Une analyse en resources constituantes des excréments humains, récupérés en coprolites des sites dans le Bassin "Salton" en Californie, révèle de différents modèles de la disponibilité des aliments préférés et utilisés. Des combinaisons spécifiques des aliments sont constatées indiquant des "repas" possibles. Les données sur le coprolite, combinées avec des analyses traditionnelles de la faune et de la flore, constituent une vue de subsistence plus complète. C'est à conseiller que les données noncoprolites soient intégrées dans lés études coprolites.

INTRODUCTION

Coprolites, preserved human fecal matter, constitute a source of considerable information regarding prehistoric diet, nutrition, health, and pharmacology (see Fry 1985, Sobolik 1990, and Reinhard and Bryant 1992 for recent reviews of coprolite studies). Unfortunately, coprolites are very fragile and susceptible to decomposition, and so rarely are recovered archaeologically.

Coprolites form direct evidence of substances consumed, although not always as food, as opposed to standard faunal and floral remains, which form indirect dietary evidence. Archaeologists studying coprolites make a number of assumptions, often with great merit, regarding the nature and origin of the specimens.

First, it is assumed that materials present in coprolites were ingested by the person from whom the coprolite came and that such materials can be readily identified. Secondly, coprolites usually are viewed as largely representing the subsistence aspect of diet, with the identification of substances ingested for ceremonial and/or medicinal purposes being more difficult to interpret (Shafer et al. 1989). Third, it is assumed that each specimen represents a unique elimination event and is not mixed or combined with other such events. In spite of this, obvious fragments, possibly representing separate events, frequently are grouped together as one specimen for analysis. Further, it generally is assumed that materials present in a coprolite represent the food consumed within the 24-hour period preceding its deposition (e.g., Fry 1985:128), although this may not be the case (e.g., Sobolik 1988a:207; Jones 1986). As such, coprolites likely are a combination of several meals (e.g., Watson 1974:240).

Other factors are of note in coprolite analysis (see Sobolik 1988b:114). As the surviving (i.e., visible) materials are those that were not digested, only the indigestible part of the diet is visually represented and we do not understand all the taphonomic problems (i.e., digestion, processing, preservation, and so on) associated with coprolites. For example, large mammals will not be visually represented in coprolites, nor will animals that have been subjected to certain types of processing (e.g., filleting fish). However, this situation is changing with the addition of the immunological technique that can identify nonvisible constituents (Newman et al. 1993). Coprolites may be discovered singly or in concentrations that probably represent latrines. While the population responsible for a latrine coprolite deposit generally is assumed to be homogeneous, this may not be the case. If a particular segment of the population (e.g., with particular culinary customs) used a specific latrine, the sample would be skewed and the interpretations incorrect. Latrine reuse over time may be an additional concern. However, since these factors cannot currently be controlled, most researchers appear to assume sample homogeneity. Cumming's (1989) study of coprolites from Nubian mummies is a rare example of these factors being known.

Most researchers focus on the inter-specimen variation, a general analysis of constituents present in a sample of coprolites. Relative abundance is assumed to represent relative importance in the diet. However, little attention is given to patterns of resource combination and utilization (i.e., intra-specimen variation). The goal of the present study is to determine the patterns of food preferences and combinations within a sample of coprolites from the La Quinta site (CA-RIV-1179) in the Salton Basin, California and to integrate noncoprolite (i.e., midden-derived) faunal and floral data into an overall view of site-specific subsistence.

THE SALTON BASIN DATA BASE

Coprolites have been recovered from six open sites in the northern Coachella Valley as part of excavation projects (Fig. 1). All sites lie within the ethnographic territory of the Cahuilla Indians (Bean 1978) who probably occupied the region at least since the final stand of Lake Cahuilla, some 500 years ago (Wilke 1978). The analysis of each of these coprolite series was conducted by first rehydrating the specimens in a solution of trisodium phosphate. Specimens then were filtered, dried, and passed through a series of small screens. Recognizable constituents

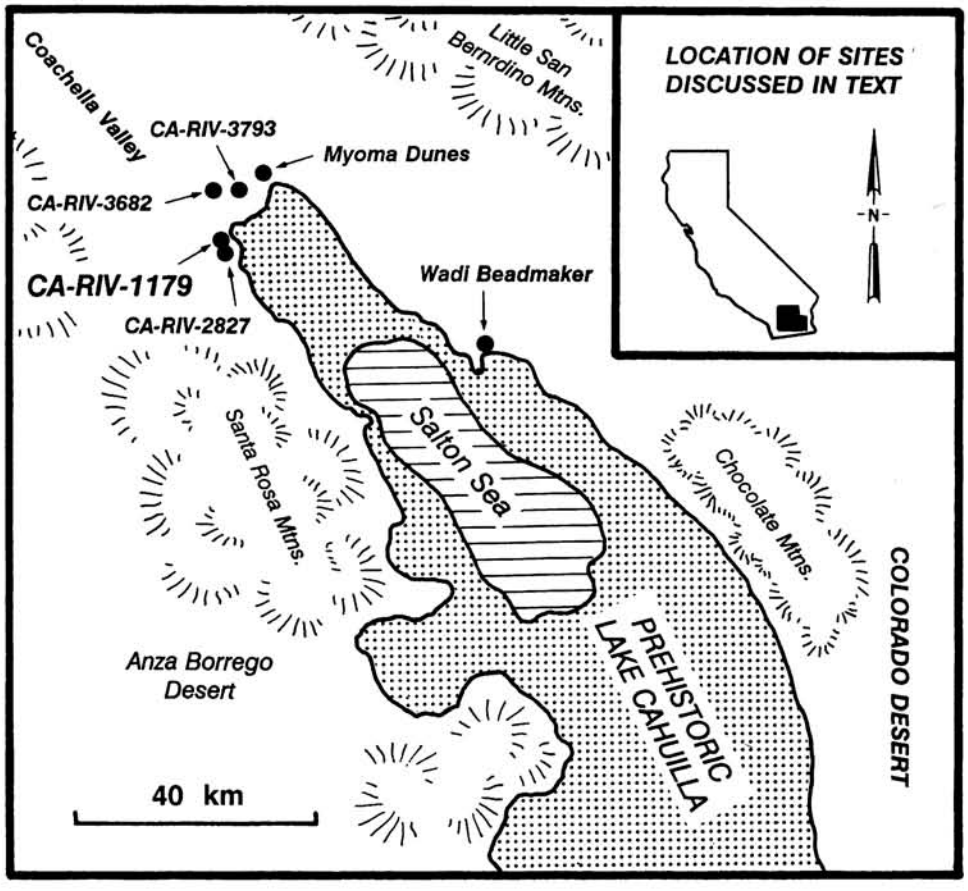

FIG. 1.—Location of prehistoric Lake Cahuilla and sites discussed in the text (adapted from Wilke 1978: Fig. 3).

were sorted and identified. Relative abundance was estimated following established techniques used in wildlife biology (see Wilke 1978:154–157 for a complete description of analytical techniques).

Three of the sites, CA-RIV-3682 (Yohe 1990), CA-RIV-3793 (Goodman and Arkush 1990; Goodman 1990), and CA-RIV-2827 (Sutton and Wilke 1988a; Farrell 1988) are small and contained limited assemblages of artifacts, ecofacts, and coprolites. The other three sites contained much larger numbers of coprolites plus other faunal and floral data.

The first of the larger sites, Myoma Dunes, is a series of habitation areas located in mesquite-anchored sand dunes along the northernmost shore of Lake Cahuilla and generally dates to the final stand of the lake, approximately A.D. 1500. Many artifacts, ecofacts, and about 1,000 coprolites were discovered. The site is located on the valley floor and is not directly adjacent to upland habitats. Analysis of materials recovered from the site was limited to a sample of the coprolites (Wilke 1978) and few complementary ecofactual data were reported.

The second large site, Wadi Beadmaker, is the remnant of an extensive camp located along the northeastern shore of the lake; it also dates to the final lake-stand. Excavation at the site resulted in recovery of numerous artifacts, ecofacts, and approximately 70 coprolites. As with Myoma Dunes, analysis of materials recovered from the site was limited to the coprolites (Wilke 1978) and no complementary ecofactual data were reported.

The third site, the La Quinta site (CA-RIV-1179), is located in an ecotone of at least three environmental zones (lake shore, desert, and mountain) along the northwestern shore of the former lake. The site was excavated in 1985. La Quinta consisted of a fairly large open camp dating from the final stand of Lake Cahuilla (ca. A.D. 1500) and contained numerous artifacts, ecofacts, cremations, and 128 coprolites. A full analytical report on the recovered materials was produced (Sutton and Wilke 1988a); this is the only such comprehensive report for a major site in the region.

Farrell (1988) analyzed 30 coprolites from the La Quinta site. Most were discovered in a relatively small area, suggesting the presence of a latrine. Macroscopic floral and faunal elements were identified to taxon where possible, the remainder being classified as unidentified fragments (Farrell 1988:132–133). Several specimens appeared to consist primarily of pollen, which was identified; however, no general pollen or phytolith studies were conducted on the samples. Abundance of materials recovered from the coprolites was ranked as abundant, frequent, infrequent, or trace based on the volume of material in each specimen.

Farrell (1988) noted fish bone in all analyzed coprolites. Two species, bonytail chub *(Gila elegans)* and razorback sucker *(Xyrauchen texanus),* were identified. Two other fish, the Colorado squawfish *(Ptychocheilus lucius)* and mullet *(Mugil cephalus),* also were present in prehistoric Lake Cahuilla. Mullet remains are abundant at some other lakeshore sites (Follett 1988:154) but were not identified at La Quinta. Squawfish remains were observed in the midden at the La Quinta site (Follett 1988:154).

Seven examples of articulated fish vertebrae were recovered from the La Quinta midden (Follett 1988); six bonytail chub and one razorback sucker. Five of the six chub examples consist of caudal vertebrae, indicating that tails had been removed and discarded (unconsumed?). The sixth chub specimen consisted of eight precaudal vertebrae. The razorback sucker specimen consisted of (apparently) precaudal vertebrae. This could possibly be the remains of a filleted fish.

THE CURRENT STUDY

The objective of this study was to conduct a comparative analysis of the La Quinta coprolite constituents (from Farrell 1988) to determine whether any patterns of resource utilization were present. Such patterns might include food combinations that could be used to delineate dietary preference or habits (i.e., meals) and differences in the seasonal use of resources. Faunal and floral materials recovered from the general midden were then compared to the coprolite data in an attempt to discover additional patterns between the two data sets.

Methods.—The constituents identified in the La Quinta coprolites (Table 1) (Farrell 1988) were compared using a hierarchical cluster analysis, part of SPSS-PC (Statistical Package for the Social Sciences, Personal Computer). Membership to a

TABLE 1.—Coprolite clusters by constituent, CA-RIV-1179.

Specimen[1]	Resource [2,3]																	
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
Cluster One																			
6 (24–32)	0	0	1	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	1
22 (16–48)	0	0	1	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	1
12 (19–33)	1	0	1	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	1
7 (23–33)	1	0	1	0	0	0	0	0	0	0	0	1	4	0	0	0	0	0	1
10 (19–38)	1	0	1	0	0	0	0	0	0	0	0	1	4	0	0	0	0	0	1
3 (25–14)	0	0	2	0	0	0	0	0	0	0	0	0	4	1	0	0	0	0	1
29 (SC–4b)	0	0	1	0	0	0	0	0	0	0	0	0	4	1	0	0	0	0	1
2 (25–22)	0	0	2	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	1
21 (16–49)	0	0	1	0	0	0	0	0	0	0	0	0	4	1	0	0	0	1	1
30 (SC–4a)	1	0	1	0	0	0	0	0	0	0	0	0	4	1	0	0	0	1	1
9 (23–30)	0	0	3	0	0	0	0	0	0	0	0	1	4	0	0	0	0	1	1
27 (16–32)	0	0	3	0	0	0	0	0	0	1	0	0	3	1	0	0	0	0	1
14 (17–51)	0	0	4	0	0	0	0	1	0	0	0	1	4	1	1	0	1	1	3
Cluster Two																			
5 (24–35)	0	0	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
20 (16–67)	0	0	3	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
4 (24–36)	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
1 (25–26)	0	0	4	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	2
17 (17–45)	0	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
18 (17–26)	0	0	3	1	0	0	0	0	1	0	0	1	0	1	0	0	0	0	4
28 (4–6)	0	0	4	0	1	0	0	0	0	0	0	1	1	0	0	0	0	1	4
Cluster Three																			
11 (19–35)	4	0	4	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2
19 (16–68)	4	0	4	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	2
16 (17–46)	4	0	4	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	2
23 (16–43)	4	0	4	0	0	0	0	0	0	0	0	0	1	2	1	0	0	1	2
15 (17–47)	4	0	4	1	0	0	0	0	1	0	0	0	2	1	0	0	0	0	3
26 (16–34)	4	0	4	1	0	0	0	0	1	0	0	0	2	1	0	0	0	0	3
13 (19–24)	3	0	3	0	0	0	0	0	0	0	0	0	3	1	0	0	0	1	2
25 (16–36)	4	0	4	0	0	1	0	0	0	0	0	0	4	0	0	1	0	1	4
Cluster Four																			
8 (23–32)	0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3
24 (16–39)	0	4	4	0	0	0	0	0	0	0	1	0	4	1	0	0	0	0	2

[1]Computer specimen numbers (1–30; see dendrogram); catalog numbers in parentheses

[2]Taxa list:

A bonytail *(Gila elegans)*
B razorback *(Xyrauchen texanus)*
C unident. fish
D tortoise *(Xerobates agassizii)*
E chuckwalla *(Sauromalus obesus)*
F unident. reptile
G cottontail *(Sylvilagus audubonii)*
H unident. mammal
I unident. vertebrate
J mussel shell *(Anodonta)*
K land snail *(Physa)*
L unident. insect
M cattail *(Typha)*
N bulrush *(Scirpus)*
O dicoria *(Dicoria canescens)*
P mesquite *(Prosopis* spp.)
Q goosefoot *(Chenopodium)*
R unident. seeds
S charcoal

[3]Abundance codes: 4 = abundant (A); 3 = frequent (F); 2 = infrequent (I); 1 = trace (T); 0 = not present

cluster was based on nearest neighbor to the center of the clusters, defined as average mean of the cluster. Numeric values (4 through 0) were assigned to the abundance rankings (abundant, frequent, infrequent, trace) given in the original study, with zero used to designate absence.

Results.— Four main clusters were defined in the analysis (Fig. 2). Each of these clusters exhibits a remarkably clear tendency of utilization of a particular resource.

Cluster One. Cluster One (n = 13) is dominated by cattail (*Typha* anthers and pollen; Farrell 1988:135); it being ranked very abundant (i.e., comprising over 50% of the mass of the specimen) in 12 of 13 samples and frequent in the other. Few fish, all identified as bonytail chub, are present; bulrush seeds (or tule; *Scirpus*) are present in trace amounts in six of the samples. No reptile remains, and only one fragment of an unidentified mammal, are present in these specimens. Charcoal occurs in only trace amounts in this cluster.

Cattail clearly was the major resource represented in this cluster. No cattail seeds were found, pollen apparently being the primary constituent in the samples (Farrell 1988:135). As it appears that at least some pollen may remain in the digestive tract up to a month after ingestion (Sobolik 1988a:208), large quantities likely represent meals while trace amounts may be residuals from earlier meals. After cattail, fish clearly is of secondary importance. Due to the low occurrence of charcoal in the samples, the fish may represent processed (e.g., dried) foods. Nonfish animal resources appear not to have been consumed in conjunction with cattail.

Farrell (1988:135) felt that the cattail was consumed raw. Cattail pollen is available fresh from May to July (Shreve and Wiggins 1964:229), suggesting that the Cluster One coprolites date from that season. Fish also should have been available in quantity during that time and their relative paucity may be the result of people concentrating on the collection of cattail.

Cluster Two. This cluster (n = 7) is dominated by unidentified fish which are mostly charred. No elements could be identified to genus. Present also are the only cottontail *(Sylvilagus)* and chuckwalla (*Sauromalus;* three scapulae in one specimen) remains identified during the study. Few plant resources were identified in this cluster and charcoal is abundant in only two specimens.

The specimens comprising Cluster Two may reflect a diet centered on the consumption of small terrestrial animal resources. This hypothesis is based on the absence of both identified fish and substantial floral remains and on the presence of (albeit few) terrestrial remains.

The presence of unidentified fish remains ranked as frequent in this cluster suggests that fish had been processed; perhaps fillets were made and dried (charred bone and infrequent charcoal being the result of the drying process) or fish (and bones) were ground on a metate. If this interpretation is correct it suggests the consumption of stored fish.

In light of the possibility discussed below, that bonytail were processed in two different ways, one resulting in the elimination of most bone, it is possible that the unidentified fish remains were bonytail and that fish was an important constituent in Cluster Two. Most visible remains (bones) were simply absent. Protein (immu-

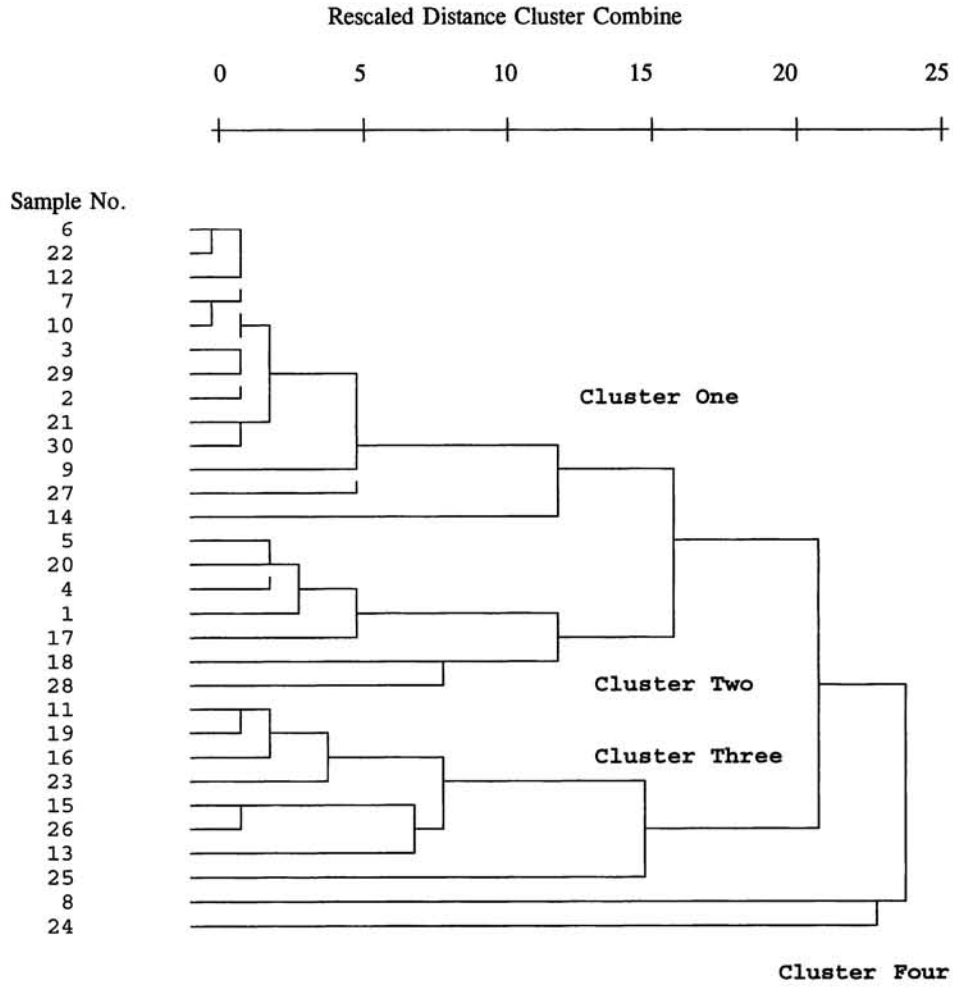

FIG. 2.—Dendrogram illustrating the clustering of coprolite constituents from the La Quinta site (CA-RIV-1179).

nological response) studies on coprolite matrix may be useful for addressing this possibility (e.g., Newman et al. 1993).

If one were to view the fish remains as evidence for consumption of stored foods, a late winter/early spring season of deposition may be indicated. The presence of chuckwalla remains suggests spring or later (Wallace 1978:109).

Cluster Three. Cluster Three (n = 8) is dominated by bonytail and unidentified fish remains (mostly charred); razorback sucker was not identified in the cluster. Tortoise and unidentified reptile are present, as is unidentified vertebrate bone. Cattail and bulrush seeds are often present, but only once in quantities considered abundant. Charcoal is present above trace amounts in each of the specimens.

In the Cluster Three samples, bonytail clearly is the primary identified resource consumed. Charcoal is relatively abundant in the specimens in this cluster and

many bones were charred (Farrell 1988:137). This suggests that fish were placed in an open fire to cook and consumed partially charred.

Bonytail remains from the midden, however, are mostly uncharred, suggesting that the fish were baked (Wilke and Sutton 1988:160). This indicates that bonytail were perhaps processed in one of two ways: (1) broiled with both meat and (charred) bone being consumed; or (2) baked with meat being removed and eaten and uncharred bones discarded.

Bulrush seeds (Farrell 1988:135) are consistently present in small quantities in the Cluster Three samples and may have been consumed in conjunction with bonytail. Bulrush produces seeds between May and August (Munz 1974:902), overlapping occurrence with cattail, although Farrell (1988:135) thought that bulrush was stored and then eaten with cattail. Bulrush formed a major constituent in some coprolites from Myoma Dunes (Wilke 1978).

Cluster Four. The fourth cluster (n = 2) contains abundant razorback and unidentified fish remains, bonytail not being identified in either specimen. Charcoal also is present in greater than trace amounts. Cattail seed is abundant in one of the specimens.

The general absence of razorback suckers in the coprolites is interesting since they are much more common in the general midden (Follett 1988). Suckers contain a large number of small bones and may have been processed differently than bonytail (e.g., filleted and broiled instead of baked whole; see McGinnis 1984:294 for observations in this regard). Thus, it is possible that razorback was a more important resource than indicated in the coprolites.

Discussion. Fish remains were consistently present in all samples although their abundance and condition (identification) varied considerably. Even if whole fish are consumed, most bone is digested (i.e., 90%; Jones 1986:55) and so not present in the visual elements of a coprolite. While this certainly impacts absolute values of fish bone abundance, it is the working assumption here that relative values are unaffected.

Several patterns are apparent in the coprolite evidence from CA-RIV-1179. First, it is clear that diet was not uniform but varied, likely on a seasonal basis. Second, the importance of fish (and other aquatic) resources appears to have changed seasonally, in spite of the presumed constant availability of fish (seasonal availability, if any, of specific fish is unknown).

Several combinations of resources were noted, forming, perhaps, the remains of "meals." Cattail (pollen, either alone or with flower heads) appears to have been consumed largely alone. Terrestrial animals seem not to have been consumed in meals with cattail, although some fish (mostly unidentified) was included. In addition, bulrush often was identified in specimens containing bonytail.

Fish, commonly viewed as a staple and perhaps even an everyday resource (e.g., Wilke 1978; Farrell 1988), appear to have formed a secondary dietary constituent during at least that portion of the year when cattail was consumed. Bonytail seems to have been the preferred fish, although razorback occasionally was obtained (the same pattern existed at Myoma Dunes Bed A; Wilke 1978:82). However, if razorback were filleted, that may account for the absence of its bones in the samples.

TABLE 2.—Floral remains from the midden recovered by flotation, CA-RIV-1179 (from Swope 1988: Table 22).

Origin	Cat. No.	Species
Hearth 1	108-4-6A	*Chenopodium, Juncus, Oligomeris linifolia, Prosopis glandulosa* var. *torreyana, Scirpus acutus, Scirpus, Sesuvium verrucosum,* unidentified
Hearth 2	108-4-33	*Chenopodium, Scirpus acutus, Scirpus validus, Sesuvium verrucosum*
Hearth 3	108-8-9A	*Chenopodium, Juncus, Oligomeris linifolia, Prosopis glandulosa* var. *torreyana, Scirpus acutus, Scirpus validus, Sesuvium verrucosum,* unidentified
Hearth 4	108-17-56	*Chenopodium, Juncus, Scirpus acutus, Scirpus validus, Sesuvium verrucosum,* unidentified
Hearth 5	108-8-21	*Amaranthus, Juncus, Prosopis glandulosa* var. *torreyana, Scirpus acutus, Scirpus validus, Sesuvium verrucosum, Typha*
Hearth 6	108-8-29	*Scirpus acutus,* unidentified
Hearth 7	108-12-25	*Scirpus*
Hearth 8	108-12-27	*Chenopodium, Scirpus acutus, Sesuvium verrucosum*
"	108-12-34	*Scirpus acutus,* unidentified
Hearth 9	108-14-33	*Scirpus acutus*
Soil Sample	108-16-73	*Chenopodium, Juncus, Scirpus acutus, Scirpus validus, Sesuvium verrucosum*
Soil Sample A	108-19-21	*Chenopodium, Juncus, Scirpus acutus, Sesuvium verrucosum*

Razorback was not identified in the same coprolite as bonytail. This is somewhat intriguing since razorback is the larger fish (McGinnis 1984:148, 166). The historic Indian tribes of the lower Colorado River considered razorback a primary food fish (Castetter and Bell 1951:219) and procured them using the bow and arrow, nets, hook and line, and basketry traps (Castetter and Bell 1951:220–222). It is possible that razorback and bonytail were taken at different times, places, and/or with different methods.

Cluster Two contained few identified remains but considerable unidentified fish bone. It may be that processed fish (possibly dried fillets) formed the basis of these meals. Included, perhaps, might be other resources unidentifiable with standard analytical techniques, such as large mammals.

Other dietary evidence.—Dietary evidence from the remainder of the La Quinta site consists of floral and faunal materials recovered from the excavations. The macrofloral remains from the site (Table 2) include the same species found in the coprolites. However, several plants were found in the excavation samples that were not discovered in the coprolites, notably *Oligomeris,* rush *(Juncus),* and purslane *(Sesuvium).* Their absence in the coprolite sample is unexplained at this time.

TABLE 3.—Terrestrial and avian faunal remains recovered from the midden at CA-RIV-1179 (from Sutton and Yohe 1988: Table 19)[1]

Scientific Name	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	Cremation	Totals
Xerobates agassizii	2	2	1	—	—	—	—	—	—	—	5
Diposaurus dorsalis	—	1	—	—	—	—	—	—	—	—	1
Sauromalus obesus	—	—	3	—	—	—	—	—	—	—	3
Order Podicipediformes	1	—	1	—	—	—	—	—	—	—	2
Pelecanus cf. *erythrorhynchos*	—	—	1	—	—	—	—	—	—	—	1
Anatidae	—	2	—	—	—	—	—	—	—	—	2
Anas sp.	—	—	—	—	—	—	—	—	1	—	1
Fulica americana	4	—	—	—	—	—	—	—	—	—	4
unident. bird	22	12	18	2	—	2	—	1	—	1	58
Sylvilagus audubonii	5	—	—	—	—	—	—	—	—	—	5
Lepus californicus	4	4	1	—	—	—	—	—	—	—	9
unident. lagomorph	31	31	10	7	1	—	—	2	—	—	82
Perognathus sp.	1	—	1	—	—	—	—	—	—	—	2
Dipodomys sp.	2	—	—	—	—	1	—	—	—	—	3
Neotoma sp.	1	—	—	—	1	—	—	—	—	—	2
Microtus californicus	—	—	—	—	1	—	—	—	—	—	1
unident. rodent	4	14	—	4	—	1	—	—	—	—	23
Canis latrans	5	—	—	3	—	—	—	—	—	—	8
Ovis canadensis	3	3	4	—	—	—	—	—	—	4	14
unident. artiodactyl	3	—	1	—	—	—	—	1	—	4	9
unident. mammal	100	40	31	14	2	2	—	—	—	—	189
Totals	188	109	72	30	5	6	—	4	1	9[2]	424

[1]All units, depth in cm.

[2]Includes eight awls (all artiodactyl).

Faunal remains (Table 3) revealed the presence (and presumed consumption) of several resources not identified in the coprolites, notably bighorn sheep and waterfowl. In addition, razorback remains were much more common in the midden than in the coprolites, as noted above, suggesting that a bone removal process was involved in the preparation of razorback. Of interest is the sudden decrease in fish remains in the upper portion of the deposit, while the remains of other animals increase. Sutton and Yohe (1988:113) suggested that this drop in fish remains "might reflect the decreasing availability of fish in conjunction with the desiccation of the lake, ca. A.D. 1500. It is [in] this later period that lagomorphs (mostly unidentified to genus) and birds (particularly quail) become the most numerous."

A MODEL OF DIET AND SITE USE

Based on the above patterns and observations the following model of seasonality and diet at the La Quinta site is proposed.

Spring.—The site was first occupied in the spring, the inhabitants having come from an unidentified winter camp (possibly another lakeshore site such as Myoma Dunes). Small terrestrial animals and some fish were exploited. In addition, it is possible that larger land animals (e.g., bighorn sheep) were exploited but are not reflected in the coprolite constituents. A possible game diversion site, apparently for bighorn sheep, is located nearby (Sutton and Wilke 1988b). Perhaps people came to the site to harvest cattail (pollen and/or flower heads) and utilized other resources until the cattail was ready. When cattail pollen did become available (late spring/early summer), it was heavily exploited. Cattail pollen formed the bulk of the diet during that time with other resources, including fish, being of secondary importance.

Summer.—Cattail would have been exhausted in early to mid-summer, although some was perhaps stored. At that time fish and waterfowl were utilized, fish (primarily bonytail) in large quantities. The paucity of razorback in the coprolites, compared to its relative abundance in the midden, suggests a processing difference between razorback and bonytail.

Although fish formed the bulk of the summer diet, other animals and various plants were exploited and consumed. Some of these resources had to be obtained at somewhat distant localities, perhaps by special purpose task groups. Being located in an ecotone, the La Quinta site would have offered a variety of localized resource opportunities, perhaps making such trips relatively infrequent.

Fall/Winter.—There is no evidence that the site was occupied during the fall or winter. Desert dicoria *(Dicoria canescens),* a winter staple (Wilke 1978:85), is largely absent in the coprolites, as are other resources thought to have formed part of the fall and winter diet (e.g., pinyon and mesquite; Wilke 1978:87).

Thus, the inhabitants of La Quinta likely moved to another residential base camp(s) for the fall and winter. The location of such camps is unknown but might be in the uplands and/or another lakeshore location. A winter occupation is indicated at Myoma Dunes, for example (Wilke 1978).

Discussion.—There are a number of questions that could not be addressed with the current (i.e., the "visible") data. For example, if bonytail were being processed in two different ways (baked versus broiled) it would result in a differential distribution of faunal elements in the coprolite samples. While bonytail bone would not be present in some samples, the presence of bonytail protein may be detectable using the immunological technique (e.g., Hyland et al. 1990). The same technique may be utilized to test for presence of other animal meats, such as deer or mountain sheep, as the bones of such animals would not likely be present in identifiable fragments in a coprolite. With this general problem in mind, six coprolites from the CA-RIV-3682 site were tested for immunological response. Although the results were negative, the identifiable species list currently is quite limited (Newman et al. 1993).

LATE PERIOD SETTLEMENT AND SUBSISTENCE ALONG NORTHERN LAKE CAHUILLA

Wilke (1978:103) proposed a changing settlement-subsistence model for the late prehistoric of the northern Lake Cahuila basin. The model was based primarily on coprolite data from Myoma Dunes and ethnographic analogy, there being few other data available. That situation is still largely true, except for the results from La Quinta. While the La Quinta dietary and seasonality data come only from one site, they suggest that some revisions in the Wilke model may be in order.

Wilke (1978) suggested that prior to the final desiccation of Lake Cahuilla (ca. A.D. 1500), a settlement/subsistence system operated which was characterized by permanent villages along the lakeshore for exploiting aquatic resources coupled with temporary seasonal camps used to exploit upland resources. After desiccation, the environment changed to the desert conditions of today. The settlement-subsistence pattern remained basically the same (permanent villages; i.e., Bean 1978:575) but was centered on permanent springs rather than the lakeshore. The economic focus shifted from aquatic resources to terrestrial resources, likely resulting in increasing utilization of the surrounding uplands and a population increase in those areas (Wilke 1978:113).

The La Quinta site was interpreted as a camp and not a permanent lakeshore village like Myoma Dunes (Wilke and Sutton 1988a:162). This interpretation was based on the seasonality of ecofactual materials. The site was viewed as being a part of a "settlement-subsistence system centered in the Salton Basin around Lake Cahuilla" (Wilke and Sutton 1988a:163) rather than one centered on upland resources (cf. Weide 1976).

Given this interpretation, the La Quinta site does not fit into the settlement-subsistence system proposed by Wilke (1978) for the final lakestand. Nor does the site fall within the parameters of a postlake adaptive system, i.e., like the historic Cahuilla. There are at least two possible explanations for this pattern. First, it may date from the very end of the last lakestand and reflect a transitional system, the adaptation to the change between lake and desert environments. Second, it may simply represent a heretofore undefined segment of the lakeshore system proposed by Wilke (1978). Whatever the case, the pattern at La Quinta is different than that found at Myoma Dunes or that of the historic Cahuilla.

I suggest that the La Quinta site is part of a transitional system; the following factors support this view. First, the site dates to the very end of the last lakestand (Sutton 1988:51), a time when such a transitional system would be expected. Second, the faunal data (Sutton and Yohe 1988:113) suggest that fish declined in importance and that other, nonaquatic, resources became more important later in time. Third, there is evidence that the La Quinta site served as a base camp, rather than as a special purpose camp, since the distribution of bighorn sheep remains suggests that those animals were butchered elsewhere and taken to the La Quinta site (Sutton and Yohe 1988:112).

That aquatic resources still are quite prominent at La Quinta suggests that the site reflects the early part of such a transitional system. At some point in time, the shoreline receded away from La Quinta and other camps were established at

lower elevations to remain close to the retreating lake. The later aspects of the transitional system would be represented at those sites, none of which have been identified and investigated.

CONCLUSIONS

People living around Lake Cahuilla at the time of its final stand (ca. A.D. 1500) functioned within a complex system of seasonal resource use and changing settlement. There is little doubt that people camped near the lake to exploit the resources present there (e.g., fish, cattail, and waterfowl). It has been commonly assumed that in those situations fish was the dominant faunal food resource and that other animals were of secondary importance.

Several interesting observations can be made from the analysis of coprolite and other dietary data. First, fish were apparently not a primary resource at all times while people were at the lake and terrestrial animals were more important at lakeside sites that previously thought. Second, cattail was very heavily exploited when available, perhaps to the exclusion of other resources for that short time.

At a gross level, the La Quinta coprolite data appear to be relatively homogeneous (i.e., fish in every sample, cattail in most). However, significant patterns do exist in the clustering of constituents. Analyses of constituent distributions and clustering can add considerable detail to the understanding of human ecology and adaptation.

By combining the analyses of multiple lines of dietary evidence, it is possible to record and analyze dietary patterns that provide considerable information regarding people in antiquity. In addition to general dietary constituents, the reconstruction of cuisine, pharmacology, and other patterns are possible. I hope that this line of research has only begun.

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LITERATURE CITED

BEAN, JOHN LOWELL. 1978. Cahuilla. Pp. 575–587 *in* Handbook of North American Indians, Vol. 8: California. Robert F. Heizer (editor). Smithsonian Institution, Washington, D.C.

CASTETTER, EDWARD F. and WILLIS H. BELL. 1951. Yuman Indian Agriculture. University of New Mexico Press, Albuquerque.

CUMMINGS, LINDA SCOTT. 1989. Coprolites from Medieval Christian Nubia: An Interpretation of Diet and Nutritional Stress. Unpublished Ph.D. Dissertation, Department of Anthropology, University of Colorado, Boulder.

FARRELL, NANCY. 1988. Analysis of human coprolites from CA-RIV-1179 and

CA-RIV-2827. Pp. 129–142 *in* Archaeological Investigations at CA-RIV-1179, CA-RIV-2823, and CA-RIV-2827, La Quinta, Riverside County, California. Mark Q. Sutton and Philip J. Wilke (editors). Coyote Press Archives of California Prehistory No. 20, Salinas, California.

FOLLETT, WILLIAM I. 1988. Analysis of fish remains from archaeological sites CA-RIV-1179 and CA-RIV-2327, La Quinta, Riverside County, California. Pp. 143–155 *in* Archaeological Investigations at CA-RIV-1179, CA-RIV-2823, and CA-RIV-2827, La Quinta, Riverside County, California. Mark Q. Sutton and Philip J. Wilke (editors). Coyote Press Archives of California Prehistory No. 20, Salinas, California.

FRY, GARY F. 1985. Analysis of fecal material. Pp. 127–154 *in* The Analysis of Prehistoric Diets. Robert I. Gilbert, Jr. and James H. Mielke (editors). Academic Press, Orlando.

GOODMAN, JOHN D. 1990. Human coprolites from archaeological site CA-RIV-3793 *in* John D. Goodman and Brooke S. Arkush: Archaeological Investigations at CA-RIV-3793, Located North of Indio in Central Riverside County, California. Report on file at the Eastern Archaeological Information Center, University of California, Riverside.

_____ and BROOKE S. ARKUSH. 1990. Archaeological Investigations at CA-RIV-3793, Located North of Indio in Central Riverside County, California. Report on file at the Eastern Archaeological Information Center, University of California, Riverside.

HYLAND, D.C., J.M. TERSAK, J.M. ADOVASIO, and M.I. SIEGEL. 1990. Identification of the species of origin of residual blood on lithic material. American Antiquity 55:104–112.

JONES, A.K.G. 1986. Fish bone survival in the digestive systems of the pig, dog, and man: Some experiments. Pp. 53– 61 *in* Fish and Archaeology: Studies in Osteometry, Taphonomy, Seasonality, and Fishing Methods. D.C. Brinkhuizen and A.T. Clason (editors). British Archaeological Reports International Series 294, Oxford.

MCGINNIS, SAMUEL M. 1984. Freshwater Fishes of California. University of California Press, Berkeley.

MUNZ, PHILIP A. 1974. A Flora of Southern California. University of California Press, Berkeley.

NEWMAN, MARGARET E., ROBERT M. YOHE II, HOWARD CERI, and MARK Q. SUTTON. 1993. Immunological protein analysis of non-lithic archaeological materials. Journal of Archaeological Science 20:93–100.

REINHARD, KARL J. and VAUGHN M. BRYANT, JR. 1992. Coprolite analysis: A biological perspective on archaeology. Pp. 245–288 *in* Archaeological Method and Theory 4. Michael B. Schiffer (editor). University of Arizona Press, Tucson.

SHAFER, HARRY J., MARIANNE MAREK, and KARL J. REINHARD. 1989. A Mimbres burial with associated colon remains from the NAN Ranch ruin, New Mexico. Journal of Field Archaeology 16:17–30.

SHREVE, FORREST and IRA L. WIGGINS. 1964. Vegetation and Flora of the Sonoran Desert, Two Volumes. Stanford University Press, Stanford.

SOBOLIK, KRISTIN D. 1988a. The importance of pollen concentration values from coprolites: An analysis of southwest Texas samples. Palynology 12:201–214.

_____. 1988b. Diet change in the Lower Pecos: Analysis of Baker Cave coprolites. Bulletin of the Texas Archaeological Society 59:111–127.

_____. 1990. A nutritional analysis of diet as revealed in prehistoric human coprolites. The Texas Journal of Science 42:23–36.

SUTTON, MARK Q. 1988. CA-RIV-1179: Site description, research focus, field method, stratigraphy, features, and dating. Pp. 37–52 *in* Archaeological Investigations at CA-RIV-1179, CA-RIV-2823, and CA-RIV-2827, La Quinta, Riverside County, California. Mark Q. Sutton and Philip J. Wilke (editors). Coyote Press Archives of California Prehistory No. 20, Salinas, California.

_____ and ROBERT M. YOHE II. 1988 Terrestrial and avian faunal remains from CA-RIV-1179. Pp. 103–117 *in* Archaeological Investigations at CA-RIV-1179, CA-RIV-2823, and CA-RIV-2827,

La Quinta, Riverside County, California. Mark Q. Sutton and Philip J. Wilke (editors). Coyote Press Archives of California Prehistory No. 20, Salinas, California.

SUTTON, MARK Q. and PHILIP J. WILKE (editors). 1988a. Archaeological Investigations at CA-RIV-1179, CA-RIV-2823, and CA-RIV-2827, La Quinta, Riverside County, California. Coyote Press Archives of California Prehistory No. 20, Salinas, California.

_____. 1988b. Archaeological investigations at the CA-RIV-2823 rock cairn complex. Pp. 15–20 *in* Archaeological Investigations at CA-RIV-1179, CA-RIV-
2823, and CA-RIV-2827, La Quinta, Riverside County, California. Mark Q. Sutton and Philip J. Wilke (editors). Coyote Press Archives of California Prehistory No. 20, Salinas, California.

SWOPE, KAREN K. 1988. Plant remains recovered by flotation from CA-RIV-1179. Pp. 119–128 *in* Archaeological Investigations at CA-RIV-1179, CA-RIV-2823, and CA-RIV-2827, La Quinta, Riverside County, California. Mark Q. Sutton and Philip J. Wilke (editors). Coyote Press Archives of California Prehistory No. 20, Salinas, California.

WALLACE, WILLIAM J. 1978. The chuckwalla: A Death Valley Indian food. The Journal of California Anthropology 5:109–113.

WATSON, PATTY JO. 1974. Theoretical and methodological difficulties in dealing with paleofecal material. Pp. 239–241 *in* Archaeology of the Mammoth Cave Area. Patty Jo Watson (editor). Academic Press, New York.

WEIDE, MARGARET L. 1976. A cultural sequence for the Yuha Desert. Pp. 81–94 *in* Background to Prehistory of the Yuha Ddesert Region. Philip J. Wilke (editor). Anthropological Papers, No. 5, Ballena Press.

WILKE, PHILIP J. 1978. Late Prehistoric Human Ecology at Lake Cahuilla, Coachella Valley, California. Contributions of the University of California Archaeological Research Facility No. 38, Berkeley.

_____ and MARK Q. SUTTON. 1988. Summary and inferences. Pp. 157–164 *in* Archaeological Investigations at CA-RIV-1179, CA-RIV-2823, and CA-RIV-2827, La Quinta, Riverside County, California. Mark Q. Sutton and Philip J. Wilke (editors). Coyote Press Archives of California Prehistory No. 20, Salinas, California.

YOHE, ROBERT M. II. 1990. Archaeological investigations at five sites located at one eleven La Quinta Center in the city of La Quinta, central Riverside County, California. Report on file, Eastern Archaeological Information Center, University of California, Riverside.

BOOK REVIEW

Delfina Cuero: Her Autobiography: An Account of Her Last Years and Her Ethnobotanic Contributions. Florence Connolly Shipek. Menlo Park, California: Ballena Press, 1991. Pp. iii, 101. $19.50 (hardcover), $12.50 (paperback). ISBN 0–87919–123–6 (hardcover), 0–87919–122–8 (paperback).

As Ballena Press Anthropological Paper No. 38, this small book includes Delfina Cuero's autobiography, which was published originally in 1968, plus such new material as an account of her life from 1968 to 1972, a partial listing of her ethnobotanical contributions, two photographs, and a map of southwestern California and adjacent Baja California. Delfina Cuero was a Diegueño Indian, or Kumeyaay, who was born about 1900 and lived in San Diego County and nearby northern Baja California Norte until her death in 1972. Her perspective on the use of and change in the landscape and natural resources of the area as well as the data on specific plants are the two distinct contributions of major interest to ethnobotanists.

The importance of the collection, consumption and storage of plants and ani-