SERIATION OF CLAM SHELL DISK BEADS IN CENTRAL CALIFORNIA

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Clam shell disk beads (CSDB) are a diagnostic artifact type for Phase 2 of the Late period in central California, ca. A.D. 1500-1850. Despite their chronometric significance, archaeologists working in central California rarely attempt to date CSDB because of the narrow time span of use during Phase 2 and the wide margins of error inherent in radiocarbon dating. Following recent advances in radiocarbon dating methods, this study uses accelerator mass spectrometry (AMS) radiocarbon dating of CSDB from CA-CCO-297 and YOL-69 to suggest that a seriation of CSDB types may be possible. This study concludes that future research efforts should be directed at developing a standard CSDB typology in tandem with radiocarbon dating calibration methods specific to CSDB. Bennyhoff and Fredrickson's (1967) CSDB typology is provided in an Appendix for use in future research.

CLAM SHELL DISK BEADS IN CENTRAL CALIFORNIA

In central California, CSDB appear in widespread use around A.D. 1500. This shift is one of the major markers of the transition between Phase 1 and Phase 2 of the Late period for the Augustine pattern, and is generally understood as indicating the development of a monetized mode of conveyance involving commoditized trade goods. CSDB-based trade networks relied less on the socially stratified trade networks organized around *Olivella* shell beads, which were the dominant mode of bead-based exchange from the Early period through Phase 1 of the Late period (Fredrickson 1994; Milliken et al. 2007; Rosenthal 2011). Ethnographic accounts show that saltwater clam shells (*Saxidomus* sp. and *Tresus* sp.), *Dentalium* shells, magnesite, and other materials were used in bead form as exchange currencies with standardized values in this period (Gifford 1947; Heizer 1975; King 1978; Kroeber 1922; Loeb 1926). In the San Francisco Bay area, CSDB were made from clam shells obtained from Bodega Bay and Point Reyes, although major bead manufacturing centers are also found well inland from the coast (Milliken et al. 2007:117).

The ethnographic record shows that various types and subtypes of CSDB held different relative values based on the qualities of the shell beads themselves. Kroeber (1922:278) noted that CSDB "varied in value according to size, thickness, polish, and age." Some California groups quantified the value of CSDB by number of beads, others by string length. The Yurok, Hupa, and other groups used forearm tattoo marks as rulers for standard bead string measurements (Kroeber 1925:23). However, Pomo, Wintun, and Maidu groups counted the number of individual beads on a string (Kroeber 1922:279). In the Historic period, the standardization of shell money value allowed for equivalencies to be made between CSDB and American dollars (Badovinac 1994). Among the Wintun, for example, "the thinnest disks were rated 80 to an American dollar, good beads 80 to 4 dollars, exceptionally thick ones 5 to a dollar" (Kroeber 1925:359).

Because bead and bead string values were standardized within and between groups, it is clear that CSDB were used as money objects. Indeed, one of the classic definitions of money objects is that they allow their users to quantitatively compare types of things that are otherwise incommensurate (Marx 1967 [1867]:94; Smith 1902 [1776]:67). In traditional anthropological theorizations, this explicit quantitative evaluation is associated with commodity exchange relationships, which stand in contrast to gift giving and other exchange relationships that do not explicitly emphasize quantification (Graeber 2001:36). However, we must be cautious when we approach such a discussion of currency and commodity exchange, for CSDB and other forms of money do not appear to have developed in tandem with "pure" market and commodity-based relationships.

Indeed, Chagnon (1970) notes that Native Californian exchanges involving shell money took place within transactional contexts primarily defined by political and kinship relations. For example, the price of a commodity—as valued by an amount of shell money—appears to have been rarely negotiable. Direct barter did not take place because exchange interactions were embedded in contexts wherein the exchanging parties were also host and guest, friend or enemy (see also Vayda 1967). Furthermore, it is likely that CSDB circulated within spheres of exchange in which they served different purposes and produced different meanings than they did in the sphere of commodity acquisition (cf. Bohannan 1955:37). Indeed, CSDB had functional and ornamental uses on baskets, pack straps, and other objects (Gifford 1947:32, 113–114), and they are most often found in mortuary contexts that can contain tens of thousands of beads (Rosenthal 2011:97-98). Thus, a broad understanding of the kinds of social, political, religious, and economic relationships at play in Native Californian life—conveyance as a "system of total services" (Hughes 2011; Mauss 1990:70)—is necessary to any understanding of CSDB-based exchange in the Late period.

THE ISSUES

California archaeologists have understood CSDB as markers of the beginning of Phase 2 of the Late period for several decades, yet there are important aspects of the artifact category that are poorly understood. We identify two related areas of research on CSDB that need attention: typological analysis and direct dating.

First, we need a comprehensive artifact typology for CSDB based on physical characteristics such as dimensions, manufacturing stage, use-wear, and condition. At present, researchers usually record such metrics, but do not assign a specific typological designation. Even major works that attempt to survey shell bead types and chronologies do not attempt to delineate different types of CSDB (e.g., Bennyhoff and Hughes 1987; Gibson 1992; Milliken et al. 2007; Rosenthal 2011). King (1990) briefly sketches a seriation of CSDB relative to other types of clam shell beads in the Channel Islands area, but does not give the topic a sustained or systematic treatment. This lack of a standard analytic framework makes intra- and intersite analysis of CSDB difficult and time-consuming. By comparison, research on *Olivella* shell beads has gained popularity and produced significant archaeological insights due to the widespread use of a standard typology (e.g., Bennyhoff and Hughes 1987; Groza 2002; Groza et al. 2011; Milliken and Schwitalla 2012). We are aware of three major CSDB typologies: Lillard et al. (1939), Gifford (1947), and Bennyhoff and Fredrickson (1967). Recently, Milliken (2005) proposed a simplification of Bennyhoff and Fredrickson's typology. As will be discussed below, this study uses Bennyhoff and Fredrickson's typology as the best starting point available to date.

Second, we need a chronological seriation of the CSDB types identified by the typological framework. CSDB can be dated directly through AMS radiocarbon dating, or they can be dated indirectly through their association with other datable materials. Researchers have not attempted systematic seriation of CSDB because the margins of error inherent to radiocarbon dating of shell make it difficult to draw conclusions within the small time window (A.D. 1500-1850) of Phase 2 of the Late period (Erlandson 2002:325). However, direct AMS radiocarbon dating has recently been shown to be effective in the refinement of bead type seriation (Gibson and Koerper 2000; Groza 2002; Groza et al. 2011; Vellanoweth 2001). These studies have shown that the chronometric uncertainties of AMS radiocarbon dating can be minimized through the use of large sample sizes and local reservoir calibration curves. Other barriers to more frequent use of AMS radiocarbon dating include high financial costs and the consent of the descendant community. Ideally, nondestructive and less expensive direct dating methods will be developed in order to allow for more samples to be obtained.

Here we follow the recent work of Groza et al. (2011), which revisited Groza's (2002) seriation of *Olivella* shell bead types using AMS radiocarbon dating. The 2011 study concluded that a ΔR value of 260 ±35 provides efficacious calibration results for *Olivella* beads in central California. A ΔR value has not yet been developed for use with CSDB, so this study uses the ΔR proposed by Groza et al.

(2011). Future research should be directed at developing more precise calibration methods for radiocarbon dates derived from CSDB.

Ultimately, a standard typology combined with effective, large-sample direct dating methods will allow researchers to track changes in the physical characteristics of CSDB across time and space. This will enable more meaningful analysis of CSDB, especially with regard to understanding Native Californian conveyance networks. In the following sections, we review previous work on CSDB typologies and chronological seriation, and then address recent empirical data from CCO-297 and YOL-69.

EXISTING CLAM SHELL DISK BEAD TYPOLOGIES

CSDB typologies for central California were developed in the early years of postwar California archaeology (Lilliard et al. 1939; Gifford 1947). As part of their early work on shell and stone beads in central California, James Bennyhoff and David Fredrickson (1967) updated the scheme developed by Lillard et al. Bennyhoff and Fredrickson's typology has become the most widely used in recent years. Examples may be found in Parker (2010).

The available copy of Bennyhoff and Fredrickson's typology is an unpublished manuscript that appears to have been typewritten by Bennyhoff and then annotated and modified by Fredrickson into the 1980s. The rough draft nature of the manuscript makes it quite difficult for the researcher to use this typology confidently, and has contributed significantly to its infrequent use. In the interest of encouraging a renewed interest in this typology, it is transcribed in the Appendix.

Bennyhoff and Fredrickson based their typology on average size measurements of CSDB found in a selective survey of central California archaeological sites. Following the ethnographic record, they used edge finish, manufacturing stage, thickness, and face diameter as typological distinctions. They intended the typology to be used primarily for analyzing entire strings of CSDB, so some subtypes have partially overlapping diagnostic measurements in order to facilitate classification of strings despite individual bead outliers. Fredrickson's modifications impose stricter measurement ranges for more precise classification of single beads. The individual bead method has some support in the ethnographic record and may be more practical for researchers studying CSDB that are not found as strings in situ. However, some of the types' size ranges overlap by thickness, which introduces a problematically subjective element to classification that should be reevaluated by future research efforts.

Despite its rough form, Bennyhoff and Fredrickson's typology is the best basic CSDB typology on hand for researchers of central California prehistory. Importantly, it is empirically derived and captures distinctions between sizes of beads that correlate to distinctions made by Native Californians in the ethnographic literature. It has the added benefit of working along a similar logic to that of the *Olivella* shell typology, making it easier to understand for researchers already familiar with that system.

Randall Milliken (2005) has proposed a simplified version of Bennyhoff and Fredrickson's typology that is more expedient for researchers working with large numbers of CSDB. To this end, Milliken's typology intentionally ignores thickness and instead focuses on manufacturing stage and face diameter. Furthermore, Milliken combined Bennyhoff and Fredrickson's A1b and A1c types into an overarching A1bc type. Milliken acknowledged that his typology possibly glosses over fine size distinctions that may exist empirically, but he concluded, "In the big picture, however, fine size sorting is probably not necessary to answer important research questions" (Milliken 2005:8).

Given the lack of any systematic regional survey of CSDB, we must disagree with Milliken's notion that this artifact category is understood well enough to ignore possible typological distinctions. As discussed above, there is significant ethnographic evidence that thickness and diameter were both important factors in the valuation of CSDB. We hold that, whenever possible, typological systems should "formulate a structure for artifact classes wherein each division in the structure is based on an empirical characteristic (or characteristics) that relates to the conceptual/behavioral distinctions made by the makers

Table 1. Hypothesized CSDB seriation in Late period central California (Augustine pattern).

PERIOD	PHASE	YEARS B.P. / A.D.	HYPOTHESIZED PREDOMINANT CSDB TYPE(S)*
Late	2a	450-250 B.P. / A.D. 1500-1700	A1 (3-8 mm face diameter)
Late	2b	250-150 B.P. / A.D. 1700-1800	A2 (9-16 mm face diameter)
Historic		150-0 B.P. / A.D. 1800-1950	A1 A2 A3 (>16 mm face diameter)

*Bennyhoff (1994:68–71); King (1978:59, Fig. 2)

and users of the artifacts" (Read 2009:42; see also Krieger 1944; Tomášková 2005). Thus, we find it necessary to incorporate both diameter and thickness in any definitive CSDB typology, and that fine typological distinctions cannot be dismissed without compelling empirical evidence. Because Bennyhoff and Fredrickson's typology is at present the best-developed typology along these lines, it will be used as a starting point for this study.

CHRONOLOGICAL SERIATION OF CLAM SHELL DISK BEAD TYPES

A seriation of CSDB within Phase 2 of the Late period Augustine pattern has not been systematically attempted beyond a few preliminary efforts by Bennyhoff (1994) and King (1978). As illustrated in Table 1, Bennyhoff and King have each hypothesized a shift from the predominance of small CSDB in Phase 2a of the Late period to the predominance of medium-sized beads in Phase 2b, followed by the addition of large beads and the resurgence of small beads in the Historic period. Bennyhoff and King saw this pattern in site data that were available to them in the 1960s through the 1980s, but this hypothesis has not been revisited in recent decades. As discussed above, AMS radiocarbon and other dating methods provide opportunities to test this hypothesis. Shifts in CSDB thickness, edge and face finish, use-wear, and other metrics have not been hypothesized or evaluated, and a more nuanced typology combined with systematic direct dating may point to additional patterns of change over time.

FINDINGS

In this study, we used AMS radiocarbon dating to test CSDB from CCO-297, a permanent village site in the vicinity of the city of Richmond on the eastern shore of the San Francisco Bay, one of the shellmounds that make up the Stege Mound complex. The site was occupied continuously from ca. A.D. 1350 to 1800, from the end of Phase 1 through Phase 2 of the Late period (DeGeorgey 2013). Thus, given a representative sample of CSDB from CCO-297, we would expect to see changes in the assemblages of CSDB types at the transitions between Phase 1, Phase 2a, Phase 2b, and the Historic period.

Banks and Orlins (1981) recovered 10 CSDB from the site, but they did not perform radiocarbon dating on any of the CSDB. In 2011, DeGeorgey (2013) recovered a total of 173 CSDB. Four of these were radiocarbon dated. An additional 118 CSDB were recovered by DeGeorgey (2014). All are finished, Class A beads, Types A1 and A2. Two CSDB were not used in the present study due to cataloging errors, giving a total sample size of 299 specimens.

Size Distribution

In order to apply Bennyhoff and Fredrickson's typology, two metrics were analyzed: diameter and thickness (Figure 1). CSDB at CCO-297 range from 5.3 to 14.9 mm in diameter, with a mean of 9.1 mm and a standard deviation of 1.99 mm. Thicknesses range from 1.4 to 5.6 mm, with a mean of 3.0 mm and a standard deviation of 0.82 mm. A density plot reveals at least two major diameter/thickness clusters centered at diameters of approximately 7.5 and 10.2 mm (Figure 2). Two clusters of divergent thicknesses tentatively appear at a diameter of 14.5 mm.

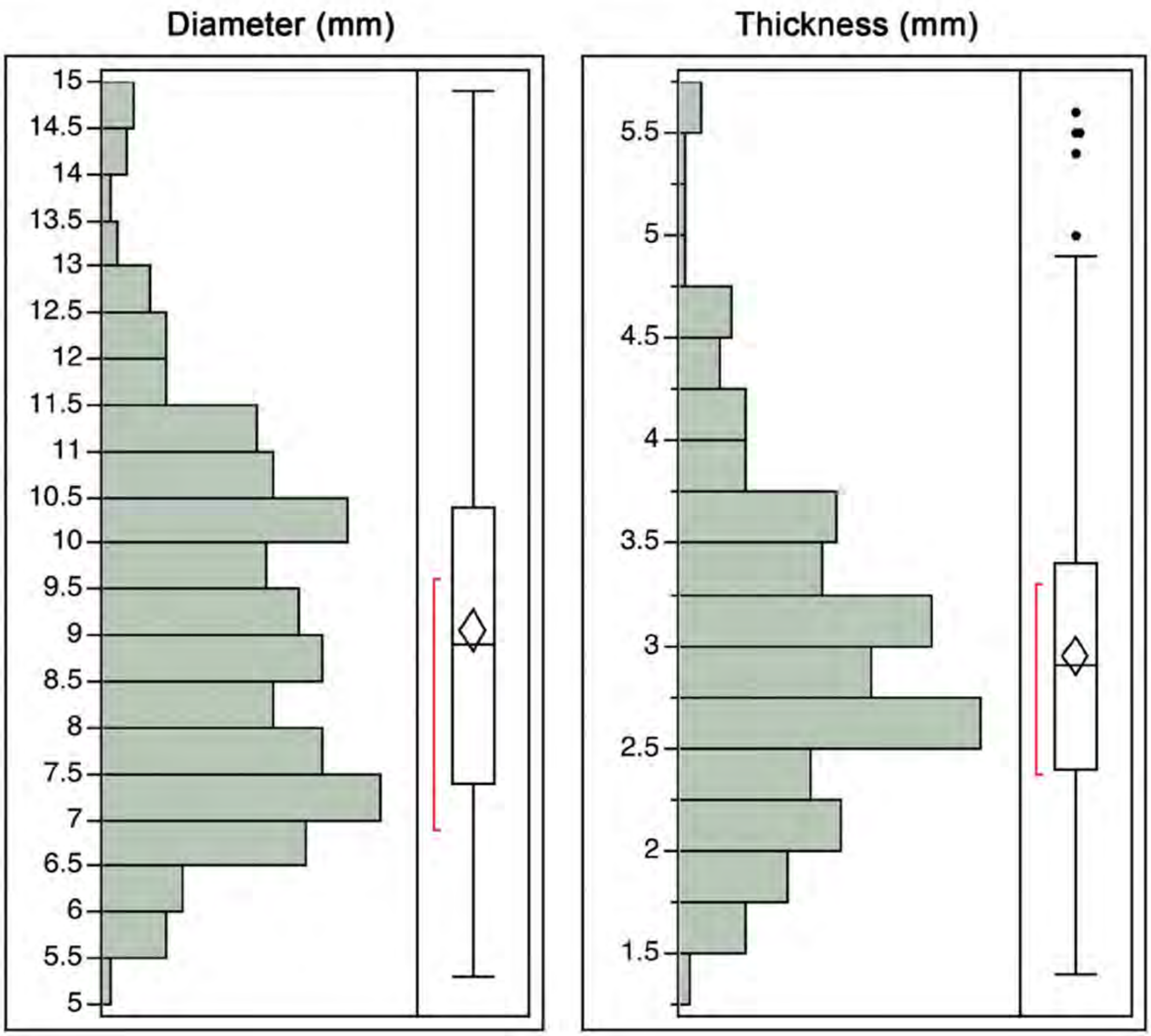

Figure 1. Diameter and thickness distributions of CSDB from CCO-297.

The application of Bennyhoff and Fredrickson's typology (Table 2; Figure 3) allows us to evaluate the accuracy of their size categories. The diameter size ranges map fairly well onto the empirical data from CCO-297, especially types A1c and A2a. As Milliken (2005) suggests, there may not be enough of a distinction between A1b and A1c seen in the distribution to warrant two types, though further study is needed before Bennyhoff and Fredrickson's categories are thrown out entirely. All of the CSDB from CCO-297 are captured by Bennyhoff and Fredrickson's "thin" types, although the minimum size ranges do not account for the thinnest beads, with thicknesses less than 2.0 mm. Despite these small discrepancies between the data from CCO-297 and Bennyhoff and Fredrickson's typology, their model largely reflects the empirical findings.

Only CSDB of types A1 and A2 have been recovered from CCO-297. Because Class A beads are the fully finished form, it appears that the Huchiun occupants of CCO-297 obtained them as finished products from other sources through regional networks of conveyance. Interestingly, none of the "thick" (e.g. Types A1d and A1e) or large (Type A3) CSDB were recovered from CCO-297. Given that thicker beads appear to have been of higher value, the lack of thick types may indicate that CCO-297 was not as

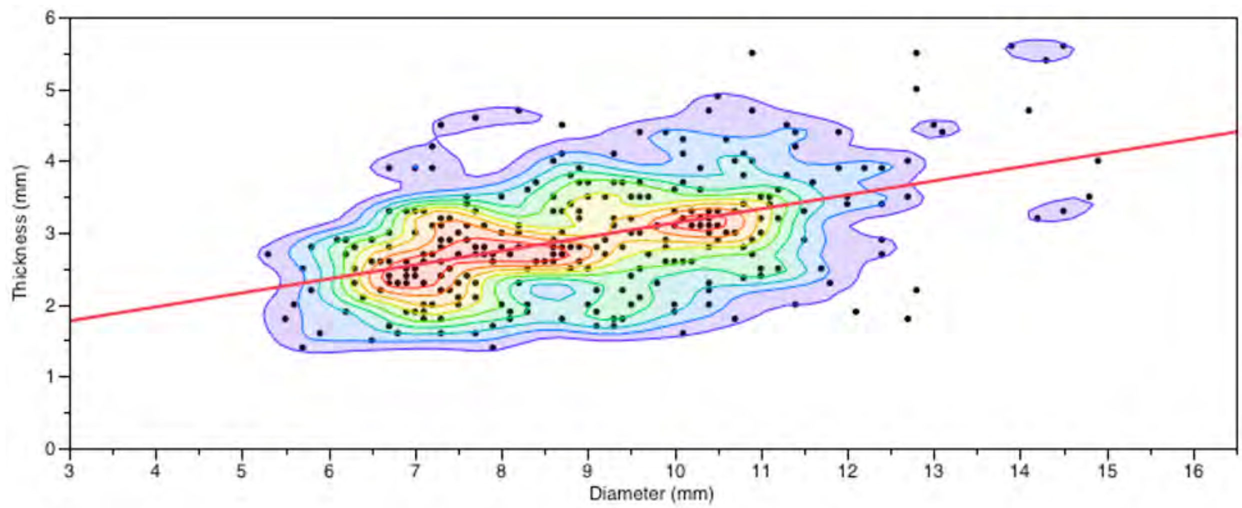

Figure 2. Scatterplot of CSDB from CCO-297, by diameter and thickness. Innermost regions (red) capture 50 percent of data points.

Table 2. Frequency of CSDB types at CCO-297.

TYPE*	FREQUENCY	PERCENT
A1b	44	14.7
A1c	82	27.4
A2a	157	52.5
A2b	16	5.4
Total:	299	100.0

* Bennyhoff and Fredrickson (1967)

affluent as other sites in central California, or that site inhabitants lacked access to these types. The lack of Type A3 beads may indicate that terminal site occupation occurred prior to the predominance of Type A3 beads seen in the Historic period by Bennyhoff (1994) and King (1978). Further interpretation of these results requires comparative data from other sites in central California. One such comparative site, YOL-69, will be discussed below.

Radiocarbon Dating

Ten CSDB from CCO-297 were submitted for AMS radiocarbon dating, and the results were calibrated using the ΔR value provided by Groza et al. (2011). Table 3 and Figure 4 summarize these results.

These results do not confirm Bennyhoff and King's seriation hypothesis. Type A1 CSDB date to a time range that includes both Phase 2a (A.D. 1500-1700) and Phase 2b (A.D. 1700-1800) of the Late period, and into the Historic period (post A.D. 1800). Four of the five Type A2 beads correspond closely to Phase 2a, though the fifth appears to be slightly younger and may belong to Phase 2b. Based on this very small sample size, it appears that the hypothesized seriation does not apply to CCO-297. However, a very preliminary hypothesis may be offered that places Type A1 beads throughout Phase 2 of the Late period and the Historic period, while Type A2 beads are limited to Phase 2a.

Ultimately, however, these conclusions are limited by the small sample size and the error factors inherent to AMS radiocarbon dating. Additional AMS dating of CSDB will allow for larger sample sizes, which will enable more robust conclusions, despite the wide margins of error at play. These data

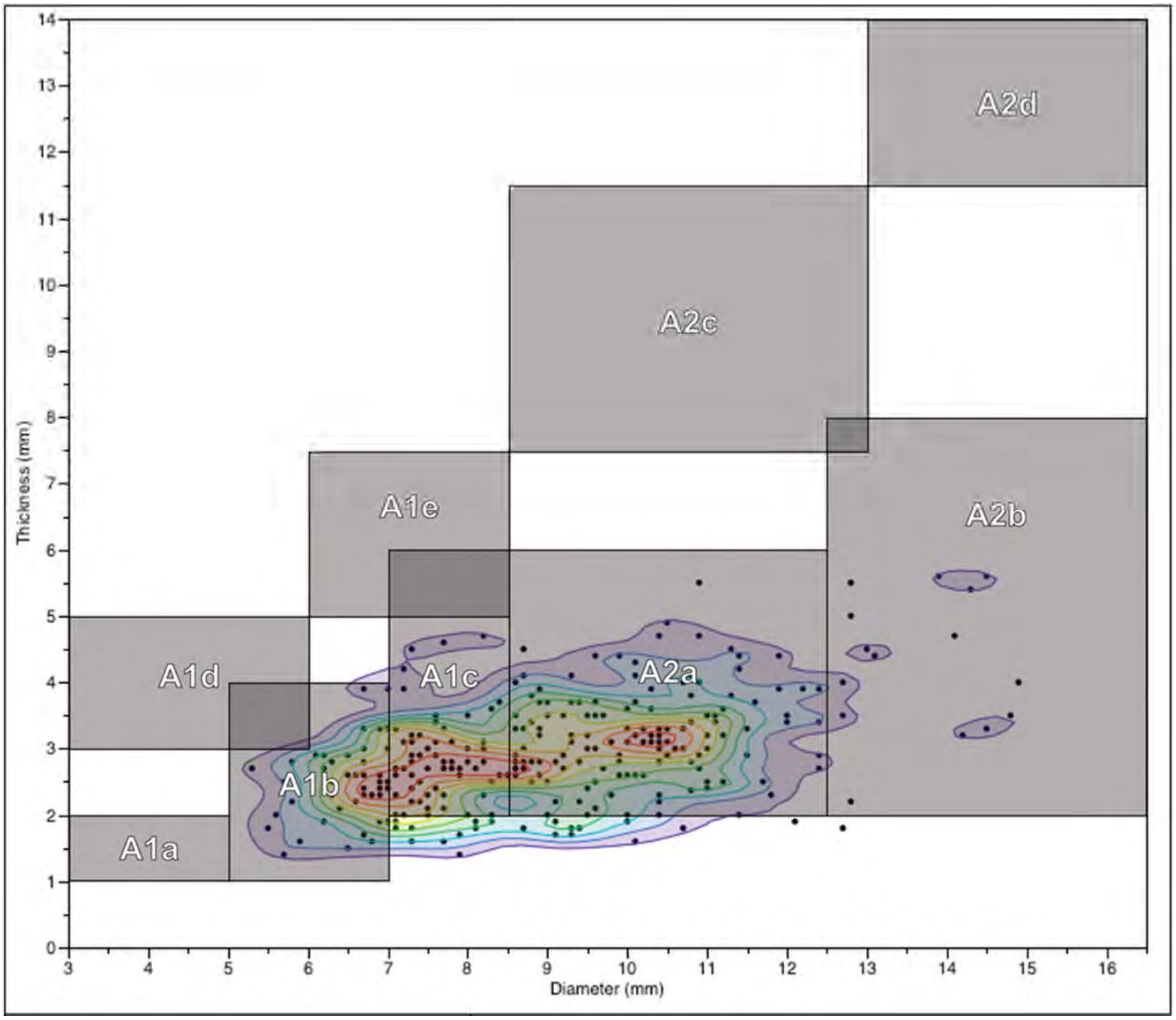

Figure 3. Density plot of CSDB at CCO-297 with Bennyhoff and Fredrickson's (1967) types.

will also assist the development of a CSDB-specific ΔR value. Such research efforts will offer more meaningful insights into the seriation of CSDB sizes and styles across time and space.

INTERSITE COMPARISON WITH YOL-69

YOL-69 is a village site situated along Cache Creek west of Woodland, California. It was occupied year-round on a permanent basis from Phase I of the Late period through the Historic period. A data recovery project was conducted in 2002, which revealed that the site was a major manufacturing center for CSDB (Wiberg 2005). Investigators recovered "more than 1,000 bead blanks and rejects, over 3000 grams of *Saxidomus* shell manufacturing debris, a cache of nested *Saxidomus* shells, numerous stone drills, and several possible bead drilling" and 24,539 finished CSDB (Milliken 2005).

Like the CSDB assemblage seen at CCO-297, small and medium CSDB predominate in the collection recovered from YOL-69, and very few large beads (type A3) were found. In contrast to CCO-297, a few "thick" beads (types A1d and A1e) were present. Two thousand eight hundred and forty-one chipped disks and disk blanks were recovered, indicating that YOL-69 was a major manufacturing center for processing imported clam shells into finished CSDB. The size distribution of the CSDB found in the

Table 3. AMS radiocarbon dates from CSDB from CCO-297 and YOL-69.

SITE	CAT. NO.	LAB NO.	DIAMETER (MM)	THICKNESS (MM)	TYPE*	CONVENTIONAL RADIOCARBON AGE	CALIBRATED RADIOCARBON AGE**
CCO-297 (DeGeorgey 2013)	21-3	Beta-324201	7.8	2.8	A1c	760 ±30	A.D. 1712-1950
	32-3	Beta-324202	14.3	5.4	A2b	940 ±30	A.D. 1511-1700
	67-92	Beta-324199	7.5	2.9	A1c	870 ±30	A.D. 1565-1833
	67-151	Beta-324200	13.1	4.4	A2b	1000 ±30	A.D. 1480-1662
	751	D-AMS-005216	12.4	2.9	A2a	922 ±24	A.D. 1519-1717
	828C	D-AMS-005217	6.4	2.1	A1b	887 ±26	A.D. 1557-1812
	1187A	D-AMS-005218	10.5	4.9	A2a	921 ±25	A.D. 1516-1721
	1697A	D-AMS-005219	12.0	3.4	A2a	882 ±26	A.D. 1563-1816
	1728	D-AMS-005220	6.7	3.9	A1b	1023 ±27	A.D. 1467-1648
	2237	D-AMS-005225	6.5	1.5	A1b	1039 ±29	A.D. 1457-1641
YOL-69 (Wiberg 2005)	1335.0	Beta-177328	†	†	A1bc	870 ±40	A.D. 1549-1853
	1458.0	Beta-177332	†	†	A1bc	880 ±40	A.D. 1538-1832
	2079.0	Beta-177338	†	†	A1bc	880 ±40	A.D. 1538-1832

* Bennyhoff and Fredrickson (1967).

** Calibrated to a 2-sigma confidence level using the MARINE 13 curve and a ΔR of 260 ±35 (after Groza et al. 2011)

† Wiberg's catalog numbers refer to whole strings of beads; thus the individual metrics of the beads submitted for AMS radiocarbon dating cannot be determined beyond the general size ranges indicated by bead type.

artifact catalog is similar to that of CCO-297 (Table 4; Figure 5). Bennyhoff and Fredrickson's typology captures high-density areas in the thickness/diameter distribution of CSDB from YOL-69, although like CCO-297 it does not capture some of the outliers present in the bead assemblage.

Three small, finished CSDB (Type A1bc) were AMS radiocarbon dated by the investigators. Because these samples are all the same size, it is clear that they were not chosen with the goal of seriation in mind. The ΔR value originally provided by Beta Analytic placed all three within the time range of about A.D. 1500 to 1700 (Late period, Phase 2a). The ΔR value proposed by Groza et al. (2011) widens the range to dates to between approximately A.D. 1550 and 1850, which spans all of Phase 2 of the Late period (Table 3; Figure 4).

This comparative case further demonstrates that Bennyhoff and Fredrickson's typology is appropriate for analysis of CSDB in central California. However, it is clear that their size ranges need to be revised to account for more recent empirical data, and more extensive AMS radiocarbon dating is necessary to effectively seriate CSDB types within Phase 2 of the Late period.

CONCLUSIONS

Together, typological categorization and radiocarbon dating of CSDB can offer important insights into shifts in sizes and styles of CSDB in Late period central California. An analysis of CSDB from CCO-297 and YOL-69 shows that Bennyhoff and Fredrickson's typology is a good framework to begin with, and that direct AMS radiocarbon dating can be an effective way to evaluate hypotheses on CSDB seriation.

Despite decades of archaeological research on central Californian beads, the methods for understanding CSDB are still in their infancies. Future research should focus on reexamining Bennyhoff and Fredrickson's size ranges, because a systematic regional analysis of sizes and styles of CSDB would enable more precise typological divisions. An updated typology for CSDB based on regional data will

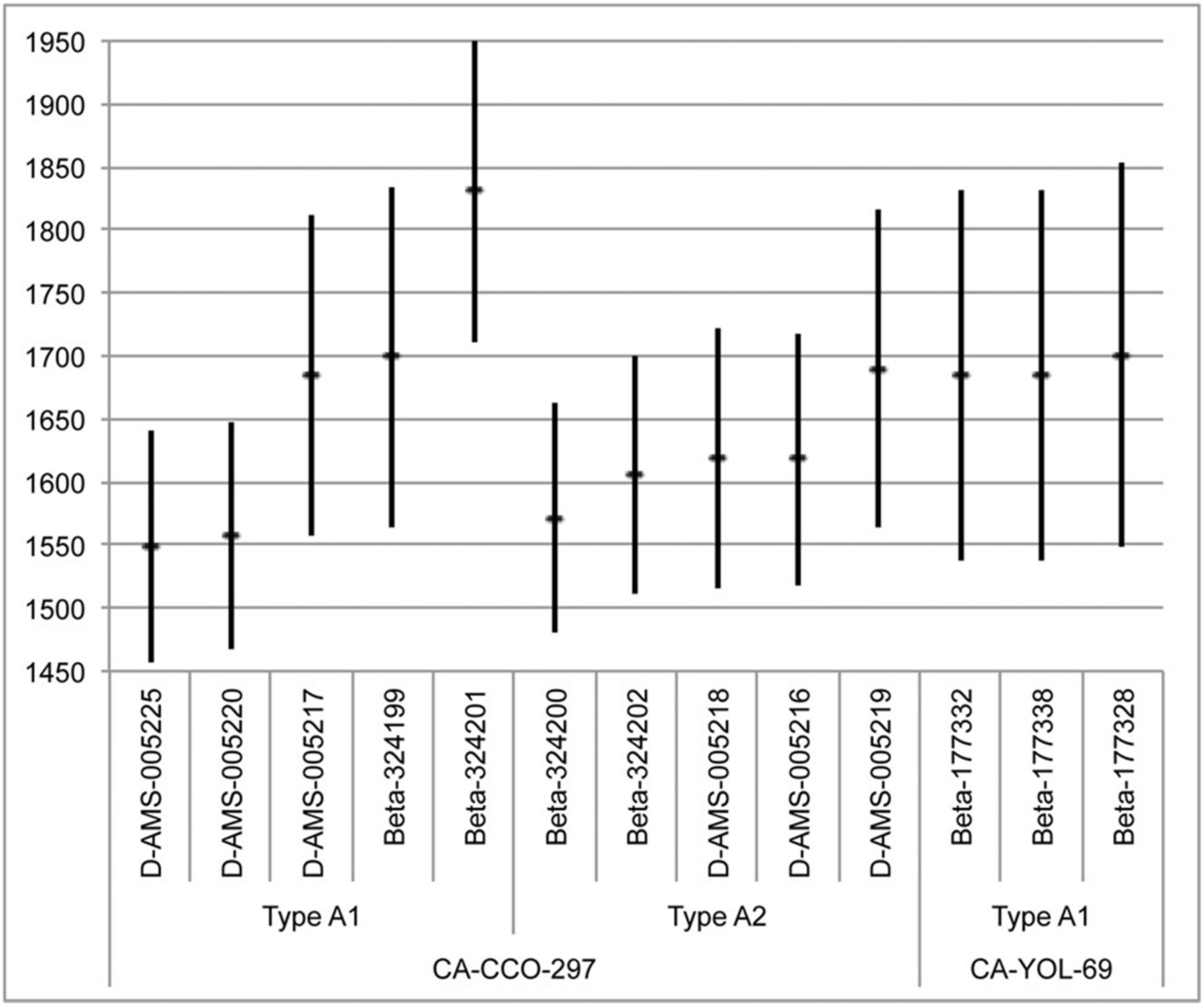

Figure 4. Clam shell disk bead AMS radiocarbon dates (A.D.) from CCO-297 and YOL-69.

allow for meaningful research into chronological seriation of CSDB, but only if more CSDB are dated using AMS radiocarbon dating and other methods. Thus, research should also be directed at developing an effective ΔR value for calibrating CSDB radiocarbon dates. Ultimately, these lines of research into CSDB will undoubtedly provide significant insights into the conveyance networks and political economies of central California in the Late period.

APPENDIX: BENNYHOFF AND FREDRICKSON'S CLAM SHELL DISK BEAD TYPOLOGY

In the 1960s, James Bennyhoff and David Fredrickson revised Lillard, Heizer, and Fenenga's (1939) CSDB typology as part of an unpublished work entitled "A Typology of Shell and Stone Beads from Central California" (Bennyhoff and Fredrickson 1967:36-38). The *Olivella* shell bead section was later expanded upon and published (Bennyhoff and Hughes 1987). The available copy of the typology appears to have been typewritten by Bennyhoff and then annotated by hand by Fredrickson. Revisions and notes in the margins were added to the document as late as the 1980s.

Table 4. Clam bead type totals from YOL-69 (Wiberg 2005).

DESCRIPTION	TYPE*	COUNT
Ground Disks	A1	18,942
	A2	2,651
	A3	14
	Total	21,607
Chipped Disks	C1	751
	C2	1,212
	C3	35
	Total	1,998
Disk Blanks	D1-2	600
	E1	168
	E2	75
	Total	843
Cylinders	G1	73
	G2	4
	Total	77
Indeterminate		14
	Grand Total	24,539

* Bennyhoff and Fredrickson (1967)

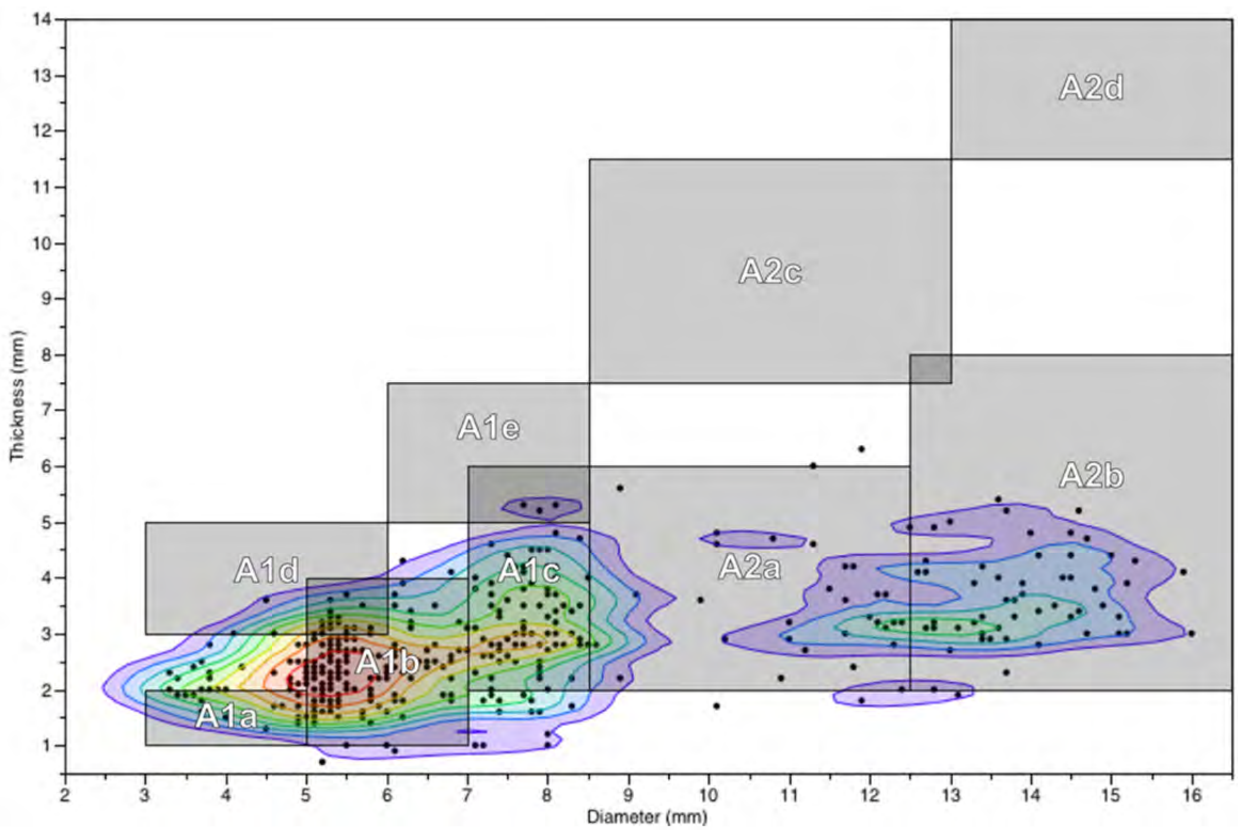

Figure 5. Density plot of sample measurements of CSDB from YOL-69 reported in Wiberg (2005), with Bennyhoff and Fredrickson's (1967) types.

Table 5. Bennyoff's typology.

CLASS A

TYPE	DESCRIPTION	SUB-TYPE	DIAMETER MIN. (MM)	DIAMETER MAX. (MM)	THICKNESS MIN. (MM)	THICKNESS MAX. (MM)	AVERAGE DIAMETER (MM)	AVERAGE THICKNESS (MM)
A1	Small		4	11				
		A1a	4	5	1	2	4	1
		A1b	5	8	1	3	7	2
		A1c	7	11	2	6	9	3
		A1d	3	5	3	5	4	3
		A1e	6	9	5	8	8	7
A2	Medium		8	17				
		A2a	8	13	2	6	11	3
		A2b	11	17	2	8	14	4
A3	Large		16	42				
		A3a	16	25	2	8	20	4
		A3b	24	42	2	8	29	4

CLASS B

Oblong CSDB. Two opposite edges are ground down so that they are flattened and parallel.
Length: 8-11 mm
Average length: 9 mm
Width: 6-9 mm
Average width: 7 mm

In an attempt to clarify matters, Bennyhoff's original typology and Fredrickson's modified version have been transcribed separately below (Tables 5 and 6). In general usage, "Bennyhoff and Fredrickson's typology" should refer to the version incorporating the most recent modifications.

It is important to note that Bennyhoff intended the typology to be used for analyzing whole strings of CSDB, so some subtypes have partially overlapping diagnostic measurements in order to allow classification of strings despite individual bead outliers. Fredrickson's modifications impose stricter measurement ranges in order to more easily classify single beads.

Bennyhoff and Fredrickson stated that CSDB are diagnostic of Phase 2 of the Late period. They hypothesized that Types A1a and A1b are diagnostic of early Phase 2, while all types occur later in Phase 2.

Sites referenced in the marginalia are COL-1, HUM-307, MRN-193, MRN-471 (Jackson 1974), SAC-6, SAC-16, SHA-400, and SON-1251.

The authors would like to thank Richard Fitzgerald (California Department of Parks and Recreation) for supplying the manuscript version of the typology presented here.

Table 6. Fredrickson's modified typology.

CLASS A

Finished CSDB. Edges ground and polished.

Type	Description	Sub-type	Diameter min. (mm)	Diameter max. (mm)	Thickness min. (mm)	Thickness max (mm)
A1	Small		3.00	8.49		
		A1a	3.00	4.99	1.00	2.00
		A1b	5.00	6.99	1.00	4.00
		A1c	7.00	8.49	2.00	6.00
	(Thick)	A1d	3.00	5.99	3.00	4.99
	(Thick)	A1e	6.00	8.49	5.00	8.00
A2	Medium		8.50	16.49		
		A2a	8.50	12.49	2.00	6.00
		A2b	12.50	16.49	2.00	8.00
	(Thick)	A2c	8.50	12.99	7.00	11.00
	(Thick)	A2d	13.00	16.49	11.00	14.00
A3	Large		16.50	42.00		
		A3a	16.50	24.99	2.00	8.00
		A3b	25.00	42.00	2.00	8.00
	(Thick)	A3c	16.50	21.00	15.00	19.00

CLASS B

Semi-ground CSDB. Drilled but partially finished. Edges somewhat irregular and incompletely ground. Same size dimensions as Class A, using minimum diameter.

CLASS C

Chipped CSDB. Drilled but unfinished. Edges only chipped. Size dimensions 2.00 mm larger than Class A, using minimum diameter.

C1: diameter = 5.00-10.49
C2: diameter = 10.50-18.49
C3: diameter = 18.50-44.00

CLASS D

Partially drilled blank. Edges chipped. Same size dimensions as Class C, using minimum diameter.

CLASS E

Undrilled blank. Edges chipped. Same size dimensions as Class C, using minimum diameter.

CLASS F

Oblong CSDB. Two opposite edges are ground down so that they are flattened and parallel.
Length: 8 to 11 mm
Width: 6 to 9 mm

CLASS G

Cylinder beads. Thickness exceeds the face diameter.
G1: diameter = 3.00-8.49 mm
G2: diameter = 8.50-16.49 mm
G3: diameter ≥ 16.50 mm

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