Large Game Hunting and Other Late Holocene Paludal Adaptations at Barka Slough

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Barka Slough on Vandenberg Air Force Base is one of the largest freshwater sloughs in Santa Barbara County. Recent excavations at the Barka Slough Site (CA-SBA-1010) revealed complex fluvial stratigraphy, multiple occupations, and occupation surfaces dating between 1290 B.C. and A.D. 670. Fine-grained stratigraphy provided an opportunity to pair multiple sets of marine shell, freshwater gastropods, and charcoal for comparison of radiocarbon analysis results. Abundant and well-preserved vertebrate faunal remains provide evidence of subsistence changing with paleoclimatic conditions. During all occupations, the site was used as a short-term residence where the focus was on hunting, butchering, and consuming deer and elk.

SBA-1010 is on the south bank of San Antonio Creek, immediately downstream from Barka Slough and 12.5 km upstream from the Pacific Ocean. Lawrence Spanne discovered the site in 1972, during an archaeological survey of Vandenberg AFB. At that time, the site was exposed in the cutbank of San Antonio Creek, buried under 1–2 m of noncultural fill. The cultural deposit was eroding from the creek cutbank. Limited emergency data recovery excavations completed between November 1972 and June 1973 revealed complex stratigraphy and a dense cultural deposit. Multiple occupations were represented, with several intact living surfaces containing abundant and well-preserved faunal remains in addition to a substantial number of lithic artifacts (Spanne 1973). In the mid 1980s, the site was investigated as part of an effort to rebuild Highway 1. Investigations included a survey, subsurface probing, backhoe trenching to define boundaries relative to the highway project, and examination of creek bank exposures to gather information concerning geomorphology and the stratigraphic context of the cultural deposit (Stone 1985, 1986; Woodman et al. 1985). In 1993, a study determined that stabilizing the banks of San Antonio Creek to stop the cultural deposit from eroding was not feasible (Thorne 1993). At about that same time, the site's eligibility for the National Register of Historic Places (NRHP) was evaluated by Chambers Group, Inc. (CGI) and Science Applications International Corporation (SAIC). That effort included boundary definition, site mapping, and excavations to recover a sample of the cultural deposit. The site was interpreted as a foragers' base camp and considered eligible for the NRHP. Because the site continued to erode and stabilization did not appear feasible, data recovery excavations were recommended (Bamforth et al. 1997).

At the request of Vandenberg Air Force Base (AFB), during September and October 2001 Applied EarthWorks, Inc. (Æ) completed excavations to recover data that would otherwise be lost to erosion (Lebow et al. 2004). That effort included eight 1-by-1-m excavation units along the eroding San Antonio Creek cutbank. Two areas selected in consultation with archaeologists at Vandenberg AFB were the focus of Æ's effort. One of these, designated Area A, was sampled with four contiguous excavation units that formed a 2-by-2 m block; the second was designated Area B and was sampled with a row of four contiguous excavation units. The two areas are only 10 m apart. The total volume excavated and screened was 5.756 m^3. All excavated sediments were wet screened; the sampling strategy included a combination of 6-, 3-, and 1.5-mm (1/4-, 1/8-, and 1/16-in) mesh. Æ's geoarchaeologist was on site during excavations, to document and interpret the stratigraphy.

This paper is divided into three sections. First, to set the stage for the remaining sections, is a synopsis of the extensive radiocarbon analysis completed not only to date the natural and cultural deposits, but also to allow comparisons of paired samples of different materials. Second is a summary of the site's depositional history. Concluding this paper is synopsis of the site's occupational history.

Radiocarbon Analysis

During data recovery field work at SBA-1010, Æ collected numerous radiocarbon samples because the combination of complex but well-preserved microstratigraphy and excellent organic preservation offered an opportunity to compare the results of radiocarbon analysis using various materials, and to define the site's depositional history with a fairly high degree of resolution. Initially, 16 radiocarbon samples were analyzed to date the site occupations. Vandenberg AFB subsequently provided funding for supplemental radiocarbon analysis, and 43 additional radiocarbon samples were analyzed. Previously, a sample had been submitted following Spanne's (1973) excavations, and 25 samples were submitted following CGI/SAIC's investigations. Altogether, 85 radiocarbon samples from SBA-1010 have been analyzed. All of Æ's radiocarbon samples were analyzed by Beta Analytic, Inc.

Table 1 summarizes relevant data for each of the 59 samples collected during Æ's investigations. Because the samples in the table are ordered by the Beta lab number, the first 16 samples are those submitted to develop the cultural chronology; the remaining 43 samples were analyzed as part of the supplemental radiocarbon study. Altogether, the analyzed collection includes 16 marine shell samples, 30 charcoal samples, nine samples of freshwater gastropods, one bone sample, one antler sample, one wood sample, and one sample of organic soil. Each of the marine shell, charcoal, bone, antler, and wood samples submitted for analysis consisted of a single specimen. In other words, no composite samples were used for these materials. Multiple freshwater

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Table 1: Radiocarbon Data from Æ's Investigations at CASBA1010, by Beta Lab Number.
[a]Sample size before pretreatment by Beta Analytic, Inc.; [b] Radiocarbon years are adjusted for $^{13}C/^{14}C$.

Æ Sample No.	Beta Lab No	Provenience	Elevation (m)	Materia Type	Sample Size (g)[a]	Processing Method	Radiocarbon Years (B.P.)[b]	Calibrated Intercept	Calibrated Range (2 sigma)	$^{12/13}$CRatio	Reservoir Correction Value
151-1	165569	N94/E104	97.37	Marine shell	162.83	standard	2120 ± 60	A.D. 510	A.D. 350–660	+0.8	225±35
255-1	165570	N94/E103	97.37	Charcoal	19.23	extended count	1810 ± 80	A.D. 230	A.D. 40–410	-25.3	NA
256-1	165571	N94/E103	97.37	Marine shell	19.30	standard	2180 ± 70	A.D. 440	A.D. 250–620	0.0	225±35
203a-2	165572	N100/E116	97.56–97.46	Marine shell	18.40	standard	2240 ± 70	A.D. 380	A.D. 170–560	-0.2	225±35
206-2	165573	N100/E116	97.46–97.36	Marine shell	10.00	extended count	2290 ± 70	A.D. 320	A.D. 120–490	-0.3	225±35
208-1	165574	N100/E116	97.46	Marine shell	17.53	standard	2310 ± 70	A.D. 270	A.D. 90–460	-0.6	225±35
166-2	165575	N94/E104	97.14–97.04	Marine shell	30.20	standard	2910 ± 60	400 B.C.	690–680 B.C.; 670–300 B.C.	0.9	225±35
168-1	165576	N94/E104	97.07	Charcoal	16.30	standard	2010 ± 60	10 B.C.	170 B.C.-A.D. 110	-23.5	NA
184-1	165577	N94/E104	96.98	Marine shell	9.16	extended count	3300 ± 80	890 B.C.	1120–760 B.C.	-0.8	225±35
99-1	165578	N100/E117	97.17	Marine shell	6.4	AMS	3290 ± 40	880 B.C.	1000–790 B.C.	-0.9	225±35
221a-2	165579	N100/E116	97.26–97.16	Marine shell	3.5	AMS	3490 ± 40	1150 B.C.	1290–1000 B.C.	0.1	225±35
224-1	165580	N100/E116	97.17	Marine shell	28.17	standard	3380 ± 60	990 B.C.	1200–820 B.C.	0.7	225±35
145a-2	166816	N94/E104	97.54–97.44	Marine shell	15.31	standard	2130 ± 60	A.D. 490	A.D. 340–560	0.3	225±35
162-1	166817	N94/E104	97.15	Charcoal	17.82	standard	1950 ± 60	A.D. 60	60 B.C.–A.D. 220	-24.2	N/A
169a-2	166818	N94/E104	97.04–96.94	Marine shell	10.61	standard	3260 ± 70	830 B.C.	1040–750 B.C.	0.5	225±35
190-1	166819	N94/E104	97.16	Charcoal	29.74	standard	2090 ± 60	100 B.C.	350–300 B.C.; 220 B.C.–A.D. 40	-24.1	N/A
188-1	168613	N94/E104	97.80	Charcoal	0.35	AMS	1310 ± 40	A.D. 690	A.D. 650–780	-24.8	N/A
189-1	168614	N94/E104	97.86	Charcoal	0.67	AMS	1250 ± 40	A.D. 770	A.D. 680–880	-24.6	N/A
204-1	168615	N100/E116	97.56–97.46	Gastropods	0.91	AMS	2530 ± 40	790 B.C.	800–520 B.C.	-11.2	N/A
211-1	168616	N100/E116	97.46–97.36	Gastropods	1.30	AMS	2630 ± 40	800 B.C.	830–780 B.C.	-9.9	N/A
212-1	168617	N100/E116	97.41	Charcoal	11.59	Standard	1870 ± 80	A.D. 130	40 B.C.–A.D. 350	-25.6	N/A
233-1	168618	N100/E116	97.65	Charcoal	0.37	AMS	1710 ± 40	A.D. 350	A.D. 240–420	-24.7	N/A
234-1	168619	N100/E116	97.53	Charcoal	1.09	AMS	1700 ± 40	A.D. 370	A.D. 240–420	-24.3	N/A
235-1	168620	N100/E116	97.55	Charcoal	1.63	AMS	1700 ± 40	A.D. 370	A.D. 240–420	-25.7	N/A
236-1	168621	N100/E116	97.51	Charcoal	0.57	AMS	1710 ± 40	A.D. 350	A.D. 240–420	-26.6	N/A
237-1	168622	N100/E116	97.59	Charcoal	0.19	AMS	1720 ± 40	A.D. 340	A.D. 230–410	-26.7	N/A
238-1	168623	N100/E116	97.47	Marine shell	2.50	AMS	2300 ± 40	A.D. 280	A.D. 170–420	0.1	225±35
239-1	168624	N100/E116	97.48	Charcoal	0.02	AMS	1780 ± 40	A.D. 240	A.D. 130–370	-24.8	N/A
284-1	168625	N94/E103	97.54	Charcoal	0.28	AMS	1470 ± 40	A.D. 610	A.D. 530–650	-21.3	N/A
285-1	168626	N94/E103	97.57	Charcoal	1.47	AMS	1480 ± 40	A.D. 600	A.D. 530–650	-26.2	N/A
286-1	168627	N94/E103	97.49	Charcoal	0.26	AMS	1490 ± 40	A.D. 580	A.D. 460–480; A.D. 520–650	-25.5	N/A
287-1	168628	N94/E103	97.45	Marine shell	1.30	AMS	2140 ± 40	A.D. 470	A.D. 380–600	1.7	225±35
288-1	168629	N94/E103	97.46	Bone	24.46	AMS	1580 ± 40	A.D. 450	A.D. 400–570	-19.4	N/A
289-1	168630	N94/E103	97.52–97.54	Antler	43.44	AMS	1680 ± 40	A.D. 390	A.D. 250–430	-19.9	N/A
290-1	168631	N94/E103	97.17	Charcoal	2.14	AMS	2680 ± 40	820 B.C.	900–800 B.C.	-24.4	N/A
291-1	168632	N94/E103	97.15	Charcoal	1.09	AMS	2840 ± 40	1000 B.C.	1110–900 B.C.	-24.8	N/A
292-1	168633	N94/E103	97.24	Charred twig	0.11	AMS	2790 ± 40	920 B.C.	1020–830 B.C.	-25.3	N/A
293-1	168634	N94/E103	96.97	Charcoal	0.14	AMS	3140 ± 40	1410 B.C.	1500–1360 B.C.; 1360–1320 B.C.	-27.0	N/A
296-1	168635	N100/E118	97.32	Charcoal	1.61	AMS	1750 ± 40	A.D. 260	A.D. 220–400	-24.6	N/A
297-1-1	168636	N100/E118	97.32	Gastropods	1.40	AMS	2590 ± 40	790 B.C.	820–770 B.C.	-10.2	N/A
297-1-2	168637	N100/E118	97.32	Charcoal	2.09	AMS	1750 ± 40	A.D. 260	A.D. 220–400	-25.6	N/A
298-1	168638	N100/E118	97.45	Charcoal	1.31	AMS	1770 ± 40	A.D. 250	A.D. 140–380	-25.2	N/A
299-1-1	168639	N100/E118	97.52	Gastropods	0.93	AMS	2470 ± 40	750 B.C.; 700 B.C.; 540 B.C.	780–410 B.C.	-10.8	N/A
299-1-2	168640	N100/E118	97.52	Charcoal	1.21	AMS	1730 ± 40	A.D. 330	A.D. 230–410	-25.4	N/A
300-1	168641	N100/E118	97.02	Wood	34.55	Standard	2260 ± 60	370 B.C.	410–180 B.C.	-25.0	N/A
301-1-1	168642	N94/E102	97.43	Gastropods	1.40	AMS	3310 ± 40	1600 B.C.	1690–1500 B.C.	-12.5	N/A
301-1-2	168643	N94/E102	97.43	Charcoal	14.88	Standard	1340 ± 60	A.D. 670	A.D. 620–790	-24.2	N/A
302-1-1	168644	N94/E103	97.41	Gastropods	0.56	AMS	2900 ± 40	1060 B.C.	1210–970 B.C.	-11.1	N/A
302-1-2	168645	N94/E103	97.41	Charcoal	1.46	AMS	1550 ± 40	A.D. 530	A.D. 420–610	-26.5	N/A
302-1-3	168646	N94/E103	97.41	Marine shell	4.74	AMS	2190 ± 40	A.D. 430	A.D. 320–550	0.3	N/A
303-1-1	168647	N94/E103	97.11	Gastropods	0.92	AMS	3550 ± 40	1890 B.C.	1970–1760 B.C.	-11.0	N/A
303-1-2	168648	N94/E103	97.11	Charcoal	0.68	AMS	2450 ± 40	520 B.C.	780–400 B.C.	-24.7	N/A
304-1-1	168649	N94/E102	96.96	Organic sediment	809.70	Standard	3210 ± 40	1490 B.C.	1630–1380 B.C.	-25.7	N/A
304-1-2	168650	N94/E102	96.96	Charcoal	0.33	AMS	2760 ± 40	900 B.C.	1000-820 B.C.	-24.6	N/A
305-1-1	168651	N95/E104	97.55	Gastropods	1.19	AMS	2660 ± 40	820 B.C.	880–790 B.C.	-11.8	N/A
305-1-2	168652	N95/E104	97.55	Charcoal	2.74	AMS	1440 ± 40	A.D. 630	A.D. 550–660	-25.4	N/A
306-1-1	168653	N95/E105	97.37	Gastropods	0.25	AMS	2890 ± 40	1040 B.C.	1200–940 B.C.	-10.8	N/A
306-1-2	168654	N95/E105	97.37	Charcoal	1.29	AMS	1540 ± 40	A.D. 540	A.D. 420–620	-27.1	N/A
306-1-3	168655	N95/E105	97.37	Marine shell	1.67	AMS	2240 ± 40	A.D. 380	A.D. 250–470	0.1	225±35

	Charcoal		Marine Shell		Gastropods		Bone		Antler		Organic Sediment	
Set	Beta No.	2-Sigma Range	Beta No.	2-Sigma Range	Beta No.	2-Sigma Range	Beta No.	2-Sigma Range	Beta No.	2-Sigma Range	Beta No.	2-Sigma Range
1			165572 165573 165574	A.D. 170–560 A.D. 120–490 A.D. 90–460	168615	800–520 B.C.						
2	168617 168624	40 B.C.–A.D. 350 A.D. 130–370	168623	A.D. 170–240	168616	830–790 B.C.						
3	168625 168626 168627 165570	A.D. 530–650 A.D. 530–650 A.D. 460–650 A.D. 40–410	168628 165569 165571	A.D. 380–600 A.D. 350–660 A.D. 250–620			168629	A.D. 400–570	168630	A.D. 250–430		
4	168635 168637	A.D. 220–400 A.D. 220–400			168636	820–770 B.C.						
5	168638 168640	A.D. 140–380 A.D. 230–410			168639	780–410 B.C.						
6	168643	A.D. 620–790			168642	1690–1500 B.C.						
7	168645	A.D. 420–610	168646	A.D. 320–550	168644	1210–970 B.C.						
8	168648	780–400 B.C.			168647	1970–1760 B.C.						
9	168650	1000–790 B.C.									168649	1630–1380 B.C.
10	168652	A.D. 550–660			168651	880–790 B.C.						
11	168654	A.D. 420–620	168655	A.D. 250–470	168653	1200–940 B.C.						

Table 2: Comparison of Paired Radiocarbon Samples from CA-SBA-1010.

gastropods were used in each sample due to the small size of individual specimens. Radiocarbon results using charcoal have been calibrated to calendar ages using the Pretoria Calibration Procedures. All marine shell samples were adjusted for the reservoir effects and isotopic fractionation, and the results were calibrated against a marine curve. Freshwater gastropods were adjusted for isotopic fractionation, but no correction for the reservoir effect was applied because correction values for freshwater shell are unknown.

The combination of complex but well-preserved microstratigraphy and excellent organic preservation evident during Æ's fieldwork offered an opportunity to compare the results of radiocarbon analysis using various materials. Specifically, thin fluvial deposits contained charcoal, freshwater gastropods (pond snails [*Pulmonata lymnae*]), and sometimes marine shell. In addition, well-defined occupation surfaces contained charcoal, freshwater gastropods, marine shell, bone, and antler.

Thirty-seven radiocarbon samples were considered suitable for comparisons of different materials. These include 11 sets of samples from the same natural or cultural features (i.e., "paired samples") expected to provide comparable results (Table 2). During Æ's field work, paired samples were selected specifically to test the comparability of dates using various materials, and great care was taken to ensure that the deposit from which samples were selected represented a brief period of time. For example, a number of the radiocarbon samples were pulled from fluvial deposits that were often only 1–2 cm thick. Each of these fluvial deposits represents a single depositional event. Similarly, cultural occupation surfaces were thin, clearly defined, and undoubtedly represent brief periods of time. When possible, charred twigs were used for charcoal samples to reduce or eliminate the problem of old wood. With the exception of the marine shell in the first and third sets, all of the samples used for the comparisons were pulled from excavation unit walls after all excavations were complete and the stratigraphy was plainly visible and well understood. Selecting samples from unit walls ensured that sample contexts were clear. As a consequence, differences in radiocarbon ages should reflect differences in the ages of the materials themselves, rather than a temporal span in occupation or deposition.

Analysis results are summarized by each set of paired samples in Table 2 and are presented graphically in Figure 1 (Lebow 2002). Because they provide 95 percent confidence in the accuracy of the results, 2-sigma ranges are presented. With one exception, in sets with multiple charcoal samples, the 2-sigma ranges for these samples are similar. The exception is the third set, which has three nearly identical charcoal dates but a fourth that is slightly older. This older charcoal date probably reflects old wood. Overall, the similarity of the charcoal age determinations within individual sets suggests that Æ was successful in selecting samples that represent brief periods of time.

Marine shell is typically abundant in archaeological sites on Vandenberg AFB and for that reason is commonly used for radiocarbon analysis. However, marine shell samples must be corrected for the reservoir effect, which can vary locally. For sites on Vandenberg AFB, Beta Analytic, Inc., uses a standard correction value of 225 ± 35 years. However, that value is theoretical. Given the abundance of marine shell on the base and its frequent use for radiocarbon dating, it is important to determine whether that theoretical value is realistic by comparing marine shell age determinations with those obtained from charcoal.

Four sets contain both charcoal and marine shell for comparison, with a total of six marine shell samples and eight charcoal samples that can be compared directly. In each of the four sets containing both charcoal and marine shell, the 2-sigma ranges from both material types overlap (Figure 1). In other words, the radiocarbon ages provided by charcoal and marine shell are statistically indistinguishable at the 95 percent confidence interval. Thus, the theoretical correction for the reservoir effect in the Vandenberg AFB region appears to be realistic.

Nine of the 11 sets contained freshwater gastropods for comparison with charcoal. As shown in Figure 1, radiocarbon age determinations for SBA-1010 freshwater gastropods in all nine sets are substantially different from ages obtained using charcoal. Overall, the freshwater gastropod ages average 1,190 years older than the charcoal age determinations. Unfortunately, the variations are not consistent; the differences in calibrated intercepts range between 790 years in Set 5 and 2,270 years in Set 6. The reason for the disparities is unknown, but regardless, freshwater gastropods do not appear to be a viable choice for radiocarbon dating.

Set 3 includes bone and antler samples to compare with charcoal samples. The bone sample yielded a 2-sigma range that is statistically identical to the three equivalent charcoal 2-sigma ranges (Figure 1). The antler sample from Set 3 is slightly younger than any of the charcoal samples, although it does overlap with the 2-sigma ranges for bone and marine shell. Bone appears to be a viable choice for radiocarbon dating; antler is less desirable but could be used if no other material is available.

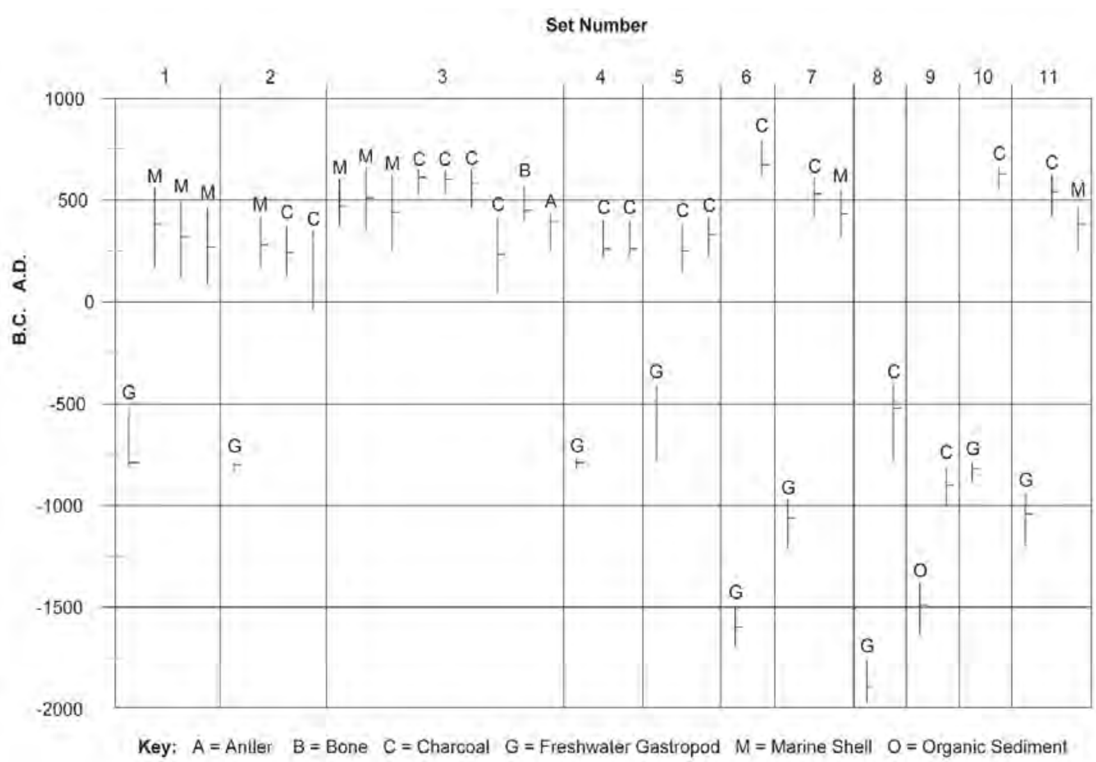
Set 9 compares a sample of organic sediments with charcoal. The organic sediment sample yielded an age determination substantially older than the charcoal sample. One possible explanation for the older date on the organic soil sample is that it contained freshwater gastropods, although the sample was examined before submission and no mention was made of gastropods. Another possibility is that the natural carbonates that make the freshwater gastropods appear old are also present in the soil. Regardless, organic sediments do not appear to be viable choices for radiocarbon dating, at least for sites along San Antonio Creek.

Overall, the radiocarbon results from SBA-1010 indicate that charcoal, marine shell, and bone are all viable materials for radiocarbon dating and should provide comparable results at 2 sigma. Antler appears to be slightly less reliable. Freshwater gastropods and organic sediments do not provide reliable age determinations. As a result of this study, age determinations based on organic soil and freshwater gastropods were not used during interpretations of SBA-1010.

SITE FORMATION HISTORY

Stratigraphy at SBA-1010 is unusually complex, reflecting alternating periods of low- and high-energy fluvial deposition. Prior to human occupation at SBA-1010, formation of the San Antonio Creek valley was relatively uniform, with valley-wide cycles of low-energy fluvial aggradation alternating with periods of soil development. At some point before about 1290–820 B.C. (3240–2770 cal B.P.), the surface at SBA-1010 stopped aggrading and a period of soil development began. This soil formed the base of Æ's excavations. Then, just before human occupation, a higher-energy fluvial event deposited a thin (1–2 cm) lens of sand and pebbles in Area A and a 5–10 cm lens of silt in Area B. These lenses marked the beginning of local floodplain accretion and

Figure 1: Radiocarbon age determinations (2-sigma ranges) for paired samples from CA-SBA-1010.



a more active and higher-energy depositional regime at SBA-1010 that coincided with the beginning of human occupation.

It is not clear what precipitated the shift to a more active depositional regime at SBA-1010. It may have been a response to a shift in the regional climate with the onset of cooler and moister conditions roughly 4,000 years ago (Kennett 1998; Morgan et al. 1991; Pisias 1978, 1979). With cooler and moister conditions, groundwater would have increased and Barka Slough and the San Antonio Creek riparian zone would have expanded and encompassed SBA-1010. However, and although the overall climatic regime may have been more mesic, Glassow (1996) posits a warm, dry period between about 3,600 and 3,100 years ago; Kennett (1998) found very low ocean temperatures (probably associated with dry terrestrial conditions) between 2800 and 2700 B.P.; and Lebow et al. (2000) found dry conditions at Swordfish Cave around 3550 cal B.P. and 2740 cal B.P. It appears, then, that there were dry periods within the overall cooler and moister climatic regime. Perhaps it was cyclical, alternating wet-dry/cool-warm climatic conditions that resulted in the shift from valley-wide fluvial aggradation to the local floodplain accretion and a more active and higher-energy depositional regime at SBA-1010.

Following the shift in depositional regimes, site formation differed between the two areas sampled during Æ's excavations. Throughout much of the history of site occupation, Area B was a series of ponds. In Area A, only 10 m to the west, alternating silt beds and sand bars reflect higher-energy fluvial deposition associated with the period of occupation.

Synopsis of Occupational History

Cultural radiocarbon age determinations indicate that SBA-1010 was initially occupied after about 1290 B.C. (corresponding to the late Early Period) and was abandoned by about A.D. 670 (the middle of the Middle Period). Æ defined seven analytic units from within that 1,960-year interval on the basis of stratigraphy, features, and, to a lesser extent, the density of cultural remains within microstratigraphic units.

The initial occupation, Analytic Unit (AU) 6, took place in Area B between 1290 and 820 B.C. (3240 and 2770 cal B.P.) and corresponded with a change in site formation processes discussed above. An occupation surface (designated as Feature 4) lies at the heart of AU 6 and is characterized by a concentration of bone and marine shell. Cultural constituents associated with AU 6 include one projectile point and one unpatterned flake tool, 877 cultural vertebrate faunal specimens, 190.29 g of marine shell, and 10 fire-altered rocks. AU 6 functioned as a short-term residence that was occupied during the course of season rounds by people using a logistically mobile (i.e., collectors') land-use strategy. The site was occupied during the early spring (March–April) and during the summer (July–September). Vertebrate faunal remains indicate that while the people were eating fish, birds, lagomorphs, carnivores, sea otters, shellfish, seeds, nuts, and berries, the emphasis was clearly on mule deer and elk. Large terrestrial mammals provided 88.5 percent of the dietary protein.

The proportion of cottontails, which prefer cooler, moister conditions, to jackrabbits, which prefer drier conditions, is referred to as the lagomorph index. A high lagomorph index indicates relatively more cottontails and cooler, moister climatic conditions. In AU 6, an exceptionally low lagomorph index suggests that climatic conditions were unusually warm and dry (i.e., drought). However, botanical remains indicate that wetland vegetation was present. Barka Slough and the riparian corridor along San Antonio Creek served as an oasis that attracted deer and elk to the water and browse in an otherwise dry landscape. In turn, the AU 6 occupants focused on the deer and elk attracted to the slough. Young deer in the AU 6 faunal assemblage indicate that the deer were relatively healthy and that the drought, while severe, had not been of sufficient duration to decimate the deer population.

Following the AU 6 occupation, a series of ponds formed in Area B, and this part of the site was not physically occupied again. After a hiatus of about 1,050 years, evidence of prehistoric activity began accumulating as one of the ponds was used for refuse disposal (AU 7).

AU 1 is the initial occupation in Area A and dates to 1120–750 B.C. (3070–2700 cal B.P.). An occupation surface excavated as Feature 3 is at the core of AU 1. Cultural constituents assigned to AU 1 include 45 flaked stone tools, nine ground stone implements, 1,985 cultural vertebrate specimens, 1,224.23 g of marine shell, and 66 fire-altered rocks. Half of the flaked stone tools were used on fresh hide and meat, indicating that the people responsible for AU 1 focused on hunting and butchering. However, AU 1 also has among the highest proportion of grinding implements, indicating that vegetal resources were important. Altogether, subsistence remains indicate that the people responsible for AU 1 were eating fish, birds, lagomorphs, rodents, carnivores, sea mammals, deer, elk, shellfish, and seeds. While large mammals provided most (76.1 percent) of the protein during the AU 1 occupation, the proportion is the second lowest among the analytic units. In contrast, the proportion of protein from cottontails and jackrabbits is relatively high.

Like AU 6, AU 1 functioned as a short-term residence during the course of normal seasonal rounds, and was occupied during early spring (March–April) and summer (July–September). The drought evident in AU 6 persisted, with an even lower lagomorph index. Still, archaeobotanical remains indicate that wetland vegetation was present, and Barka Slough continued to be a magnet for deer and elk. However, by this time the continued drought had affected the deer population and, consequently, AU 1 occupants relied more on lagomorphs, particularly drought-adapted jackrabbits.

The part of SBA-1010 sampled by Æ was abandoned for approximately 400 years following the AU 1 occupation. However, excavations by CGI/SAIC found evidence of occupations during this period in other parts of the site (Bamforth et al. 1997).

AU 2 is stratigraphically superior to AU 1 in Area A and reflects occupation of SBA-1010 between 350 B.C. and A.D. 220 (2300 and 1730 cal B.P.). No features were identified. It was occupied during the early spring, when it served as a short-term residence during the course of season rounds. Cultural constituents include 36 flaked stone tools and two ground stone implements, 1,028 cultural vertebrate faunal specimens, 456.90 g of marine shell, and 11 fire-altered rocks. Like the earlier occupations, AU 2 had a high proportion of tools that were used on fresh hide and/or meat, and a high proportion of tools associated with hunting. However, unlike AU 1, plant processing did not seem to be particularly important. Subsistence remains indicate that the AU 2 occupants were eating shellfish, fish, reptiles, birds, lagomorphs, rodents, carnivores, sea mammals, deer, and elk; most of the dietary protein derived from large mammals. Unlike either of the two previous occupations, which had lower-than-expected faunal diversity due to an emphasis on deer (AU 6) or lagomorphs (AU 1), the more diverse AU 2 assemblage indicates AU 2 occupants were not emphasizing any particular animals.

The AU 2 lagomorph index increased, suggesting that the drought conditions associated with AUs 1 and 6 had ameliorated. Bones from young deer are present, indicating that the deer population was relatively healthy. However, when compared with other sites on Vandenberg AFB, the lagomorph index is still unusually low, indicating that while conditions had improved, drought conditions existed and Barka Slough was still an oasis for deer and elk.

AU 3 is stratigraphically superjacent to AU 2 and was occupied between A.D. 250 and 640 (1700–1310 cal B.P.). No features were identified in AU 3. Cultural materials assigned to AU 3 include 32 flaked stone tools and two ground stone implements, 312 cultural vertebrate faunal specimens, 255.94 g of marine shell, and 20 fire-altered rocks. The lithic assemblage differs from earlier assemblages in that half of the flaked stone tools were used on plants and only a single tool was used on fresh hide and/or meat. However, the vertebrate faunal assemblage reflects a clear emphasis on hunting and butchering deer and elk. Small animal categories are only negligibly represented, while large mammals provided 97.5 percent of the protein—the highest proportion among all analytic units.

Like the previous analytic units, AU 3 was used as a short-term residence. However, it was occupied during the fall/winter (October–December), and the site's role in the settlement system was different than during previous occupations. Specifically, the technological organization evident in the AU 3 lithic assemblage indicates that rather than serving as a residence during the normal course of seasonal rounds, AU 3 appears to have been used by people whose primary residence was elsewhere—such as a winter village or a long-term residence. A group traveled specifically to SBA-1010 for large game and to collect/process plants, and then returned to the primary residence. In this regard, AU 3 functioned more like a special-use location. Climatic conditions during this occupation were apparently moister and cooler.

AU 4 is an occupation surface (Feature 1) that is stratigraphically superior to AU 3; the radiocarbon age assignment is A.D. 250–640 (1700–1310 cal B.P.), virtually identical to AU 3. Cultural constituents in AU 4 include 29 flaked stone tools and nine ground stone implements, 1,193 cultural vertebrate faunal remains, 1,757.42 g of marine shell, and 46 fire-altered rocks. Functional analysis indicates that the flaked stone tool assemblage is very diverse, and it has the lowest proportion of tools associated with hunting found in Area A. It also has the highest proportion of grinding implements. Subsistence remains include seeds, shellfish, fish, reptiles, amphibians, birds, lagomorphs, rodents, carnivores, sea mammals, deer, and elk. The vertebrate faunal assemblage is less diverse than expected due to an emphasis on lagomorphs. AU 4 has the second lowest proportion of protein from large mammals, which is offset by a relatively high proportion of protein from lagomorphs.

AU 4 functioned as a short-term residence that was occupied during the spring (March–June) and late fall/early winter (November–December). Unlike AU 3, it was occupied during the course of normal seasonal rounds. Climatic conditions during the occupation were cooler and moister, as the lagomorph index is substantially higher than in AUs 6, 1, and 2. However, while the artiodactyl index (the ratio of artiodactyls to lagomorphs) is fairly low, which would appear to suggest dry climatic conditions, it appears increasingly mesic conditions probably meant sufficient water and browse were available for deer and elk at locations other than Barka Slough, and the slough and associated wetlands were no longer the strong magnet for deer and elk that they had been during drier conditions. As a consequence, the number of artiodactyls taken relative to lagomorphs (i.e., the artiodactyl index) decreased during the AU 4 occupation.

AU 5 (A.D. 320–670, 1630–1280 cal B.P.) is stratigraphically above AU 4 in Area A, and represents the terminal occupation in that area. No features were identified. Cultural constituents assigned to AU 5 include 18 flaked stone tools, 1,083 cultural vertebrate fauna, 1,123.30 g of marine shell, and 31 fire-altered rocks. No ground stone tools were recovered. AU 5 has the most diverse faunal assemblage, with high proportions of small- and medium-sized animals and correspondingly low proportions of large mammals. When compared to the other analytic units in terms of dietary contribution, AU 5 has the highest proportion of protein from shellfish, fish, reptiles, birds, lagomorphs, and rodents, but, conversely, the lowest proportion of protein from large terrestrial mammals (i.e., deer and elk).

AU 5 is similar to AU 3 in many respects. It was occupied during the fall/winter (August–February) and served as a short-term residence. Like AU 3, technological signatures in the lithic assemblage indicate that the site functioned more like a special-use location, and was used by people whose primary residence was a winter village or long-term residential site located elsewhere. A group would travel specifically to Barka Slough to hunt for a brief period of a few days and then would return to the primary residence. Like AU 4, the lagomorph index is high, probably reflecting cooler, moister climatic conditions. Also like AU 4, the artiodactyl index is low, indicating that sources of water and browse for deer and elk were available at locations other than Barka Slough, so the slough was no longer an oasis that attracted large numbers of deer and elk.

AU 7 in Area B is the most unusual analytic unit. It includes Feature 2, which represents refuse disposal in a pond between A.D. 230 and 560 (1720 and 1390 cal B.P.). It probably was associated with the AU 3, 4, or 5 occupations in Area A. Cultural constituents assigned to

AU 7 include four flaked stone tools, 266 vertebrate faunal specimens, and 680.19 g of marine shell. Bone and shell in the Feature 2 assemblage are relatively unfragmented because they were not trampled. AU 7 has the second-highest proportion of protein from large mammals (after AU 3), but this high proportion probably represents selective disposal of larger bones that would tend to be in the way on the occupation surface. Most of the large mammal bones in Feature 2 are low-meat utility elements (such as antler), also reflecting disposal behavior. Like AUs 3 and 5, AU 7 was used exclusively during the fall/winter (October–January).

AUs 7 and 5 represent the terminal occupations in Areas B and A, respectively. Subsequently, site formation shifted from deposition by fluvial processes to deposition of a massive mudflow, or alternatively, a large bank slump. Regardless, the fluvial processes associated with human occupation were no longer occurring, and the site (or at least the portions of the site sampled by Æ and CGI/SAIC) was abandoned.

All occupations at SBA-1010 share two important characteristics. All were associated with large mammal hunting, butchering, and consumption; in every case, large mammals contributed more than 60 percent of the dietary protein. Furthermore, all occupants used the site as a short-term residence. SBA-1010 was a place where people resided for a few days to a week or so, and hunting and butchering large game was a primary activity during that period.

Differences between occupations are also apparent. During the earliest occupations (AUs 6, 1, and 2), the site was used in the spring and summer months and was occupied during the course of normal seasonal rounds. Paleoclimatic conditions were apparently very warm and dry, and Barka Slough was an oasis where water and browse attracted deer and elk from the surrounding xeric landscape. Subsequent occupations (AUs 3, 4, and 5) occurred during cooler and moister conditions, when Barka Slough was less of a magnet for large game because water and browse were available elsewhere. AUs 3 and 5 were occupied during the fall/winter by people who journeyed from their primary residence specifically to SBA-1010 to hunt and collect, and then returned to the primary residence. Contrary to Bamforth et al. (1997), the technological organization during all occupations indicates that the people were collectors using a logistically mobile land-use strategy.

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