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A Late Prehistoric Marine-Shell Bead from Oregon's Hawksy Walksy Valley

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Marine-shell beads have been recovered from numerous archaeological sites throughout the Intermountain West. Direct radiocarbon determinations and typological cross-dating indicate that groups conveyed beads long distances inland throughout the Holocene. Because the oxygen and carbon isotopic signatures of Callianax *(previously* Olivella*) sp. snail shells reflect local sea surface temperature, researchers over the past 15 years have started to assign beads to source regions (stretches of the coast from which people collected shells). We report radiocarbon and stable isotope data for a C*allianax biplicata *bead from Oregon's Hawksy Walksy Valley, the only bead that has been recovered from this archaeologically important region. These data indicate that the bead was conveyed ~400 km. inland at 480–285 cal B.P. from somewhere along the Oregon or northern California coasts. We place these results within the context of other provenance studies of beads in the northern Great Basin to add to our understanding of how, when, and from where coastal producers conveyed shell beads to inland consumers.*

Marine-shell beads, including those made from the shells of olive snails (formerly *Olivella* sp., now *Callianax* sp.), were conveyed inland to consumers during both the pre-contact and historic periods in the Intermountain West. Ethnographically, the Northern Paiute, Klamath, and Modoc used shell beads to adorn necklaces, clothing, and hair (Fowler 1992; Stern 1998). Shell beads have been found attached to feather plumes, wands, necklaces, and moccasins at archaeological sites in the western Great Basin (Hattori 1982; Heizer 1951; Loud and Harrington 1929). Archaeological evidence suggests that their conveyance started during the early Holocene, if not earlier (Fitzgerald et al. 2005; Rice 1972; Smith et al. 2016). Bennyhoff and Hughes (1987; Hughes and Bennyhoff 1986) have outlined likely routes through which shell beads moved from major production centers in northern, central, and southern California to interior sites during the Holocene. They have suggested that during the early Holocene, *Callianax* shells from the northern California or Oregon coasts probably reached the northern Great Basin via a network along the Columbia River. Conversely, they have suggested that during a peak in shell-bead exchange between ~4,000–2,200 cal B.P., most *Callianax* beads likely originated along the central California coast. Between 2,200 and 1,300 cal B.P., central and southern California were probably the source of most *Callianax* beads. Between 1,300 and 500 cal B.P., northern California groups produced most of the beads that reached the northern Great Basin (Bennyhoff and Hughes 1987), while southern California groups had their own intensive shell bead industry (Arnold 1992). Jenkins et al. (2004a) have suggested that middle Holocene populations in Oregon's Fort Rock Basin obtained *Callianax* beads from the Oregon coast but also perhaps via a network that extended from southern California northward along the Sierra/Cascade front. Raab and Howard (2000) and Vellanoweth (2001) similarly have suggested that during the middle Holocene, *Callianax* beads (especially the grooved rectangular type) moved into the Fort Rock Basin from southern California. Finally, Largaespada (2006) has argued that northern Great Basin groups obtained *Callianax* beads from the California, Oregon, and Washington coasts. Bottman (2006) condensed these hypotheses into three generalized models that could account for the presence of *Callianax* beads at sites in Oregon's Fort Rock Basin, where he conducted his thesis research: (1) a central California network brought beads through a western Great Basin redistribution center from which they moved

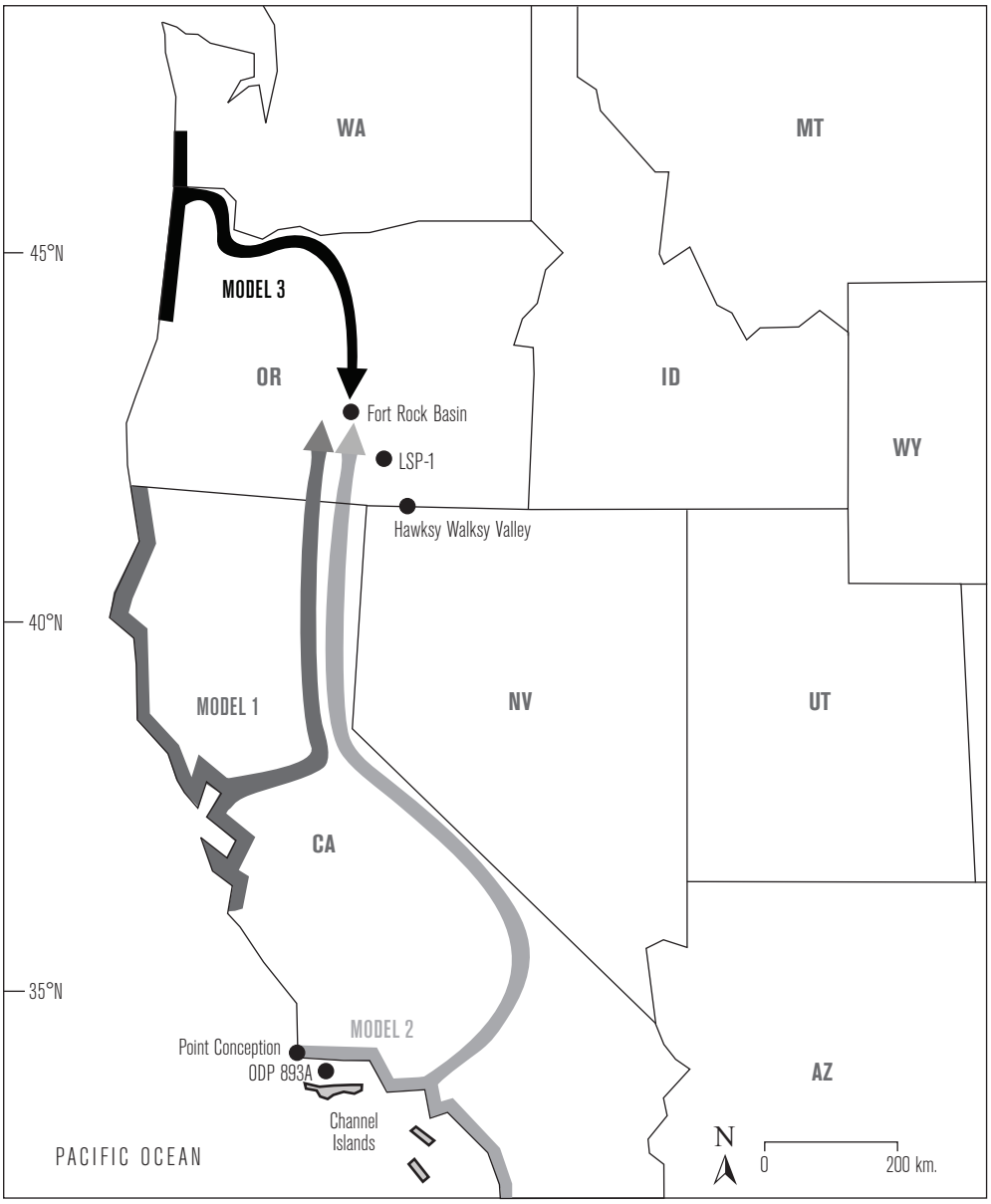

Figure 1. Hypothesized trade routes by which marine shell beads may have been conveyed into the northern Great Basin (Figure adapted from Bottman 2006).

northward (*sensu* Bennyhoff and Hughes 1987); (2) a southern California network brought beads produced on the southern Channel Islands inland and then northward along the Sierra Nevada/Cascade front (*sensu* Jenkins et al. 2004a; Raab and Howard 2000; Vellanoweth 2001); and (3) a Pacific Northwest network brought beads made of shells harvested at various locations along the northern California, Oregon, and Washington coasts inland along the Columbia River (*sensu* Bennyhoff and Hughes 1987; Galm 1994; Jenkins et al. 2004a; Fig. 1).

With the exception of Bottman's (2006) study, which we discuss in greater detail below, these and other efforts to explain when and from where marine-shell beads were conveyed inland have relied mostly on typological cross-dating using particular shell-bead types. While researchers sometimes assign ages to beads at inland sites based on associations with dated features or strata, most are assigned to broad time periods based on the fact that they are morphologically similar to beads recovered from well-dated sites in coastal areas. Over the last 15

years or so, researchers have started to submit marine-shell beads for accelerator mass spectrometer (AMS) radiocarbon dating (Erlandson et al. 2005; Fitzgerald et al. 2005; Groza 2002; Groza et al. 2011; Smith et al. 2016; Vellanoweth 2001). AMS dating represents a major improvement over typological cross-dating because it provides absolute and precise age estimates for individual beads. Various correction rates have been developed to address variable marine reservoir effects along different stretches of the Pacific Coast (e.g., Ingram and Southon 1996; Jazwa et al. 2012; Moss and Erlandson 1995).

Stable isotope analysis of marine-shell beads has also become common in recent years. Oxygen ($\delta^{18}O$) and carbon ($\delta^{13}C$) values of beads can help to identify where along the Pacific Coast the shells were collected. Shell carbonate $\delta^{18}O$ is affected by sea surface temperature (SST) and salinity (Eerkens et al. 2005, 2007, 2009; Killingley and Berger 1979; Wefer and Berger 1991). Because the salinity of ocean water is relatively consistent in the eastern Pacific (Eerkens et al. 2009; Urey 1947), $\delta^{18}O$ values primarily reflect SST, which in turn is tied to latitude and seasonality (Epstein et al. 1951, 1953; Horibe and Oba 1972). Seasonal variability and the effects of short-term temperature fluctuations such as El Niño events can be controlled for by sampling a bead multiple times across the shell's growth lines (e.g., Eerkens et al. 2005, 2009; Shackleton 1973). The $\delta^{13}C$ is affected by seasonal upwelling events, which differ in intensity along the Pacific Coast (Killingley and Berger 1979). Together, the $\delta^{18}O$ and $\delta^{13}C$ values of *Callianax* shells can be used to assign beads to source regions (stretches of coast along which the snails lived). California's Point Conception serves as a natural border between a southern region and a northern region, with marked differences in the isotopic signatures of the shells of snails living on either side. This is related in part to the local convergence of the California Current, bringing cold water south, and the Southern California Counter-current bringing warmer water north.

Eerkens' and his colleagues (2005, 2007, 2009, 2010) shell-bead sourcing studies demonstrated that *Callianax* beads at late Holocene sites in southern California likely originated in the southern source region. Using similar methods, Bottman (2006) analyzed *Callianax* beads from middle and late Holocene residential sites in Oregon's Fort Rock Basin to evaluate the generalized models of shell-bead conveyance in the northern Great Basin discussed above (see Fig. 1). He concluded that most of the Fort Rock Basin beads originated in southern California. Recently, Smith et al. (2016) analyzed six *Callianax* beads from the LSP-1 rockshelter in Oregon's Warner Valley, a site that saw repeated short-term use during the Holocene. They determined that four early Holocene specimens, one middle Holocene specimen, and one late Holocene specimen likely originated along the Oregon or Washington coasts. Those results differed from Bottman's (2006), suggesting that marine-shell bead conveyance in the northern Great Basin varied in time, space, or perhaps in accordance with the manner in which people occupied sites. We present here the results of AMS and stable isotope analyses for the only *Callianax* bead to be recovered from Oregon's Hawksy Walksy Valley, a remote but archaeologically-rich area of southeastern Oregon. We also compile previously published stable isotope data for all sourced beads from the northern Great Basin to summarize what we know about shell bead conveyance.

HAWKSY WALKSY VALLEY

Hawksy Walksy Valley (HWV) is a small, internally-draining basin along the Oregon-Nevada border ~400 km. from the Pacific Ocean (Fig. 1). The valley once held a pluvial lake, although its hydrological history remains poorly understood (Christian 1997a; Nials 1999). Christian's (1997a, 1997b) thesis research, which included both pedestrian surveys and site testing, constitutes the only major archaeological study conducted in HWV. Christian (1997a) recorded ~50 sites and numerous isolated projectile points. An abundance of Western Stemmed Tradition (WST) and concave base points led Christian to conclude that HWV was most intensively used during the terminal Pleistocene/early Holocene, at which time the basin probably held a lake or wetland. He also recovered a variety of other diagnostic point types in fewer numbers, reflecting periodic use of HWV during the middle and late Holocene.

Site 35HA2598

Christian (1997a) tested four sites in HWV, including 35HA2598, a relatively small (~0.15 $km.^2$) lithic scatter located along the basin's western margin. Diagnostic

Table 1

RADIOCARBON DATE OBTAINED ON CHARCOAL FROM STP-1, 35HA2598

Sample ID	Catalog ID	^{14}C B.P. Age	pMC
D-AMS 025349	96-6-54	Modern	99.81 ± 0.33

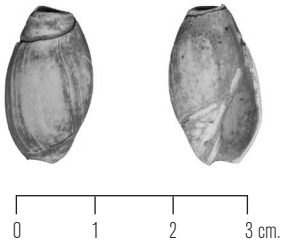

Figure 2. ***Callianax biplicata*** **Type A1c (large, simple spire-lopped) bead from Hawksy Walksy Valley, Oregon.**

artifacts recovered from the site's surface include 14 WST points, one crescent, one Cody/Alberta point, one Northern Side-notched point, one concave base point, one Elko Corner-notched point, and one Rosegate point. A few bifaces and unifaces and a variable-density flake scatter comprised the remainder of the artifacts at 35HA2598. Christian (1997b) noted a charcoal concentration on the ground surface adjacent to a WST point and excavated a 1 m.^{2} test pit (STP-1) at that location. His crew excavated in arbitrary 10-cm. levels and terminated the unit at 40 cm. below the surface. They collected charcoal and flakes from each level, and they interpreted the feature as a buried prehistoric hearth. Recently, we submitted sagebrush charcoal from Level 4 (30–40 cm.) of the feature to DirectAMS in Bothell, WA for AMS radiocarbon dating. The sample returned a modern age, which suggests either that the feature was the remnants of a recent campfire or that we submitted a piece of intrusive charred sagebrush (Table 1). Christian (1997b) also collected a *Callianax* shell bead from Level 1 (0–10 cm.) in STP-1.

MATERIALS AND METHODS

The bead from 35HA2598 was manufactured from the shell of a *Callianax biplicata* (purple olive snail; Fig. 2). It measures 19.4 mm. in length, 10.9 mm. in width, and has a spire opening of 3.5 mm. The end was lopped off perpendicular to the shell's long axis down to one of the suture lines, and part of the outer lip was broken off, perhaps to facilitate stringing. Its size and the way in which it was modified indicate that the bead is a type A1c—large, simple spire-lopped (Bennyhoff and Hughes 1987; Milliken and Schwitalla 2012). Type A1 beads are the most common type of shell bead recovered in the northern Great Basin, and they have been found in early, middle, and late Holocene contexts at numerous sites (Largaespada 2006).

Because collecting samples for AMS and staple isotope analysis is destructive, we generated a three-dimensional scan of the bead using an Artec Spider 3D Scanner and Artec Studio 12 Software. We then submitted it to the University of Georgia's Center for Applied Isotope Studies (CAIS) for AMS dating and δ^{18}O and δ^{13}C analysis. CAIS staff cleaned the bead manually and with a weak HCl solution to remove superficial contaminants and collected 50–100 µg. carbonate samples at 1–3 mm. intervals along transects across the shell's growth lines, beginning at the shell's lip and progressing towards its spire, using a Dremmel tool. Carbonate samples were reacted with 100 percent H_3PO_4 to recover CO_2. Stable isotope values were measured using a GasBench-IRMS and are reported with reference to PDB with an error of <0.1‰. CAIS staff obtained two radiocarbon assays: one from near the shell's lip and one near the shell's spire.

Table 2

RADIOCARBON DATES OBTAINED FOR THE HAWKSY WALKSY VALLEY *CALLIANAX* BEAD

UGA ID	Sample Location	δ^{13}C ‰	^{14}C B.P. Age	pMC	2σ cal B.P. range ($\Delta R = 240 \pm 50$)[a,b]
32834	Lip	1.28	990 ± 30	88.48 ± 0.30	285 – 490
32834	Spire	1.13	980 ± 25	88.43 ± 0.29	280 – 480

[a]Date calibrated using Oxcal 4.2 online calibration program (Bronk Ramsey 2009) with Marine13 curve (Reimer et al. 2013).

[b]Marine reservoir correction rate of 240±50 developed by Moss and Erlandson (1995) for the Oregon coast.

RESULTS

Table 2 presents the radiocarbon dates obtained on the lip and spire of the bead. The radiocarbon ages of the two samples (990±30 and 980±25 ^{14}C B.P.) have overlapping error, which is to be expected for two assays obtained

Table 3

STABLE ISOTOPE DATA COLLECTED AT 16 POINTS ACROSS THE SHELL'S GROWTH LINES

UGA ID	Distance from Lip (mm.)	$\delta^{13}C$ ‰	$\delta^{18}O$ ‰
32834-1	0	1.54	2.33
32834-2	1	1.66	2.42
32834-3	2	1.38	2.38
32834-4	3	1.94	2.12
32834-5	5	1.74	2.31
32834-6	7	1.70	2.75
32834-7	8	1.37	2.74
32834-8	11	2.09	1.88
32834-9	13	0.91	1.95
32834-10	17	1.01	2.17
32834-11	19	1.38	2.87
32834-12	22	2.17	2.00
32834-13	24	1.62	2.46
32834-14	26	1.32	2.43
32834-15	28	1.33	2.53
32834-16	30	1.16	2.04
	Average	1.52	2.34
	Standard Deviation	0.36	

on a short-lived species. Given the $\delta^{18}O$ and $\delta^{13}C$ values of the bead (see below), we believe that it came from the northern source region—most likely the Oregon coast. We therefore applied the marine reservoir correction rate (ΔR) of 240±50 developed by Moss and Erlandson (1995) for that region. When that correction rate is applied, the 2σ calibrated age range of the combined dates is 480–285 cal B.P. This makes it the youngest directly dated bead from the northern Great Basin.

Table 3 and Figures 3 and 4 present the $\delta^{13}C$ (0.91 to 2.17‰) and $\delta^{18}O$ (1.88 to 2.87‰) values for the HWV bead. While the bead's $\delta^{13}C$ values fall within the range of shells from the northern source region, provenience interpretations cannot be obtained from $\delta^{13}C$ data alone because the $\delta^{13}C$ ranges for the two regions overlap substantially. The bead's $\delta^{18}O$ values provide a clearer picture. Enriched $\delta^{18}O$ values indicate that the snail grew in relatively cold water. The $\delta^{18}O$ values for the period during which the bead was harvested (480–285 cal B.P.)—obtained from planktonic foraminiferal species from the

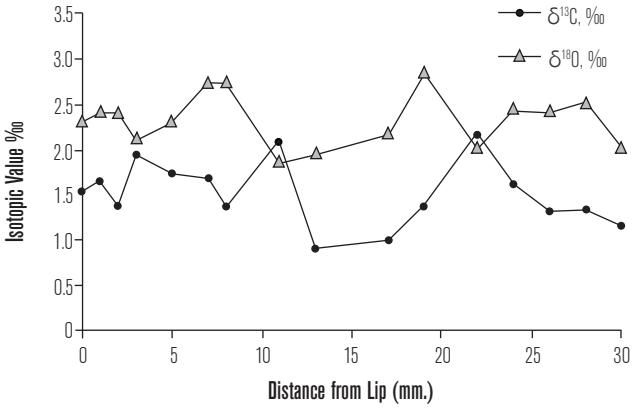

Figure 3. Isotope values for 16 sampled locations across the growth lines of the Hawksy Walksy Valley *Callianax biplicata* bead reflecting seasonal fluctuations in SST and upwelling.

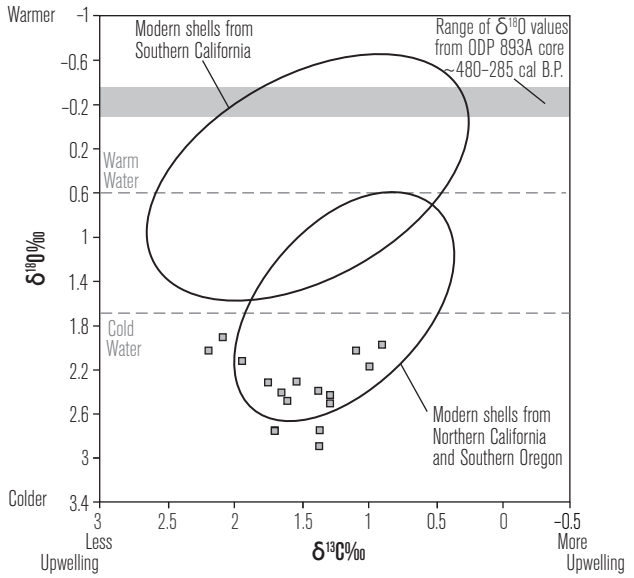

Figure 4. Carbon and oxygen isotope values (gray squares) recorded for the Hawksy Walksy Valley *Callianax biplicata* bead. Ovals represent the range of values obtained from modern *Callianax* shells between Big Sur, Cal. and southern Oregon (Eerkens and colleagues' northern source region) and locations south of Point Conception (Eerkens and colleagues' southern source region). The upper dashed line illustrates the cutoff (0.6‰) in $\delta^{18}O$ values with individual readings less than that indicating growth in the southern source region. The lower dashed line illustrates the cutoff (1.7‰) in $\delta^{18}O$ with individual readings greater than that indicating growth in the northern source region. The shaded bar shows the range of $\delta^{18}O$ values recorded derived from ODP 893A, ~480–285 cal B.P., the period during which the snail whose shell was used to make the Hawksy Walksy bead lived. Note that both the y- and x-axes are inverted, with more negative values up and to the right. Figure adapted from Smith et al. (2016).

ODP 893A sediment core in the Santa Barbara Basin—range from –0.36 to –0.08‰ (Kennett and Kennett 2000; Kennett et al. 2013). These values are within the modern range for southern California established by Eerkens et al. (2007, 2009). This suggests that SSTs in southern California when the shell used to make the HWV bead was harvested were not significantly different from those at present. In other words, there is no indication that there was a period of cooler SST when the shell was harvested during which $\delta^{18}O$ values could have mimicked those of more northerly, colder waters. Based on these measurements, the bead almost certainly originated along the far northern California or Oregon coasts.

DISCUSSION

While the data presented here are from a single *Callianax* bead (the only one found in HWV), when considered together with other beads from the northern Great Basin that have been submitted for isotopic analysis, our results add to the growing picture of marine-shell bead exchange in the region. Table 4 lists all of the sourced *Callianax* beads from Oregon (30 beads from seven sites), their radiocarbon ages (either obtained from the beads themselves or from associated terrestrial samples), and their 2σ calibrated age ranges.[1] Table 5 lists the $\delta^{18}O$ and $\delta^{13}C$ values for each bead, their inferred regional source, and which of Bottman's (2006) three conveyance

Table 4

RADIOCARBON DATED SAMPLES ASSOCIATED WITH CALLIANAX BEADS FROM OREGON SUBMITTED FOR ISOTOPIC ANALYSIS

Location	Bead Catalog Number	Bead Type	^{14}C B.P. Date(s)	2σ cal B.P. Range[a]	Lab Number	Reference for ^{14}C Date	Notes
Hawksy Walksy	96-6-54	A1c	990 ± 30 (lip) 980 ± 25 (spire)	480–285[b]	UGA-32834	This Study	Directly dated bead; 2σ cal B.P. range is a combination of both dates
Carlon Village	1028-63-H2-2-C-3-24	A1a	590 ± 40	655–535	Beta-121929	Wingard (2001)	Date on associated terrestrial sample
Carlon Village	1028-63-H4-1-B-3-4	A1a	630 ± 60	680–540	Beta-114215	Wingard (2001)	Date on associated terrestrial sample
Carlon Village	734-63-1-6B-10	A2a	1,780 ± 70	1,870–1,560	Beta-121928	Wingard (2001)	Date on associated terrestrial sample
Bowling Dune	932-C1-1-1-C-3-5	B3	2,890 ± 70	3,230–2,850	Beta-75078	Jenkins (2004)	Date on associated terrestrial sample
DJ Ranch	932-DJ2-U3-A-3-1	B3	3,370 ± 60 3,380 ± 100 3,510 ± 80	3,830–3,570	Beta-75088 Beta-75085 Beta-75087	Moessner (2004)	Dates on associated terrestrial samples; 2σ cal BP range is an estimate for "Occupation Period 3" (Moessner 2004:110) during which time this bead was discarded
DJ Ranch	932-DJ2-U6-D-2-6	A1a	3,370 ± 60 3,380 ± 100 3,510 ± 80	3,830–3,570	Beta-75088 Beta-75085 Beta-75087	Moessner (2004)	Dates on associated terrestrial samples from ; 2σ cal BP range is an estimate for "Occupation Period 3" (Moessner 2004:110) during which time this bead was discarded
Bergen	1171-BE-11-B-1-1	A2a	4,090 ± 40	3,885–3,595[c] 3,905–3,640[d]	OS-28990	Helzer (2004)	Date on associated *Tivela stultorum* (Pismo Clam) shell bead; given equivocal δO^{18} values (see Table 5) we applied two different correction rates
Bergen	1171-BE-12-D-8-2	A2a	4,090 ± 40	3,885–3,595[c] 3,905–3,640[d]	OS-28990	Helzer (2004)	Date on associated *Tivela stultorum* (Pismo Clam) shell bead; given equivocal δO^{18} values (see Table 5) we applied two different correction rates
Bergen	1136-BE-9-A-5-2	A1b	3,990 ± 70	4,800–4,240	Beta-134687	Helzer (2004)	Date on associated terrestrial sample
LSP-1	3191	A2a	4,560 ± 25	4,770–4,190[b]	UGA-21830	Smith et al. (2016)	Directly dated bead
Bowling Dune	932-C1-5-1-D-8-1	A1a	4,610 ± 90	5,580–4,990	Beta-75079	Jenkins (2004)	Date on associated terrestrial sample
Bergen	1171-BE-10-A-9-1	A1a	5,230 ± 40	5,455–5,205[d]	OS-28987	Helzer (2004)	Directly dated bead
Bergen	1171-BE-11-A-14-4	A1a	5,310 ± 45	5,530–5,260[c] 5,570–5,290[b]	OS-28986	Helzer (2004)	Directly dated bead; given equivocal δO^{18} values (see Table 5) we applied two different correction rates

Table 4 (*Continued*)

RADIOCARBON DATED SAMPLES ASSOCIATED WITH CALLIANAX BEADS FROM OREGON SUBMITTED FOR ISOTOPIC ANALYSIS

Location	Bead Catalog Number	Bead Type	^{14}C B.P. Date(s)	2σ cal B.P. Range[a]	Lab Number	Reference for ^{14}C Date	Notes
Big M	734-4-B1-6-28	A1a	4,755 ± 65	5,600–5,320	Beta-39908	Jenkins (1994)	Date on associated terrestrial sample
Big M	734-4-B2-5-7	A1b	4,755 ± 65	5,600–5,320	Beta-39908	Jenkins (1994)	Date on associated terrestrial sample
Big M	734-4-B2-5-25	A1a	4,755 ± 65	5,600–5,320	Beta-39908	Jenkins (1994)	Date on associated terrestrial sample
Big M	734-4-B1-26-14	A1c	4,880 ± 110	5,900–5,330	Beta-39907	Jenkins (1994)	Date on associated terrestrial sample
Big M	734-4-B1-15-4	A1a	4,880 ± 110	5,900–5,330	Beta-39907	Jenkins (1994)	Date on associated terrestrial sample
Big M	734-4-B1-1-33	A1b	4,880 ± 110	5,900–5,330	Beta-39907	Jenkins (1994)	Date on associated terrestrial sample
Big M	822-4-TU1-92-A1-13	n/a	4,905 ± 65	5,880–5,480	Beta-57008	Jenkins (1994)	Date on associated terrestrial sample
Big M	822-4-5-13-C1-4	A2a	4,910 ± 60	5,875–5,485	Beta-57007	Jenkins (1994)	Date on associated terrestrial sample
Bergen	1171-BE-12-C-PH-6	A1b	5,620 ± 45	5,475–5,240[d]	OS-28988	Helzer (2004)	Directly dated bead
Bergen	1171-BE-3-B-16-8	A1a	5,190 ± 40	6,170–5,775	Beta-153979	Helzer (2004)	Date on associated terrestrial sample
Bergen	1136-BE-3-A-10-3	A2	5,930 ± 60	6,220–5,920[d]	OS-28996	Helzer (2004)	Directly dated bead
LSP-1	2104	A2a	7,890 ± 30	8,260–7,960[b]	UGA-21827	Smith et al. (2016)	Directly dated bead
LSP-1	2478	A2c	8,520 ± 30 (lip) 8,740 ± 30 (spire)	9,165–8,770[b]	UGA-21829	Smith et al. (2016)	Directly dated bead; 2σ cal BP range is a combination of both dates
LSP-1	761	A1a	8,870 ± 30	9,435–9,120[b]	UGA-21825	Smith et al. (2016)	Directly dated bead
LSP-1	1374	A2c	8,860 ± 30 (spire) 8,920 ± 30 (mid) 9,010 ± 30 (lip)	9,475–9,230[b]	UGA-21826	Smith et al. (2016)	Directly dated bead; 2σ cal BP range is a combination of three dates
LSP-1	2477	A1a	9,200 ± 30	9,815–9,490[b]	UGA-21828	Smith et al. (2016)	Directly dated bead

[a]All dates calibrated using OxCal 4.2 (Bronk Ramsey 2009) and either the IntCal 13 or Marine13 curves (Reimer et al. 2013). 2σ calibrated ranges are rounded following the conventions of Suiver and Polach (1977).

[b]Correction rate of 240±50 developed by Moss and Erlandson (1995) for the Oregon Coast applied.

[c]Correction rate of 290±35 developed by Ingram and Southon (1996) for the northern California coast applied.

[d]Correction rate of 261±21 developed by Jazwa et al. (2012; Brendan Culleton, personal communication, 2012) for the southern California coast applied.

models (central California, southern California, and the Pacific Northwest) the isotopic data support. Direct and associated radiocarbon dates for the beads fall into three general periods: (1) pre-8,000 cal B.P. (n=5); (2) ~6,200–3,000 cal B.P. (n=21); and (3) post-1,900 cal B.P. (n=4).

Although relatively small, the sample provides an opportunity to draw some tentative conclusions about marine-shell bead exchange in Oregon. First, the inland conveyance of shell beads in the northern Great Basin began during the early Holocene, if not earlier (Smith et al. 2016), around the same time that marine-shell bead conveyance began in the southern Great Basin (Fitzgerald et al. 2005) and bead production at coastal sites emerged (Erlandson et al. 2005; Lebow et al. 2015). Early Holocene bead conveyance inland may have also involved the westward movement of obsidian from interior sources to coastal sites (Davis et al. 2004; Erlandson et al. 2011; Lebow et al. 2015). The four early Holocene beads, all recovered from Warner Valley's LSP-1 rockshelter, originated in colder waters—probably along the Oregon coast (Smith et al. 2016). This trend is consistent with Bennyhoff and Hughes' (1987) suggestion that the oldest beads in the northern Intermountain West came from the Oregon or Washington coasts (Bottman's Model 3).

Second, roughly two-thirds of the beads date to between ~6,200 and ~3,000 cal B.P.; most of them were recovered from Fort Rock Basin sites (Bergen, Big M, Bowling Dune, and DJ Ranch). That interval corresponds closely with the Bergen Period of Fort Rock Basin prehistory (Jenkins et al. 2004b). The Bergen Period was characterized by a marked increase in residential stability that was manifested in the form of houses and storage pits. Lowland resources (fish, seeds, and small game) were important, and artiodactyls were hunted in upland locations. Population levels appear to have been relatively high (Jenkins et al. 2004b; Louderback et al. 2010) and the

Table 5

STABLE ISOTOPE DATA AND INFERRED SOURCE REGIONS FOR OREGON *CALLIANAX* BEADS

Location	Bead Catalog Number	Bead Type	2σ cal B.P. Range	No. of Samples[a]	$\delta^{18}O$ ‰ Average and Range[b]	$\delta^{13}C$ ‰ Average and Range[b]	Inferred Source	Supports Model(s)	Reference for Isotope Values
Hawksy Walksy	96-6-54	A1c	480–285	16	2.34 (1.88, 2.87)	1.52 (0.91, 2.17)	Oregon	3	This Study
Carlon Village	1028-63-H2-2-C-3-24	A1a	655–535	3	0.48 (0.19, 0.60)	1.55 (1.28, 1.76)	So. CA	2	Bottman (2006)
Carlon Village	1028-63-H4-1-B-3-4	A1a	680–540	3	0.79 (0.71, 0.95)	1.52 (1.27, 1.98)	So. CA	2	Bottman (2006)
Carlon Village	734-63-1-6B-10	A2a	1,870–1,560	3	–0.71 (-0.74, –0.65)	0.67 (0.64, .0.73)	So. CA	2	Bottman (2006)
Bowling Dune	932-C1-1-1-C-3-5	B3	3,230–2,850	3	0.96 (0.79, 1.28)	2.09 (1.96, 2.29)	So. CA	2	Bottman (2006)
DJ Ranch	932-DJ2-U3-A-3-1	B3	3,830–3,570	3	0.52 (0.26, 0.92)	1.84 (1.64, 2.07)	So. CA	2	Bottman (2006)
DJ Ranch	932-DJ2-U6-D-2-6	A1a	3,830–3,570	3	1.39 (1.21, 1.53)	1.72 (1.56, 1.84)	So. CA	2	Bottman (2006)
Bergen	1171-BE-11-B-1-1	A2a	3,885–3,595 3,905–3,640	3	1.24 (1.30, 1.42)	1.37 (0.15, 0.17)	So. CA/ No. CA	2-Jan	Bottman (2006)
Bergen	1171-BE-12-D-8-2	A2a	3,885–3,595 3,905–3,640	3	0.80 (0.45, 1.05)	1.58 (1.54, 1.65)	So. CA/ No. CA	2-Jan	Bottman (2006)
Bergen	1136-BE-9-A-5-2	A1b	4,800–4,240	3	0.79 (–0.08, 0.17)	1.24 (0.58, 1.78)	So. CA	2	Bottman (2006)
LSP-1	3191	A2a	4,770–4,190	4	1.41 (1.23, 1.77)	0.98 (-0.38, 1.77)	Oregon	3	Smith et al. (2016)
Bowling Dune	932-C1-5-1-D-8-1	A1a	5,580–4,990	3	0.90 (0.68, 1.30)	1.73 (1.68, 1.77)	So. CA/ No. CA	2-Jan	Bottman (2006)
Bergen	1171-BE-10-A-9-1	A1a	5,455–5,205	3	–0.01 (–0.27, 0.27)	0.47 (-0.19, 1.13)	So. CA	2	Bottman (2006)
Bergen	1171-BE-11-A-14-4	A1a	5,530–5,260 5,570–5,290	3	1.81 (1.59, 1.94)	1.93 (1.82, 2.13)	No. CA/ So. OR	3-Jan	Bottman (2006)
Big M	734-4-B1-6-28	A1a	5,600–5,320	3	–0.14 (–0.27, 0.07)	0.77 (0.65. 0.83)	So. CA	2	Bottman (2006)
Big M	734-4-B2-5-7	A1b	5,600–5,320	3	–0.48 (–0.83, –0.13)	1.71 (1.63, 1.84)	So. CA	2	Bottman (2006)
Big M	734-4-B2-5-25	A1a	5,600–5,320	3	0.18 (–0.05, 0.40)	1.21 (0.83, 1.82)	So. CA	2	Bottman (2006)
Big M	734-4-B1-26-14	A1c	5,900–5,330	2	0.944 (0.76, 1.13)	1.77 (1.62, 1.92)	So. CA/ No. CA	2-Jan	Bottman (2006)
Big M	734-4-B1-15-4	A1a	5,900–5,330	2	0.77 (0.75, 0.78)	1.87 (1.54, 2.21)	So. CA	2	Bottman (2006)
Big M	734-4-B1-1-33	A1b	5,900–5,330	3	–0.22 (–0.33, –0.12)	1.01 (0.71, 1.19)	So. CA	2	Bottman (2006)
Big M	822-4-TU1-92-A1-13	n/a	5,880–5,480	3	0.47 (–0.25, 0.86)	0.99 (0.85, 1.10)	So. CA	2	Bottman (2006)
Big M	822-4-5-13-C1-4	A2a	5,875–5,485	3	0.57 (0.42, 0.65)	1.76 (1.68, 1.90)	So. CA	2	Bottman (2006)
Bergen	1171-BE-12-C-PH-6	A1b	5,475–5,240	3	–0.13 (1.35, 1.66)	1.54 (0.10, 0.15)	So. CA	2	Bottman (2006)
Bergen	1171-BE-3-B-16-8	A1a	6,170–5,775	3	1.57 (1.28, 1.71)	1.88 (1.83, 1.98)	So. CA/ No. CA	2-Jan	Bottman (2006)
Bergen	1136-BE-3-A-10-3	A2	6,220–5,920	3	–0.12 (–0.68, –0.27)	1.36 (0.95, 1.84)	So. CA	2	Bottman (2006)
LSP-1	2104	A2a	8,260–7,960	6	2.63 (2.33, 3.06)	1.89 (1.63, 2.33)	Oregon	3	Smith et al. (2016)
LSP-1	2478	A2c	9,165–8,770	13	2.53 (1.55, 3.16)	1.51 (.35, 2.24)	Oregon	3	Smith et al. (2016)
LSP-1	761	A1a	9,435–9,120	6	1.45 (0.99, 2.20)	1.66 (0.42, 2.25)	Oregon	3	Smith et al. (2016)
LSP-1	1374	A2c	9,475–9,230	18	2.16 (1.73, 2.76)	0.94 (0.38, 1.35)	Oregon	3	Smith et al. (2016)
LSP-1	2477	A1a	9,815–9,490	6	1.76 (.99, 2.27)	0.87 (–0.26, 1.33)	Oregon	3	Smith et al. (2016)

[a]Carbonate samples were collected along transects across the shell's growth lines beginning at the tip and moving towards the spire, generally at 1–3 mm. intervals.

[b]With the exception of the Hawksy Walksy Valley bead, the measurements of which are presented in Table 3, the full lists of $\delta^{18}O$ and $\delta^{13}C$ measurements available in Bottman (2006) and Smith et al. (2016).

increased trade in exotic goods signals increasing social complexity. Jenkins et al. (2004a; also see Largaespada 2006) suggest that during the middle Holocene the Fort Rock Basin was an outlying but critical component of an exchange network that brought beads from California northward into the Oregon interior. The data presented in Tables 4 and 5 support this interpretation, with most of the beads dating to between 6,200 and 3,000 cal B.P. coming from either southern or northern California (Bottman's models 1 and 2). The data are also consistent with both Bennyhoff and Hughes' (1987) proposed peak in shell bead production ~4,000–2,200 cal B.P. and the fact that beads made from the shells of other species that only grow in southern waters (e.g., *Callianax dama* and *Tivela stultorum*) were recovered at some Fort Rock Basin sites (Largaespada 2006). One notable exception to this trend is a bead from the LSP-1 rockshelter dated to 4,770–4,190 cal B.P. Like the early Holocene specimens from that site, it originated from the Oregon coast rather than southern or northern California.

Finally, the post-1,900 cal B.P. beads from the Fort Rock Basin (n = 3) came from southern California, suggesting some long-term continuity in the relationships between coastal producers and Fort Rock Basin consumers, a relationship established during Bergen Period. Those beads were recovered from Carlon Village, a cluster of eight large stone-ring houses that likely served as a socio-economic hub for the region (Jenkins et al. 2004b; Wingard 2001). The fact that the three Carlon Village beads originated in southern California is consistent with Bennyhoff and Hughes' (1987) suggestion that most *Callianax* beads were produced in that region between ~2,200 and 1,300 cal B.P. but conflicts with their suggestion that northern California became the dominant production location after ~1,300 cal B.P. The lone bead recovered from outside of the Fort Rock Basin—the HWV bead which is the focus of this paper—originated along the Oregon coast. In that regard, it is like the earlier beads recovered from the LSP-1 rockshelter.

In summary, although the sample of sourced beads remains small in the northern Great Basin, the isotopic data suggest that multiple networks were responsible for bringing marine-shell beads into the region. Early Holocene beads from the LSP-1 rockshelter originated exclusively in colder waters, probably along the Oregon coast. Middle and initial late Holocene beads from residential sites in the Fort Rock Basin primarily originated in warmer waters south of Point Conception. Finally, late Holocene beads from both the Fort Rock Basin and HWV reflect a mix of source locations. These trends are generally consistent with existing models of *Callianax* bead conveyance (e.g., Bennyhoff and Hughes 1987; Jenkins et al. 2004b) in terms of diachronic change; however, our results suggest that there may have been variations across space. The Fort Rock Basin fostered longer-term residential occupations featuring houses, storage features, substantial artifact diversity, varied subsistence resources, and relatively abundant decorative and/or economic items such as shell and bone beads (Jenkins et al. 2004b). Because groups were apparently tethered to productive places during the middle and late Holocene, the Fort Rock Basin may have experienced greater socioeconomic complexity than other less productive basins, including the northern Warner Valley and HWV, where there is minimal evidence of longer-term occupations (Christian 1997a; Jenkins et al. 2004b; Smith et al. 2017). We propose that the differences in the origins of marine-shell beads from sites within and beyond the Fort Rock Basin reflect a homeland-hinterland scenario where—as Jenkins et al. (2004b) suggested—the Fort Rock Basin represented a distal but important node in an extensive exchange network that brought beads from California northward into the Oregon interior. In contrast, more mobile groups living in other less populated basins may have relied more on groups living on the Oregon coast to obtain shell beads. This is an hypothesis that needs to be tested with future AMS and isotopic analyses of additional *Callianax* beads collected from both longer- and shorter-term sites in the Fort Rock Basin, Warner Valley, Catlow Valley, and other basins in the region.

CONCLUSION

This study has presented the results of AMS and isotopic analyses of a marine-shell bead from Oregon's HWV and compared them with the results from all sourced beads from the northern Great Basin. It contributes to our understanding of *Callianax* bead conveyance in two ways. First, the HWV bead to our knowledge is the youngest directly dated marine-shell ornament from the northern Great Basin, and is rivaled only by two ~600-year-old specimens from Carlon Village,

located ~200 km. northwest of HWV (Bottman 2006). This extends our understanding of the temporal range during which shell beads were transported to the interior. Second, the isotopic signature of the HWV bead indicates that—like the early and late Holocene beads from the LSP-1 rockshelter—the shell originated along the Oregon coast, which contrasts with the southern California origin of most of the middle and late Holocene beads in Bottman's (2006) Fort Rock Basin sample. Collectively, the compiled data suggest that marine-shell bead conveyance in the northern Great Basin may have differed more across space (e.g., homeland vs. hinterland sites) than time. This idea, which is based on a small sample, can be further evaluated by submitting additional shell beads from numerous northern Great Basin sites that are currently housed in museum collections for both AMS and isotopic analysis. We urge other researchers to pursue such analyses in order to help us collectively better understand how, when, and from what locations groups conveyed shell beads into the Oregon interior.

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NOTE

[1]The age estimates for the beads listed in Bottman's (2006) Tables 1 and 2 were derived from a variety of sources. Some represent the midpoints of calibrated age ranges provided by radiocarbon dates on beads, some represent the midpoints of calibrated age ranges provided by single radiocarbon dates on terrestrial samples stratigraphically associated with beads, and some represent the midpoints of calibrated age ranges for combinations of terrestrial samples stratigraphically associated with the beads. Because the most recent marine and terrestrial calibration curves and some updated regional marine reservoir correction rates were not yet available when Bottman (2006) conducted his analysis, we recalibrated all of the radiocarbon dates on which he based his age estimates, using the appropriate curves and regional correction rates.

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