Table 9 — Ceramics from 410N 410E.

FS #	*Level*	*Total*	*>3cm*	*<3cm*	*Type*	*Grams*	*Summary Statistics*
71	2	1	1	0	Orange Incised	20.8	Average wt. all ceramics = 5.3g
71	2	4	0	4	Orange pottery	6.0	Average wt. Orange Incised = 20.3g
72	3	7	0	7	Orange pottery	5.0	Average wt. Orange Plain = 14.2g
73	4	2	2	0	Orange Plain	30.3	No. of ceramics per 25,000 cm^3 = 5.4
73	4	1	1	0	Orange Incised	15.7	Grams of ceramics per 25,000 cm^3 = 28.9
73	4	10	0	10	Orange pottery	10.6	UID or <3cm sherds to >3cm sherds = 3.2:1
74	5	1	1	0	Orange Incised	15.7	Incised vs. Plain (g) = 121.8:42.5 or 2.9:1
75	6	1	1	0	Orange Plain	12.2	
75	6	1	1	0	Orange Incised	43.4	
75	6	4	0	4	Orange pottery	4.6	
76	7	1	0	1	Orange pottery	3.0	
77	8	3	0	3	Orange pottery	8.5	
77	8	2	2	0	Orange Incised	26.2	
Total		38	9	29		202.0	

Table 10 — Ceramics from 410N 520E.

FS #	*Level*	*Total*	*>3cm*	*<3cm*	*Type*	*Grams*	*Summary Statistics (* = Orange ceramics only)*
187	2	1	0	1	St. Johns	1.2	Average wt. all ceramics = 1.7g*
187	2	20	0	20	Orange pottery	23.9	Average wt. Orange Incised = 0g
187	2	2	2	0	Orange Plain	18.8	Average wt. Orange Plain = 7.4g
188	3	1	1	0	Orange Plain	5.6	No. of ceramics per 25,000 cm^3 = 10.8*
188	3	21	0	21	Orange pottery	35.1	Grams of ceramics per 25,000 cm^3 = 18.3*
189	4	6	0	6	Orange pottery	5	UID or <3cm sherds to >3cm sherds = 15.3:1*
190	5	5	0	5	Orange pottery	2	Incised vs. Plain (g) = 0:29.4*
191	6	4	0	4	Orange pottery	10.2	
192	7	4	0	4	Orange pottery	0.5	
193	8	1	1	0	Orange Plain	5	
193	8	1	0	1	Orange pottery	2.2	
Total		66	4	62		109.5	

make the ring. The pit-looking feature beneath the ring at 410N 520E may be one example of such prior use. Similarly, the early date from 340N 520E may simply represent one of these early activities left behind by people living at the ring site in a ring formation prior to the deposition of great amounts of shell. The shell from which the date was obtained lies in direct line with the eastern arm of the ring, suggesting an architectural connection.

The three other dates are nearly contemporaneous with each other. They came from contexts near the bottom-most levels of dense shell, rather than thin shell or other early cultural features beneath the ring. Thus, these should be seen as dating the initial deposits of dense shell, but not necessarily the initial activity at the ring site. We conclude from the radiocarbon dates and profiles that initial construction of the dense deposit of shell began around 3500 to 3600 B.P., but that activity

Table 11 — Ceramics from 440N 410E.

FS #	*Level*	*Total*	*>3cm*	*<3cm*	*Type*	*Grams*	*Summary Statistics*
87	1	4	0	4	Orange pottery	7.9	Average wt. all ceramics = 14.7g
88	2	1	1	0	Orange Incised	4	Average wt. Orange Incised = 30.4g
88	2	2	0	2	Orange pottery	2.1	Average wt. Orange Plain = 13.3g
89	3	1	1	0	Orange Plain	13.3	No. of ceramics per 25,000 cm^3 = 2.6
89	3	2	0	2	Orange pottery	2.1	Grams of ceramics per 25,000 cm^3 = 37.6
90	4	3	3	0	Orange Incised	82.1	UID or <3cm sherds to >3cm sherds = 1.1:1
91	5	2	2	0	Orange Incised	171.3	Incised vs. Plain (g) = 304.2:13.3 or 22.9:1
91	5	2	0	2	Orange pottery	3.3	
92	6	3	3	0	Orange Incised	26.8	
93	7	1	1	0	Orange Incised	24	
93	7	1	0	1	Orange pottery	0.6	
94	9	1	0	1	Orange pottery	0.6	
Total		23	11	12		338.1	

Table 12 — Ceramics from 440N 510E.

FS #	*Level*	*Total*	*>3cm*	*<3cm*	*Type*	*Grams*	*Summary Statistics*
79	2	3	0	3	Orange pottery	2.1	Average wt. all ceramics = 2.4g
80	3	15	0	15	Orange pottery	17.8	Average wt. Orange Incised = 16.9g
81	4	1	1	0	Orange Incised	27.2	Average wt. Orange Plain = 15.5g
81	4	1	1	0	Orange Plain	14.2	No. of ceramics per 25,000 cm^3 = 8.1
81	4	33	0	33	Orange pottery	34.4	Grams of ceramics per 25,000 cm^3 = 19.5
82	5	1	1	0	Orange Plain	14.2	UID or <3cm sherds to >3cm sherds = 9.8:1
83	6	2	2	0	Orange Plain	33.6	Incised vs. Plain (g) = 33.7:62 or 1:1.8
83	6	5	0	5	Orange pottery	2.2	
84	7	2	0	2	Orange pottery	2.4	* *feature = 1 level for shell volume calculations*
86	8	1	1	0	Orange Incised	6.5	
86	*8	1	0	1	Orange pottery	1.8	
Total		65	6	59		156.4	

at the ring site began earlier. Based on the single date from 340N 540E, the site was occupied at least as early as 3860 B.P.

DISCUSSION

Accuracy of Probing Shell Rings

Using probes to identify buried shell deposits in rings has only been used once before (Russo and Saunders 1999). The accuracy of probing thus remains a question open to empirical verification. In some respects the depth to which shell is identified by a probe is subjective. Based on the sound of scraping shell against the probe, the feel of vibrations related to scraping shell, and variations in resistance in the push of the probe through the ground, the depth of shell is assessed by the human prober. As soon as the resistance is met, the prober measures the depth to which the probe has been inserted into the soil. As the probe is pushed through the deepest and last deposit of shell, tac-

Table 13 — Ceramics from 470N 430E.

FS #	*Level*	*Total*	*>3cm*	*<3cm*	*Type*	*Grams*	*Summary Statistics (* = Orange ceramics only)*
211	1	1	0	1	St. Johns	2.4	Average wt. all ceramics = 3.9g*
212	2	1	0	1	St. Johns erode	3.9	Average wt. Orange Incised = 24.8g
212	2	2	0	2	St. Johns	1.2	Average wt. Orange Plain = 4.1g
213	3	1	1	0	St. Johns check	2.6	No. of ceramics per 25,000 cm^3 = 3.1*
213	3	1	0	1	St. Johns	0.1	Grams of ceramics per 25,000 cm^3 = 12.34*
213	3	1	0	1	Orange pottery	0.1	UID or <3cm sherds to >3cm sherds = 3.2:1*
214	4	1	0	1	St. Johns	0.2	Incised vs. Plain (g) = 49.6:12.2 or 4.1:1*
214	4	1	1	0	Orange Plain	6.1	
214	4	7	0	7	Orange pottery	4.9	
215	5	2	2	0	Orange Incised	49.6	
215	5	7	0	7	Orange pottery	9.7	
216	6	1	1	0	Orange Plain	3.0	
216	6	1	0	1	Orange pottery	9.6	
217	7	1	0	1	Orange pottery	0.3	
218	lost	1	1	0	Orange Plain	3.1	
Total		29	6	23		96.8	

tile and aural aspects of resistance change and the prober measures that point determined to no longer contain shell as the greatest shell depth.

It seems intuitive that the skill of the prober may play a part in obtaining accurate probe measures. Sound, touch, resistance all appear to be subjective qualities, and all the more so when they are needed in combination to determine a reading. But the same might be said of visual measures of shell depth. For example, looking down into the bottom of a shovel test to measure where shell deposits end could result in different depths by different measurers depending on how far the measurer sticks his/her head into the hole, the quality of their vision to determine objects close up, or what each sees as shell and non-shell. Is sand with just a few flecks of shell in it a shell deposit or a sand deposit?

Based on experience, we felt that probing for shell is fairly accurate (within 10 to 20 percent of the visually inspected deposit depths). However, we sought to assess the accuracy of probe versus visual measures of shell by comparing the depths of each. Figures 7–10 compare the depths of our shell probes against the visually determined shell depths in our shovel tests. Those who drew the profile were unaware of the depths of shell as determined by probes. And those who probed the shell depths took readings before the shovel tests were dug. All thirteen shovel tests were dug in arbitrary 10-centimeter levels and placed at or adjacent to the probe locations.

Based on the thirteen comparative samples only three probes matched the depths of shell deposits as identified in measures of shell observed in profiles (Figure 11). The other ten had an average difference in thickness measure of 13 centimeters. These probes were either thinner (46 percent) or thicker (31 percent) than the visual meaures of shell thickness. The greatest difference between the two methods was 20 centimeters. The probe readings predicted the visual readings for the top of shell deposits 61 percent of the time. However, we note that the majority of these samples started at the surface. Shell seen at or near the surface may have influenced the probers starting measures, regardless if they did not feel resistance for a centimeter or two. Three of the shovel tests had shell that started well below surface. Of these, one probe identified the starting depth at the same

Table 14 — Ceramics from 469N 453E (1-by-2-meter unit, including 0.25-by-1-meter column sample).

FS #	*Level*	*Total*	*>3cm*	*<3cm*	*Type*	*Grams*	*Summary Statistics (* = Orange ceramics only)*
100	1	1	1	0	St. Johns Check	3.5	Average wt. all ceramics = 3g*
101	2	2	2	0	St. Johns Comp	8.4	Average wt. Orange Incised = 16g
101	2	3	3	0	St. Johns Check	24.2	Average wt. Orange Plain = 9.6g
101	2	1	1	0	St. Johns Plain	5.2	No. of ceramics per 25,000 cm^3 = 4.7*
101	2	9	0	9	St. Johns	18.0	Grams of ceramics per 25,000 cm^3 = 14.3*
101	2	4	0	4	Orange pottery	10.4	UID or <3cm sherds to >3cm sherds = 6:1*
102	3	1	0	1	Sand tempered	2.5	Incised vs. Plain (g) = 687.2:344.6 or 2:1*
102	3	18	0	18	St. Johns	51.6	
102	3	4	4	0	St. Johns Check	47.4	
102	3	23	0	23	Orange pottery	31.4	
102	3	1	1	0	Orange Incised	5.8	
102	3	1	1	0	Orange Plain	4.0	
103	4	1	1	0	St. Johns Plain	6.3	
103	4	9	0	9	St. Johns	7.9	
103	4	3	3	0	Orange Plain	26.1	
103	4	2	2	0	Orange Incised	12.5	
103	4	27	0	27	Orange pottery	35.8	
104	5	3	3	0	Orange Incised	23.7	
104	5	1	1	0	Orange Plain	5.4	
104	5	19	0	19	Orange pottery	30.3	
105	6	71	0	71	Orange pottery	148.4	
105	6	3	3	0	Orange Plain	21.1	
105	6	7	7	0	Orange Incised	100.7	
106	7	7	7	0	Orange Incised	67.8	
106	7	46	0	46	Orange pottery	93.1	
107	8	0	0	0	LOST	0	
108-9	9	10	10	0	Orange Incised	80.0	
108-9	9	11	11	0	Orange Plain	92.6	
108-9	9	52	0	52	Orange pottery	72.8	
110	10	2	2	0	Orange Incised	8.6	
110	10	5	5	0	Orange Plain	70.5	
110	10	64	0	64	Orange pottery	101	
111	11	4	4	0	Orange Incised	59.9	
111	11	3	3	0	Orange Plain	35.5	
111	11	74	0	74	Orange pottery	27.9	
112	12	5	5	0	Orange Incised	47.9	
112	12	6	6	0	Orange Plain	64.7	
112	12	63	0	63	Orange pottery	62.5	
113	13	2	2	0	Orange Plain	19.8	
113	13	31	0	31	Orange pottery	28.0	
114	14	1	1	0	Orange Incised	39.7	
114	14	1	1	0	Orange Plain	4.9	
115	15	1	1	0	Orange Incised	240.6	
Total		602	91	511		1848.4	

Table 15 — Ceramics from 470N 480E.

FS #	*Level*	*Total*	*>3cm*	*<3cm*	*Type*	*Grams*	*Summary Statistics*
219	2	1	1	0	Orange Incised	47.8	Average wt. all ceramics = 11.1g
219	2	4	0	4	Orange pottery	4.7	Average wt. Orange Incised = 21g
220	3	2	2	0	Orange Plain	138.8	Average wt. Orange Plain = 38g
220	3	1	1	0	Orange Incised	36.9	No. of ceramics per 25,000 cm^3 = 5.4
220	3	10	0	10	Orange pottery	66.8	Grams of ceramics per 25,000 cm^3 = 60.5
221	4	1	1	0	Orange Plain	6.3	UID or <3cm sherds to >3cm sherds = 2.3:1
222	5	1	1	0	Orange Plain	10	Incised vs. Plain (g) = 168.3:265.9 or 1:1.6
222	5	2	2	0	Orange Incised	16.3	
222	5	6	0	6	Orange pottery	10.7	
223	6	1	1	0	Orange Plain	75.8	
223	6	3	3	0	Orange Incised	54.1	
223	6	11	0	11	Orange pottery	16.7	
224	7	1	0	1	Orange pottery	9.8	
225	8	2	0	2	Orange pottery	2	
225	8	1	1	0	Orange Incised	13.2	
225	8	2	2	0	Orange Plain	35	
Total		49	15	34		544.9	

Table 16 — North ring units: Orange ceramics from shell strata.

Test	*Plain(g)*	*Incised(g)*	*UID (g)*	*Total(g)*	*cm^3 shell*	*Summary Statistics*
470N430E	3(12.2)	2(49.6)	17(24.6)	22 (86.4)	225,000	Average wt. all = 3.7 g
469N453E	36 (344.6)	43 (687.2)	474 (642.2)	553 (1,673.4)	*2,925,000	Average wt. OP = 8.5 g
470N480E	7(265.9)	8(168.3)	34(110.7)	49(544.9)	225,000	Average wt. OI = 17.1 g
						OI vs. OP = 1.5:1 g
Total	73(622.7)	53(905.1)	525(777.5)	624(2,304.7)	3,375,000	Ceramics per 25,000 cm^3 = 17.1g
						No. ceramics per 25,000 cm^3 = 4.6
** includes column sample*						No. ID ceramics per 25,000 cm^3 = 0.9

Table 17 — Middle ring units: Orange ceramics from shell strata.

Test	*Plain(g)*	*Incised(g)*	*UID (g)*	*Total(g)*	*cm^3 shell*	*Summary Statistics*
380N400E	2(18.3)	1(7.8)	84(165.1)	87(191.2)	225,000	Average wt. all = 3.6 g
410N410E	3(42.5)	6(121.8)	29(37.7)	38(202.0)	175,000	Average wt. OP = 11.8 g
410N520E	4(29.4)	0	61(78.9)	65(108.3)	150,000	Average wt. OI = 46.8 g
440N410E	1(13.3)	10(304.2)	12(20.6)	23(338.1)	225,000	OI vs. OP = 2.8:1 g
440N510E	4(62.0)	2(33.7)	59(60.7)	65(156.4)	200,000	Ceramics per 25,000 cm^3 = 25.5 g
						No. ceramics per 25,000 cm^3 = 7.1
Total	14(165.5)	10(467.5)	245(363.0)	278(996.0)	975,000	No. ID ceramics per 25,000 cm^3 = 0.6

Table 18 — South ring units: Orange ceramics from shell strata.

Test	*Plain(g)*	*Incised(g)*	*UID (g)*	*Total(g)*	*cm³ shell*	*Summary Statistics*
320N430E	0	0	13(15.3)	13(15.3)	125,000	Average wt. all = 6.4 g
340N410E	8(96.7)	5(316.0)	42(83.4)	55(496.1)	250,000	Average wt. OP = 19.4 g
340N540E	0	0	2(0.2)	2(0.2)	50,000	Average wt. OI = 45.9 g
350N400E	6(168.2)	2(28.9)	42(54.9)	50(252.0)	200,000	OI vs. OP = 1.2:1 g
359N532E	1(41.9)	0	7(7.6)	8(49.5)	75,000	Ceramics per 25,000 cm^3 = 26.2 g
380N530E	1(3.9)	1(22.2)	1(0.1)	3(26.2)	100,000	No. ceramics per 25,000 cm^3 = 4.1
						No. ID ceramics per 25,000 cm^3 = 0.8
Total	16(310.7)	8(367.1)	107(161.5)	131(839.3)	800,000	

Table 19 — West ring units: Orange ceramics from shell strata.

Test	*Plain(g)*	*Incised(g)*	*UID (g)*	*Total(g)*	*cm³ shell*	*Summary Statistics*
320N430E	0	0	13(15.3)	13(15.3)	125,000	Average wt. all = 5.6 g
340N410E	8(96.7)	5(316.0)	42(83.4)	55(496.1)	250,000	Average wt. OP = 17 g
350N400E	6(168.2)	2(28.9)	42(54.9)	50(252.0)	200,000	Average wt. OI = 32.4 g
380N400E	2(18.3)	1(7.8)	84(165.1)	87(191.2)	225,000	OI vs. OP = 2.3:1 g
410N410E	3(42.5)	6(121.8)	29(37.7)	38(202.0)	175,000	Ceramics per 25,000 cm^3 = 31.1 g
440N410E	1(13.3)	10(304.2)	12(20.6)	23(338.1)	225,000	No. ceramics per 25,000 cm^3 = 5.5
						No. ID ceramics per 25,000 cm^3 = 0.9
Total	20(339.0)	24(778.7)	222(377.0)	266(1,494.7)	1,200,000	

Table 20 — East ring units: Orange ceramics from shell strata.

Test	*Plain(g)*	*Incised(g)*	*UID (g)*	*Total(g)*	*cm³ shell*	*Summary Statistics*
340N540E	0	0	2(0.2)	2(0.2)	50,000	Average wt. all = 2.4 g
359N532E	1(41.9)	0	7(7.6)	8(49.5)	75,000	Average wt. OP = 13.7 g
380N530E	1(3.9)	1(22.2)	1(0.1)	3(26.2)	100,000	Average wt. OI = 18.6 g
410N520E	4(29.4)	0	61(78.9)	65(108.3)	150,000	OI vs. OP = 1:2.4 g
440N510E	4(62.0)	2(33.7)	59(60.7)	65(156.4)	200,000	Ceramics per 25,000 cm^3 = 14.8 g
						No. ceramics per 25,000 cm^3 = 6.2
Total	10(137.2)	3(55.9)	130(147.5)	143(340.6)	575,000	No. ID ceramics per 25,000 cm^3 = 0.6

point in the drawn profile. The other two probes averaged 10 centimeters difference from the profiles. For determining the ending of shell, the probe depths were identical to the profile drawings at four shovel tests. The average difference for the other nine probes was 10 centimeters with the greatest difference being 18 centimeters.

A number of factors account for differences seen between probing and visually measuring shell depths. In many of the initial and ending levels that contained shell, soil contained only occasional oyster. The chances of a small probe (½-inch diameter) hitting shell when over half the matrix lacks shell is thus reduced. That is, shell probes work best in situations where fairly dense amounts of shell are encountered. They are less reliable in measuring thin scatters of shell. We suspect too, that the fragility and size of individual shell matters. We found it easier to feel oyster and clam with the probes, but a little more problematic to recognize the presence of the thin and small sized mollusks such as coquina. Shell hash is also prob-

Table 21 — Expanded groupings of east and west shovel tests, the test unit, and total site unit Orange ceramic statistics.

Test	***Plain(g)***	***Incised(g)***	***UID (g)***	***Total(g)***	***cm^3 shell***	***Summary Statistics***
West Ring						
320N430E	0	0	13(15.3)	13(15.3)	125,000	Average wt. all = 5.5 g
340N410E	8(96.7)	5(316.0)	42(83.4)	55(496.1)	250,000	Average wt. OP = 15.2 g
350N400E	6(168.2)	2(28.9)	42(54.9)	50(252.0)	200,000	Average wt. OI = 31.8 g
380N400E	2(18.3)	1(7.8)	84(165.1)	87(191.2)	225,000	OI vs. OP = 2.4:1 g
410N410E	3(42.5)	6(121.8)	29(37.7)	38(202.0)	175,000	Ceramics per 25,000 cm^3 = 27.7 g
440N410E	1(13.3)	10(304.2)	12(20.6)	23(338.1)	225,000	No. ceramics per 25,000 cm^3 = 5.1
470N430E	3(12.2)	2(49.6)	17(24.6)	22 (86.4)	225,000	No. ID ceramics per 25,000 cm^3 = 0.9
Total	23(351.2)	26(828.3)	239(401.6)	288(1,581.1)	1,425,000	
East Ring						
340N540E	0	0	2(0.2)	2(0.2)	50,000	Average wt. all = 4.6 g
359N532E	1(41.9)	0	7(7.6)	8(49.5)	75,000	Average wt. OP = 23.7 g
380N530E	1(3.9)	1(22.2)	1(0.1)	3(26.2)	100,000	Average wt. OI = 20.4 g
410N520E	4(29.4)	0	61(78.9)	65(108.3)	150,000	OI vs. OP = 1:1.8 g
440N510E	4(62.0)	2(33.7)	59(60.7)	65(156.4)	200,000	Ceramics per 25,000 cm^3 = 27.7 g
470N480E	7(265.9)	8(168.3)	34(110.7)	49(544.9)	225,000	No. ceramics per 25,000 cm^3 = 6
Total	17(403.1)	11(224.2)	164(258.2)	192(885.5)	800,000	No. ID ceramics per 25,000 cm^3 = 0.9
North Ring						
469N453E	36 (344.6)	43 (687.2)	474 (641.6)	553 (1,673.4)	2,925,000	Average wt. all = 3.1 g Average wt. OP = 9.6 g Average wt. OI = 16 g OI vs. OP = 2:1 g Ceramics per 25,000 cm^3 = 14.3 g No. ceramics per 25,000 cm^3 = 4.7 No. ID ceramics per 25,000 cm^3 = 0.7
All Units	76(1,098.9)	80(1,739.7)	877(1,301.4)	1,033(4,140.0)	5,150,000	Average wt. all = 4 g Average wt. OP = 14.5 g Average wt. OI = 21.7 g OI vs. OP = 1.6:1 g Ceramics per 25,000 cm^3 = 20.1 g No. ceramics per 25,000 cm^3 = 5 No. ID ceramics per 25,000 cm^3 = 0.8

Table 22 — Radiocarbon dates.

Provenience	***Lab. No.***	***Sample***	***Uncorrected Age B.P.***	***Conventional Age B.P.***	***^{13}C ‰***	***Maximum of Cal. Age Ranges (intercept) 1 sigma [2 sigma]***	***Orange Ceramics***
340N540E, L4	Beta 154816	oyster	3450+/-60	3860+/-60	-0.2	[3970] 3890 (3820) 3720 [3650]	1 (0.1 g)
469N453E, L12	Beta 154817	oyster	3210+/-50	3600+/-50	-1.2	[3620] 3550 (3470) 3440 [3370]	74 (175.1 g)
380N400E, L9	Beta 165598	oyster	3120+/-60	3490+/-70	-2.2	[3530] 3440 (3360) 3310 [3210]	2 (4.4 g above)
410N520E, L6	Beta 165599	oyster	3180+/-70	3590+/-70	+0.5	[3640] 3560 (3460) 3390 [3330]	4 (10.2 g)

All calibrated ages were determined by Beta Analytic with calibration data found in Stuiver et al. 1998. Local reservoir correction was not applied.

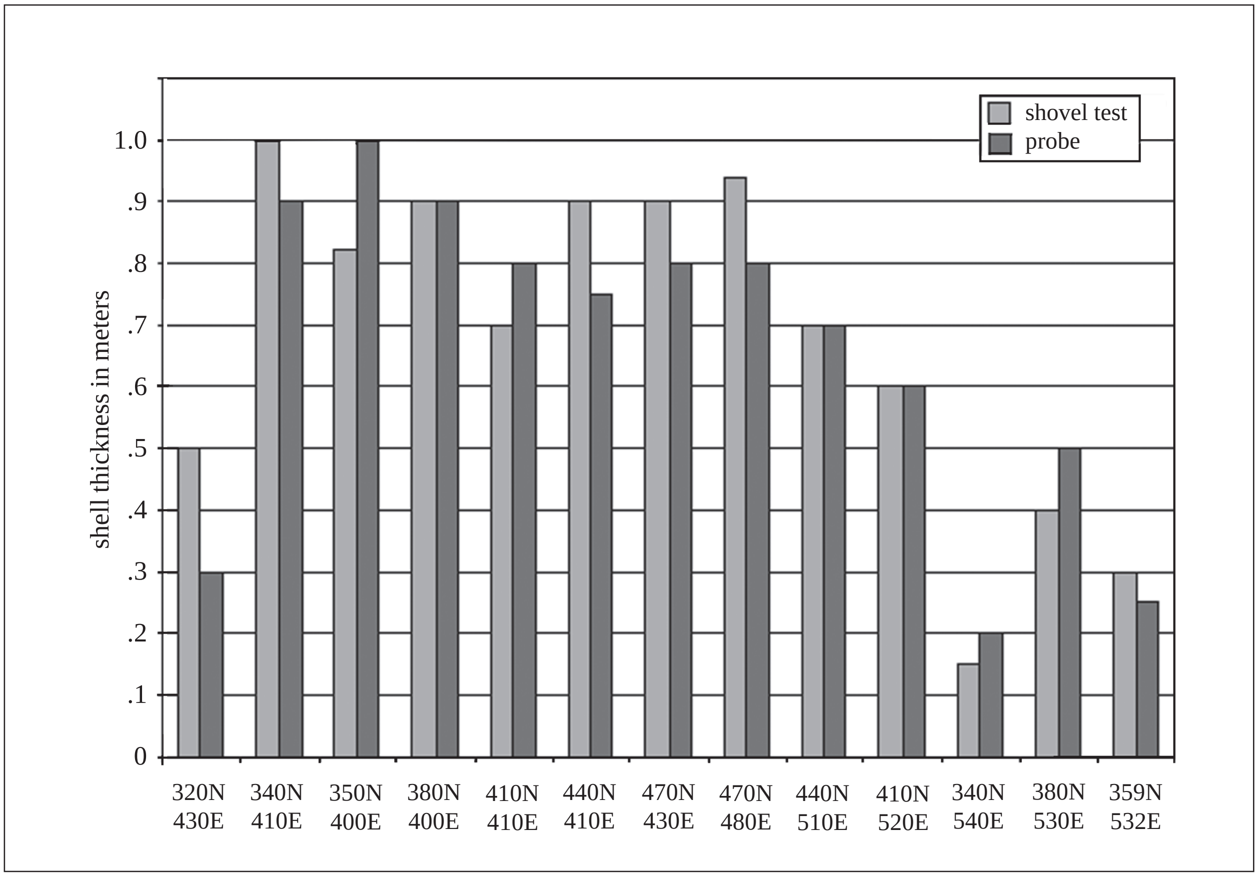

Figure 11 — Probe versus shovel test profile determinations of shell thickness (in meters).

lematic, we suspect for similar reasons. The shell has insufficient or different kinds of resistance to identify with probes. With time, however, we would expect that skill could be acquired to identify these different shell matrices.

Other factors which may help account for the slight differences in results of the two methods include the way probe depths are measured. Once the probe is pushed through the bottom shell midden, the release of resistance may plunge the probe into sterile subsoil. The individual probing must then pull the probe back to the presumed point at which the probe broke through the shell. This is usually only 5 or 10 centimeters, but it is an individuals estimate which can introduce some error. Also, when measuring the depths for the start and stopping of shell, the prober usually rounds off to the nearest 5 centimeters. That is, if the probe encountered shell at 8 centimeters below surface it would generally be recorded as 10 centimeters. Such rounding off occurs in profile drawing too, of course, but, perhaps not as often.

Overall we believe probing is very accurate for determining the relative depths of shell deposits in shell rings and other shell middens. In determining starting depths of shell at the surface, the probe is obviously highly accurate when compared to visual determinations. In cases where the initial depths of shell are subsurface, the probes either identified the depths accurately or varied by no more than 10 centimeters. In terms of determining ending depths, the probes were within 10 centimeters seven times and directly on the mark four times. The two cases where the bottom depths varied more than 10 centimeters both involved loose shell at the bottoms of the units, always problematic for both visual and probing assessments. The good news for determining volumes of shell at rings is that our probe data reveals that shell thickness based on probing achieved 96 percent of the total thickness based on visual inspection for the thirteen tests (8.5 versus 8.8 centimeters, Table 23). That is, the plus/minus errors, however small, encountered with probing tended to even out in our samples.

Post-Occupational Soil Deposition

Based on our probing and shovel testing we can conclude that some degree of site burial has occurred since the ring was constructed. Soils at the site are primarily sand. On top of the thicker portions of the ring this sand was generally more abundant, but intermixed with shell, in the top 10 to 20 centimeters. In the southeastern corner of the ring, however, up to 40 centimeters of sand without shell actually overlie the shell ring. Units 340N 540E and 359N 532E show this phenomenon clearly. It is unclear how this soil was deposited on top of the shell, but eolian deposition and bioturbation/gravity are the most likely alternative candidates.

Wind-borne transport of sand is commonplace along the Florida coastlines. Trees and other vegetation act as windbreaks that stop and filter out sand as it is blown off beaches. The vegetation deaccelerates the wind blown particles causing them to fall and accumulate on the forest floor. In this case, that floor happens also to contain the Guana Shell Ring, but similar phenomena have been observed at other rings (Scudder 1993). In dense, but loosely packed shell, the small sand particles will migrate downward through the interstices among individual shells and only thin surfaces deposits of sand may be accumulated. Where shell is thinly deposited or absent, however, tightly packed soils preclude downward migration of eolian deposits resulting in the build up of sand and the burial of archaeological deposits. Consequently, shell middens near windblown sand sources often have little sand accumulation on their higher elevations where shell is loose, but more at lower elevations where more compact soil matrices inhibit soil migration. Such is likely the case at Guana.

An alternative explanation for site burial is that the shell, and other cultural materials, are moving down through gravity and bioturbation (sensu Mitchie 1990). No doubt this happens at all sites in sandy soils to some degree given sufficient time and the right biological disturbance conditions. However, it does not seem to satisfactorily account for the "horizons" of shell deposits buried beneath sand at Guana. If migration was occurring, one

Table 23 — Probed versus observed shell thicknesses (in meters).

Location	Probed Shell			Observed Shell			Thickness Difference
	Thickness	Start Depth	End Depth	Thickness	Start Depth	End Depth	
ST 320N 430E	0.30	0.30	0.60	0.50	0.20	0.70	0.20
ST 340N 410E	0.90	0.00	0.90	1.00	0.00	1.00	0.10
ST 350N 400E	1.00	0.00	1.00	0.82	0.00	0.82	-0.18
ST 380N 400E	0.90	0.00	0.90	0.90	0.00	0.90	0.00
ST 410N 410E	0.80	0.00	0.80	0.70	0.00	0.70	-0.10
ST 440N 410E	0.75	0.05	0.80	0.90	0.00	0.90	0.15
ST 470N 430E	0.80	0.10	0.90	0.90	0.00	0.90	0.10
ST 470N 480E	0.80	0.10	0.90	0.94	0.00	0.94	0.14
ST 440N 510E	0.70	0.00	0.70	0.70	0.00	0.70	0.00
ST 410N 520E	0.60	0.00	0.60	0.60	0.00	0.60	0.00
ST 340N 540E	0.20	0.35	0.55	0.15	0.25	0.40	-0.05
ST 380N 530E	0.50	0.00	0.50	0.40	0.00	0.40	-0.10
ST 359N 532E	0.25	0.40	0.65	0.30	0.40	0.70	0.05
Total	8.50			8.81			0.31

would expect the midden shell to be more dispersed vertically, throughout the soil column, rather than in one compact strata. Shell does not migrate down en masse as one unit, but individual particles migrate in relation to their relative sizes. Particle size is critical to downward migration. Generally, the smaller the item, the faster it migrates (Gunn and Foss 1994). Yet oyster, other shell, and artifacts of widely varying sizes are found together beneath sterile sands at the southeast section of the site. Smaller items are not at the bottom of the shell deposits with only large shell on top. The shell constituents, regardless of size, remain together as would be expected in an intact midden.

Other possible causes of sand deposition over much of the ring include storm tossed or fluvial deposition or the cultural deposition of sand as part of ring ceremonies or later historic activity. While eolian deposition seems a satisfactory explanation at this point, future work at the site should seek a definitive answer to the question.

Cultural Affiliation of the Guana Shell Ring

One goal of the grant was to determine the site's temporal and cultural occupation. While the radiocarbon dates have indicated a period of occupation between 3900 and 3500 B.P., we note that a number of cultures of this time period built shell rings in the region. Below is a brief review of these cultures, the character of their ring architecture, and the kinds of material culture they exhibit. After the discussion, we pull together the evidence that we have and examine to which of these ring building cultures Guana seems most related.

▪ *Archaic Shell Rings in the Southeastern U.S.*

The Southeast U.S. Late Archaic coastal landscape has revealed upwards of 60 shell rings and an uncounted number of what seem to be distinctive shell ring-producing cultures distinguished by the unique shapes of their rings, artifact assemblages, and dates of occupation.

▪ *South Carolina*

Along the central South Carolina coast, Thom's Creek sand-tempered pottery producers and fiber-tempered ceramic producing Stalling's cultures constructed a number of shell rings between 4200 and 3200 B.P. (Sassaman 1993; Trinkley 1985). At least twenty-five rings have been identified, varying widely in size from 30 to over 100 meters in diameter (Saunders 2001). Rings are generally circular to semicircular in shape and are found in isolation or in groups of two to four. They range in height from only a few centimeters to nearly six meters (Fig Island). At Coosaw and Skull Creek, two rings join together to form figure 8s. Shell ring function has been interpreted as either living, i.e., villages (Trinkley 1985) or ceremonial sites (Cable 1997). In both interpretations, the interior plaza is seen as an area kept relatively clean of debris, although evidence of communal food processing/consuming activities can be found. The shell ring is seen as being made up of the incidental discard of food refuse under or behind living floors or the sweepings of feast refuse from the communal plaza to the sides of the plaza (Cable 1997; Trinkley 1997).

Thom's Creek pottery is often poorly fired and decorated with punctations, incisions, and other designs (Trinkley 1976). While some of the techniques used in decorating pottery are similar to those used on Orange ceramics found at Guana (e.g., punctating, incising), the design motifs differ in style. Ceramics are often very abundant in South Carolina rings and variably include fiber-tempered types (Stallings) and clay balls. Worked bone objects are common; while chipped lithic tools and exotics are relatively rare. In terms of subsistence, oysters are the dominate shellfish with periwinkle (*Littorina irrorata)* common. Coquina are not found. The most abundant vertebrates are estuarine fish with freshwater turtle, deer, and other terrestrial mammals less abundant.

▪ *Georgia*

Near the Savannah River and south into coastal Georgia, the St. Simons culture built circular to semicircular shell rings from 4300 B.P. to at least 3700 B.P. Not many radiocarbon dates have been obtained from Georgia Shell rings, so the exact range of ring building may have covered a greater period of time. The largest ring is found at Sapelo

Shell Ring, approximately 90 meters in diameter and 4 meters in height at its tallest point. Prior to modern destruction, two other rings stood nearby. Most Georgia rings are considerably smaller, ranging between 30 and 70 meters across. Of the two ring sites that have been intensively investigated, Sapelo has been interpreted as a permanently settled community/ceremonial center (Waring 1968:245–246) while Marrinan (1975:117) could not offer a function or define the permanency of occupation at Canon's Point. At Sapelo, the central areas is seen as clean of debris while the ring is seen as the pilings of food placed next to small habitations (households) which moved frequently resulting in the ring buildup (Waring and Larson 1968:273).

The ceramic assemblages from Georgia rings consist of fiber-tempered wares which exhibit designs characterized by incising and punctates similar to those found on Stallings wares. In fact, Stallings and St. Simons types are often used interchangeably (Williams and Thompson 1999). Other common artifacts often include bone pins, while less frequently found are baked clay, ground stone, shell tools, and chipped lithics (Marrinan 1975; Waring and Larson 1968). Artifact assemblages are defined as meager and utilitarian (Marrinan 1975:108). Orange pottery types, including Tick Island Incised, have been recovered from Georgia shell rings, although St. Simons types are by far the most abundant (Marrinan 1975:61). In descending order, oyster, estuarine fish, crab freshwater fish, turtle, and terrestrial mammal remains have been found in the shell deposits at Georgia rings (Marrinan 1975).

▪ *Mississippi*

The Late Archaic Cedarland and the Poverty Point period Claiborne shell rings of coastal Mississippi, date between 3200 to 3100 B.P., but perhaps as early as 4000 B.P. (these ages are uncorrected and based on charcoal [cf. Bruseth 1991; Gagliano and Webb 1970]). Before they were destroyed, both sites were rather large, measuring between 165 and 250 meters in outside diameter, respectively. They stood 5 meters above the adjacent river at their highest points, but shell depth is reported as no more than 2 meters over much of both sites (Bruseth 1991:11,16). Both were semicircular with openings to the west. One author sees the Cedarland site as less of a shell ring with a sterile central plaza, than as a circular village consisting of shell/earth midden surrounded by a semicircular "constructed" pile of shell bounding the "center portion of the site" on all sides except the west (Bruseth 1991:9, 20). That is, the "plaza" was not an area kept clean of debris for communal activities, but a living area itself; and the ring was not a living area, but an architectural construction designed for some unknown reason to surround the living area. In contrast, the adjacent Claiborne site is seen as a ring upon which habitation occurred. The ring resulted from the discard of habitation debris underfoot or next to households on the rings (Bruseth 1991:14–15). On the other hand, the rings, whatever their primary functions, are also seen as somehow linked to the fact that "defense was an important consideration of village layout" (Bruseth 1991:13, 21).

Cedarland contained no pottery; while Claiborne yielded fiber-tempered and a small amount of "untempered" pottery. Aside from pottery, the sites were remarkable for the abundances of artifacts, particularly exotic lithics. While many of the artifacts are utilitarian in nature, others are decorative and often considered related to ceremony, e.g., plummets, gorgets, pendants, beads, and bone and copper ornaments (Bruseth 1991:12). Baked clay objects were abundant at Claiborne, and steatite and copper objects are identified as high status items, being that they were found in association with burials (Bruseth 1991:18). While Cedarland was comprised largely of oyster and earth, Claiborne contained much more *Rangia* clam.

▪ *Northwest Florida*

The Florida panhandle contains at least two horseshoe-shaped shell middens, the Elliott's Point period Buck Bayou site (Thomas and Campbell 1991) and the Late Archaic Meig's Pasture site (Curren et al. 1987) measuring 125 meters and about 100 meters in greatest lengths, respectively. These structures, however, seem distinctively dif-