ARTICLE

THE ARCHAEOLOGY OF CLAM COVE, LAKE CLARK NATIONAL PARK AND PRESERVE, SOUTHCENTRAL ALASKA

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ABSTRACT

This article reviews the history of site investigations at the Clam Cove site (SEL-006) in Southcentral Alaska. Radiocarbon dates from the subsurface archaeological deposits at the site suggest that this portion of the rockshelter excavated by Joan Townsend in 1969 dates to 1700 radiocarbon years ago. Studies of archaeobotanical and shellfish remains provide context for the activities of the site residents during this time. Although we do not know the antiquity of the pictographs on the walls of the rockshelter, contextual evidence suggests these are affiliated with the Alutiiq or their ancestors. This article reviews the history of site investigations over the last 53 years and shows how recent analyses contribute to knowledge of Cook Inlet precontact history. We reflect on the importance of site monitoring and working with descendant communities to ensure ethical engagements and interpretations of the site.

INTRODUCTION

In 1969, Joan Townsend excavated the Clam Cove site (SEL-006), along the western shoreline of Cook Inlet, Southcentral Alaska. Although Townsend (1968, 1969) wrote reports of her survey and excavation, the age of the site and the nature of its contents have remained largely unknown. In 2001, the University of Oregon and the National Park Service entered into a cooperative agreement to document two badly deteriorating rock-art sites in Lake Clark National Park and Preserve, one of which is the Clam Cove site. This and the Tuxedni Bay site (KEN-229) are two of 115 pictograph sites documented in the Alaska Resources Heritage Survey (Perrot-Minnot 2020), and two of the three known in the National Park Service Alaska system (with the Salt Chuck Pictograph site in Glacier Bay National Park, Southeast Alaska). Baird (2003, 2004, 2006) visited the site and later compiled a detailed inventory of pictograph images and analyzed their meaning using ethnographic information. Clam Cove now appears as one of the richest pictograph sites in Alaska, and it was listed on the National Register of Historic Places in 2017. This article presents results from our 2001–2003 field investigations and laboratory analyses and condition-assessment updates conducted by the National Park Service (NPS) in 2018. The available data on the site's age and its archaeological contents add to the record of the activities at Clam Cove and shed light on the history of Cook Inlet.

HISTORY OF RESEARCH AT CLAM COVE

Lake Clark National Park and Preserve in Southcentral Alaska is a wilderness area of over four million acres (Fig. 1). People have occupied the area for at least 11,000 years, representing a wide variety of cultures. These include small, highly mobile bands of hunters, socially stratified fisher-hunter-gatherers who built substantial seasonal villages and relied on stored salmon, European and American fur traders and prospectors, as well as the present-day descendants of all these and other groups (Tennessen 2014). Core-and-blade lithic technology found in the oldest sites is consistent with the Paleoarctic tradition (ca. 12,000–7000 years ago). Evidence of Northern Archaic culture (ca. 6500–2000 years ago) is widespread on the western side of the park, as are traces of the Norton tradition (ca. 2300–950 years ago). Arctic Small Tool tradition (ASTt, ca. 4700–2500 years ago) materials have also been identified in the park, most notably at Magnetic Island in Tuxedni Bay (Rogers et al. 2013).

Most of the documented archaeological sites in the park, however, are affiliated with Dena'ina Athabaskans. Archaeological signatures consistent with Dena'ina settlement and occupation dated to ca. 2000 years ago and younger are widespread throughout the park. The park lies adjacent to Alutiiq territories to the south and Yup'ik territories to the west. In 1968, University of Manitoba archaeologist Joan Townsend and two graduate students, William Morgan and David Stuart, surveyed and tested archaeological sites in Iliamna Lake's vicinity. Townsend (1968) reported that the Clam Cove site was revealed to

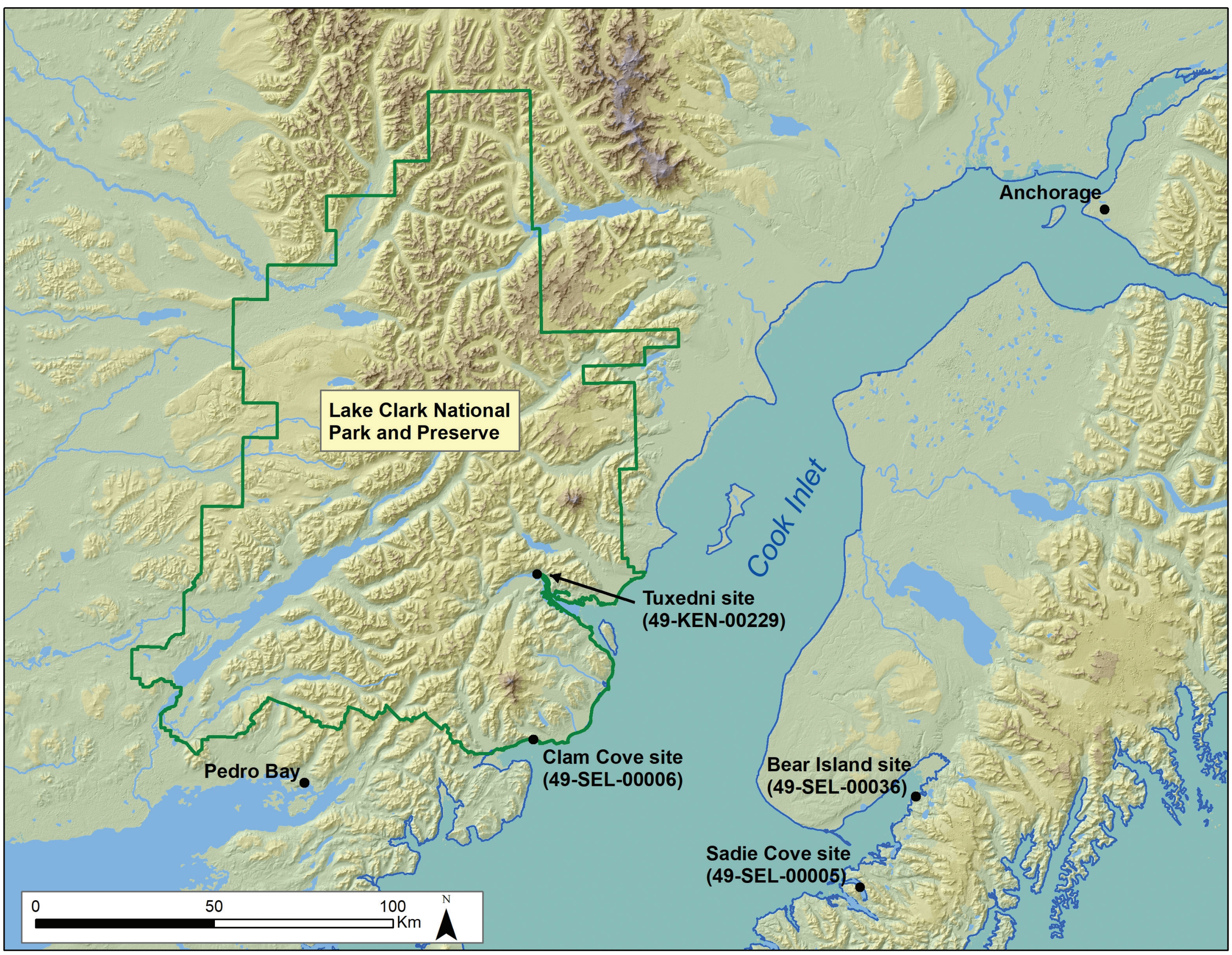

Figure 1. Map of research area, Lake Clark National Park and Preserve, Alaska.

her by Iliamna informants, but little else is known about the local people who told her about the site. Townsend (1968:4) wrote:

> On the basis of a report, we flew to Chinitna Bay, Cook Inlet, to examine pictographs in a small rock shelter at Clam Cove. This area is considered to be a part of the Iliamna Lake-Tanaina culture area although it is located on Cook Inlet. The Indians, in historic times, as well as the Iliamna Lake Aglegmiut Eskimos, often made the short portage to the Inlet for hunting both land and sea mammals as well as for fishing and collecting clams. In addition, Tanaina frequently moved back and forth between the Inlet and the lake, living in each place several years at a time. The pictographs are rapidly fading and many are virtually invisible.

Townsend (1968:5) returned with Morgan and Jack Culley to excavate the Clam Cove rockshelter the following summer. In 1969, Townsend (1969:2–3) reported that extensive rockfall from ceiling collapse restricted their excavation. In addition, she noted that "amateurs" had dug through some of the deposits. Nevertheless, Townsend and her assistants excavated two large test pits (3 m x 5 m and 5 m x 5 m). In a field photograph, one excavator is standing waist-deep in a depression approximately 1 m deep (Shah 2006: Fig. 256). Townsend (1969:3) reported:

> The midden area was composed of two bands of charcoal, each about one inch thick, separated from each other by a narrow, one-inch band of grey, sterile beach sand. Many flint flakes were found throughout both occupation bands. Three artifacts were recovered: a thick biface, possibly a knife, with flake scars suggesting percussion flaking; a thin biface fragment, probably a projectile point base, whose flake scars suggested pressure flaking; one coarse whetstone. . . . One midden layer was located which ranged in depth from approximately 43 inches below the modern surface to about 78 inches in the area which was probably at the mouth or just outside the cave.

Townsend (1968:2) noted that the materials resembled artifacts collected from the Pedro Bay site, located on Iliamna Lake's northeast end, approximately 65 km inland from Clam Cove. Reger reported a date of 4460 ± 90 BP (5315–4860 cal BP using the IntCal20 curve, Beta-181377) for this early component at Pedro Bay (Reger and Townsend 2004). Townsend (1969:3) hypothesized that if a relationship existed between the Pedro Bay and Clam Cove sites, it would be reasonable to expect a similar date from charcoal collected at Clam Cove. The age of the Clam Cove site is discussed later in this article.

Although the Clam Cove pictographs have been described (Petersen 1971; Stevens 1974; Stevens and Partnow 1972), the archaeological deposits and their contents have received very little attention. In 1976, Cook Inlet Region, Inc. (CIRI) requested that the Clam Cove Rock-Painting site be designated a historical place under Section 14(h)(1) of the Alaska Native Claims Settlement Act (ANCSA). Based on that application, in July 1987, archaeologists with the Bureau of Indian Affairs, ANCSA Program (BIA-ANCSA) visited the site. In addition to documenting the pictographs, they reported a large hole (3 m x 1.5 m x 0.8 m) in the southwest corner of the rockshelter, thought to be evidence of looting. Griffin (1989:26) wrote, "Numerous flecks of charcoal can be seen within this excavated area but a distinct charcoal lens was not observed. Two wooden entry posts were uncovered by this activity and are located along the western wall." The BIA-ANCSA team did not conduct excavations at the site, either in the rockshelter or the nearby habitation area. But the team did fully record the site and the nearby habitation area.

After a visit in 1992, Steve Klingler and Doug Reger (1993) reported evidence of recent camping at the site, including remnants of a lean-to shelter, a hearth, and refuse in the rockshelter. Such use was undoubtedly harming the site's remains. Then, in 1996, Jeanne Schaaf (then an archaeologist for Lake Clark and Katmai National Park and Preserve) visited Clam Cove and reported that "up to 80 percent of the images recorded in 1989 by BIA were very faint or had exfoliated" from the pictograph panels (NPS 2001:2). Schaaf evaluated the site and reported its poor condition. This report led to the National Park Service seeking funding to analyze and interpret the Clam Cove and Tuxedni Bay pictograph sites before any further loss.

In 2001, the NPS supported fieldwork at Clam Cove conducted by Melissa Baird, Jeanne Schaaf, and photographer James Henderson (Henderson 2001). The primary purpose of this visit was to document the site and photodocument the pictographs. In July 2002, Doug Reger, at the request of the NPS, traveled to Winnipeg to meet with Joan Townsend, from whom he obtained photographs of the 1969 excavations. In September 2002, Schaaf visited the site with conservator Monica Shah, who later developed a conservation and management plan for the pictographs (Shah 2006). In August 2018, NPS personnel visited the site and undertook a condition-assessment update, following protocols developed by Shah (2006). The team documented the site, which consisted of photographing individual rock-art panels and an overview of the entire rockshelter overhang. A few photographs were digitally filtered to enhance pigment visibility. The team noted that the site is deteriorating, likely facilitated by the processes described by Shah (2006)—mainly spalling and exfoliation of the rock surface, lichen and vegetation growth, and surface moisture, percolation, and runoff (Figs. 2 and 3). The surface moisture and runoff in particular seem to be increasing, possibly exacerbated by increased vegetation growth along the top edge of the rockshelter. As a result, several portions of the pictographs can no longer be seen or are barely visible. In light of the steadily declining condition of the site, this article shares previously unpublished research results.

THE CLAM COVE SITE AND COLLECTIONS

The Clam Cove site is in a bay with the Dena'ina placename *Niłghenk'enulyun*, which translates as "mixed vegetation grown together," possibly referencing the location of several backshore house depressions (Kari and Smith 2017; Smith 2020). Figure 4 presents the Clam Cove site map. The entrance to the Clam Cove rockshelter is about 3 m above sea level and approximately 9 m away from the high-tide line. The interior is 7 m deep and 9 m wide, and 75 images are found on two sandstone rock faces that are designated the south and west walls (Baird 2003, 2004, 2006). Figures 5 and 6 present a rendering of the pictographs on the south and west walls of the shelter. Today, trees and shrubs grow along the overhang above the pictographs, obscuring their location. Of note is the vegetation along the entire Chinitna Bay coast, which has changed since the site was first documented (Hannam et al. 2020); in 2018 the vegetation was noticeably thicker than in photographs from 1969, 1987, and 2005. Backshore vegetation at Clam Cove has moved seaward and has colonized and stabilized the beach sand berm in front of the site partly due to tectonic uplift. The rockshelter floor consists of a mix of silt, sand, and gravel, likely deposited by both wave action and human activity. To date, sedimentologi-

Figure 2. Image showing surface runoff, lichen, and vegetation growth on pictographs.

Figure 3. Image showing spalling and exfoliation of the rock surface.

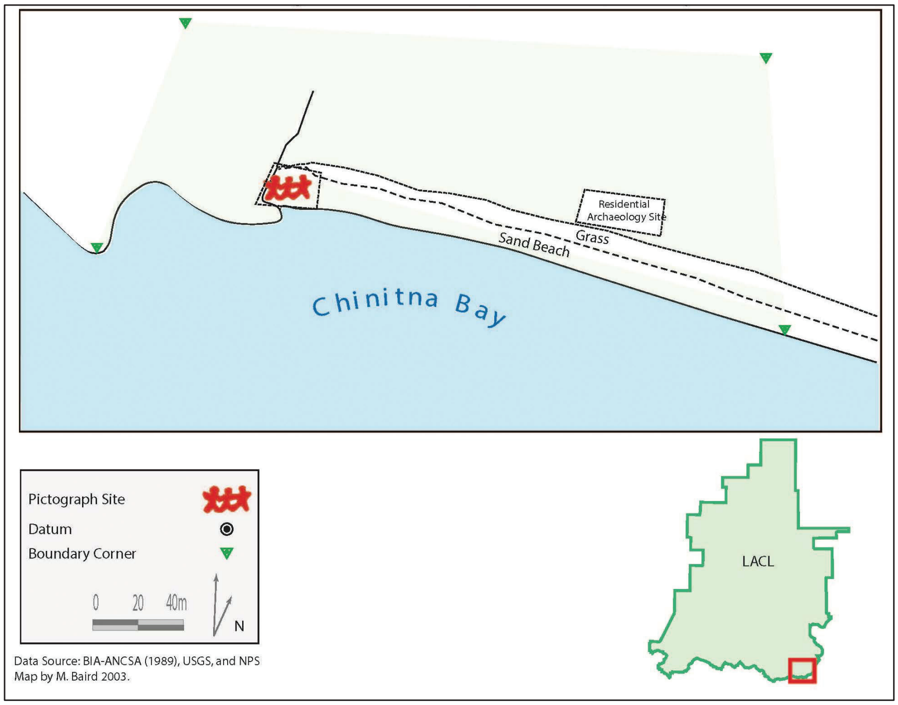

Figure 4. Map of the Clam Cove site.

cal analyses or depositional histories have not been conducted. In 1968, Townsend (1968:3) noted considerable rockfall that consisted of very large boulders within the shelter. In 2001, this area was mostly clear of large rocks and boulders.

In January 2002, the National Park Service loaned Townsend's collections and notes to the University of Oregon for analysis. The collection includes copies of Townsend's field notes written on the original paper field bags. Table 1 lists the materials in this collection. The lithic artifacts, wood charcoal, and shell were recovered from subsurface sediments excavated in the rockshelter. The provenience of the pigment sample, apparently removed from a rock wall, is not explicitly known. Although

Table 1: Archaeological assemblage from Townsend's 1969 excavation.

Catalog Number	Description	Material	Provenience/Remarks	Weight (g)
1660	whetstone	sandstone	Pit 1; whetstone and chipped knife found in light cream sand, 45" from top modern ground level, 126" from shelter apex, 14'8" from the edge of the shelter. It is broken on one side, and striations run the length of the whetstone. Length 16.5 cm; width 6.4 cm; thickness 1.3 cm	259.2
1661	knife	basalt	Pit 1; Box 1; charcoal Band 1. Length 5.1 cm; width 2.9 cm; thickness 0.6 cm	14.5
1662	retouched flake	basalt	Pit 1; Box 8; area between charcoal bands; flake broken. Length 1.9 cm; width 1.8 cm; thickness 0.02 cm	1.7
1663	flake		Pit 1; Box 7; ground face. Length 3.2 cm; width 2.0 cm; thickness 0.03 cm	4.1
1664	pigment fragments (5)	sandstone	Box 7; removed from rockshelter wall; unknown provenience	
1665	flakes (30)	basalt	Pit 2; Box 2; charcoal layer below red sand and above gray silt	7.6
1666	flake (1); noncultural (1)		Pit 1; Box 7; one flake is noncultural sandstone	4.9
1667	flakes (3); noncultural (2)		Pit 1; Box 7; charcoal band #1	11.5
1668	flakes (4)	basalt	Pit 1; Box 8; area between charcoal bands	6.0
1669	shell		Pit 1: Box 3; between charcoal bands; no charcoal in sample	120.9
1670	shell		Locale 1; Box 4; no charcoal in sample	64.9
1670	charcoal		Pit 1; Box 6; charcoal Band 2 associated with single flaked point	2.6
1670	charcoal		Locale 1; Box 5	20.4
1670	charcoal		Locale 1: Box	51
1670	charcoal		Locale 1: Box 10; associated with knife and whetstone	8.1
1670	charcoal		Locale 1; Box 3	0.2

Catalog numbers from LACL-125.

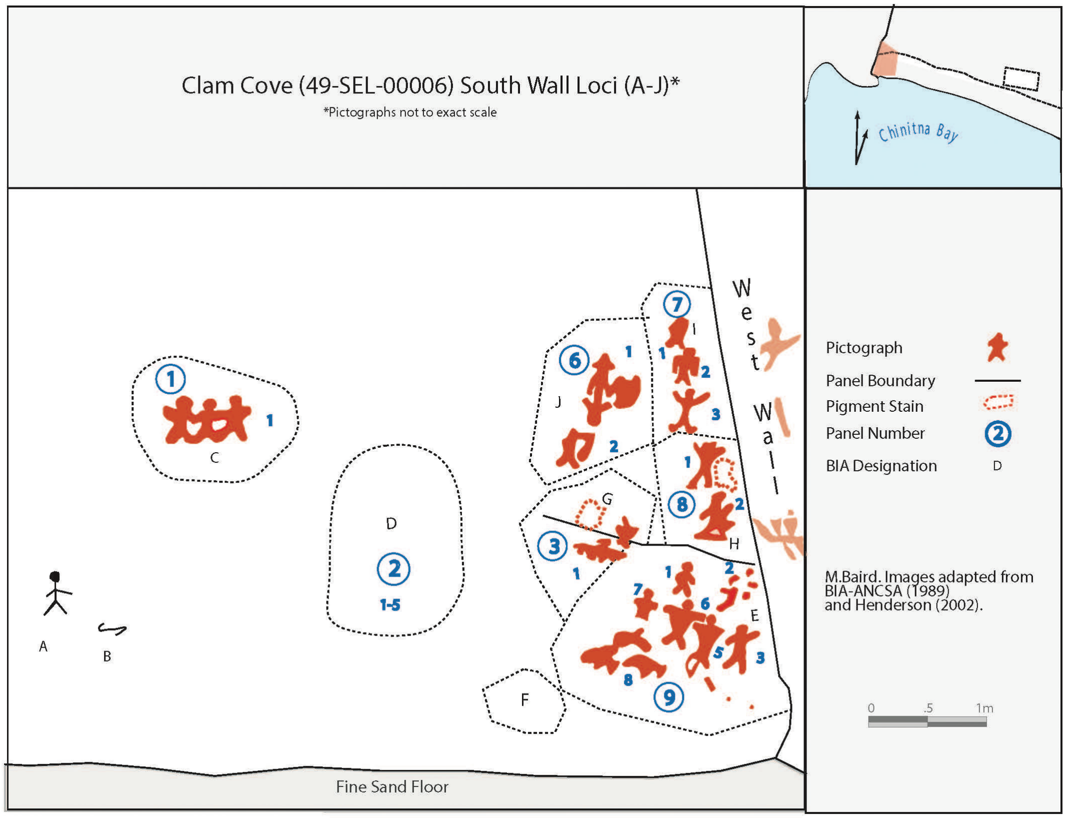

Figure 5. Pictograph images from South Wall.

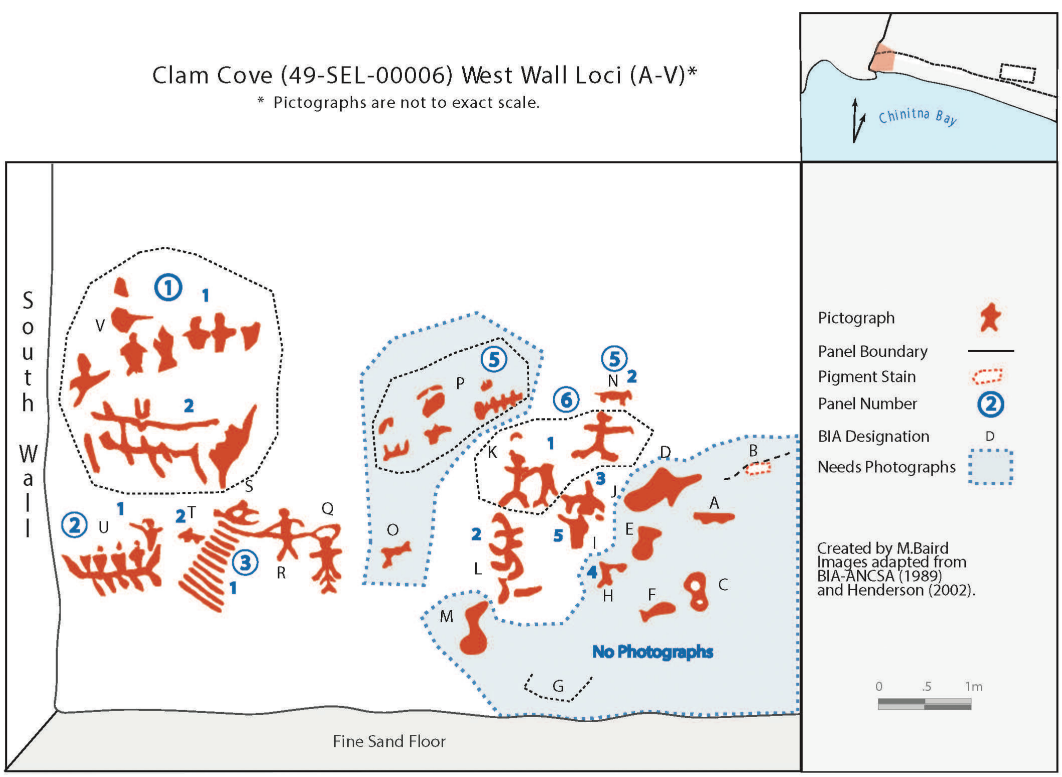

Figure 6. Pictograph images from West Wall.

Townsend (1969) did not describe her field methods in detail, the excavation photographs suggest subsurface deposits were not screened. Our interpretation of the Clam Cove materials is necessarily limited by the small quantities of artifactual, paleobotanical, and faunal remains recovered. Acidic soils, moist conditions, and even wave action contributed to poor conditions for preservation. Looting has undoubtedly also resulted in the loss of the bone, wood, and perishable artifacts that may have been present.

Nevertheless, by dating wood charcoal, we have provided the first chronological data on the occupation of Clam Cove. At the University of Oregon, Baird and Moss conducted various laboratory analyses on materials from the site. Townsend's Clam Cove collection was returned to the NPS for permanent curation in 2006.

PALEOBOTANICAL ANALYSES

The wood charcoal Townsend collected in 1969 had not been analyzed before this study. In May 2002, we contracted Dr. Margaret Helzer to identify six wood charcoal samples. We intended to identify short-lived species that would provide radiocarbon dates only minimally affected by the "old wood" problem (Schiffer 1986). Helzer's analysis provides valuable information on wood taxa used by site inhabitants.

Helzer (2002) analyzed the samples in cross section using a 70x binocular microscope. She used wood-identification manuals (e.g., Friedman 1978; Miles 1978) and a modern charcoal collection as references while making identifications. Before analysis, each sample was weighed. Because each sample contained numerous pieces of charcoal, Helzer selected some of the larger pieces that typically show more of the distinctive features that permit identification. She snapped each piece of charcoal in half and then examined the cross-section under the microscope. While diagnostic features seen at this magnification allow for identification at the family and genus level, thin sections are generally required for species identification. Helzer did not make such thin sections but was able to identify one species because it is the only member of its genus in the project area. Identified charcoal pieces were sorted into types, counted, weighed, and placed in labeled foil packets.

Helzer identified six genera and one species: spruce (*Picea*), hemlock (*Tsuga*), Alaska yellow cedar (*Chamaecyparis*), Douglas fir (*Pseudotsuga menziesii*), birch (*Betula*), alder (*Alnus*), and willow (*Salix*). Her identifications are presented in Table 2. The spruce is most likely Sitka spruce (*Picea sitchensis*), which grows along the Pacific coast as far north as Cook Inlet and Kodiak Island. The hemlock is either western hemlock (*Tsuga heterophylla*) or mountain hemlock (*Tsuga mertensiana*), both of which grow in the region. Spruce was the most common conifer identified by Helzer, who identified it in four out of six samples, while hemlock was identified in two of six samples. Spruce and hemlock generally grow together in mixed stands in the coastal forest. Helzer also identified Alaska yellow cedar in one sample; this species is much less abundant in coastal forests at this

Table 2: Archaeobotanical remains.

Name	Sample #					
	1	2	3	4	5	6
Gymnosperms						
Alaska cedar (*Chamaecyparis*)				7 0.16		
spruce (*Picea*)	1	0.01		18 1.08	3 0.10	
Douglas fir (*Pseudotsuga menziessi*)			25 14.8	3 0.47		
hemlock (*Tsuga*)	1	< 0.01		8 0.40		
conifer (Coniferae)				10 0.32	4 < 0.01	
Dicotyledons						
alder (*Alnus*)	14	0.03				
birch (*Betula*)	76	1.53		1 < 0.01	4 < 0.01	14 0.35
willow (*Salix*)						
Total charcoal (g)		8.26	20.5	5.21	0.17	2.69

Recorded weight in grams (g).

latitude. The final conifer tree is Douglas fir, identified in two samples. This finding is particularly notable, as Clam Cove is far north of the northern limit of Douglas fir (53° north in central British Columbia [Lepofsky et al. 2001; Lepofsky et al. 2003]). This suggests that the Clam Cove site residents most likely obtained Douglas fir in the form of driftwood. Alaska yellow cedar may also have been gathered as driftwood.

The three deciduous species grow locally. The alder may be either mountain alder (*Alnus crispa*) or Sitka alder (*Alnus sinuata*), found in only one sample. Likewise, willow charcoal was found in one sample. The numerous Alaska willow species cannot be distinguished based on minute anatomy (Lepofsky et al. 2003:140). The most common deciduous taxon in the Clam Cove assemblage was birch, which Helzer identified in five samples. Several birch species grow in this part of Alaska, including paper birch (*Betula papyrifera*), Kenai birch (*Betula kenaica*), dwarf birch (*Betula nana*), and shrub birch, (*Betula glandulosa*) (Schofield 1989:61). None of the plants identified are obvious food plants, although the inner bark and sap of some may be eaten. The most likely use of the charcoal identified at Clam Cove was as firewood. Most of the firewood was obtained from trees and shrubs that grow locally, but some were obviously collected as driftwood.

In our selection of wood samples for radiocarbon dating, we avoided the long-lived species and tried to avoid those that were likely to have been driftwood, taxa more likely to suffer from Schiffer's (1986) "old wood" problem. For this reason, birch charcoal was one of the materials submitted for radiocarbon dating.

RADIOCARBON DATING

In June 2002, Beta Analytic provided radiocarbon results for three birch charcoal samples and one marine shell sample selected for dating by Moss (Table 3). The three birch charcoal samples were too small for conventional radiometric dating, so they were dated using AMS. The marine shell sample was dated using the conventional method. The analysis of three birch charcoal samples from Townsend's Pit 1 produced uncorrected radiocarbon dates of 1680 ± 40 BP (Beta-168515), 1740 ± 40 BP (Beta-168516), and 1730 ± 40 BP (Beta-168517). A single cockle shell (*Clinocardium nuttallii*) from Locale 1 produced a radiocarbon age of 970 ± 60 cal BP (Beta-168518; Baird 2003).

The samples from Pit 1 date to approximately the same period, about 1625 cal BP, or about AD 325. Interestingly, the occupations represented in charcoal bands 1 and 2 date to roughly the same period. We have one date from the shell midden deposit in Townsend's Locale 1; although this sample produced a somewhat more recent date, after calibration, the age range of this shell date and those of the birch charcoal dates overlap. Thus, we can generalize that the occupational deposits tested by Townsend date to approximately 1700 radiocarbon years ago. This is interesting in light of Townsend's (1969) tentative observation that the Clam Cove artifacts were similar to those from the early component of the Pedro Bay site, dated to over 4300 years ago. Thus, the Clam Cove pictograph site's age postdates the Pedro Bay site and predates the historic Dena'ina house site about 132 m east of the decorated rockshelter (also encompassed within Clam Cove; see Griffin 1989; Schaaf 2013). These domestic remains correspond to the "modern house pits just inside the north point of Chinitna Bay" described by Frederica de Laguna (1975:137). It should be noted that, according to the current archaeological record, the Dena'ina occupation along coastal Cook Inlet began between 1500 and 1000 years ago (Reger and Wygal 2016).

ARTIFACTS

The small Clam Cove artifact assemblage contains a sandstone whetstone, a small biface, a retouched flake, and some lithic debitage. The collections do not appear to include the thin biface described by Townsend (1969:3). The whetstone (catalog no. LACL-125-1660) was made from locally available material (Fig. 7). The thin block was

Table 3: Radiocarbon dates.

Lab Number	RCYBP (1 σ)	Cal BP (2σ)	Material	$^{13}C/^{12}C$ Ratio	Provenience
Beta-168515	1680 + 40	1520 (1610) 1700	birch (*Betula*)	–25.0	Pit 1, charcoal Band 1, Box 10
Beta-168516	1740 + 40	1550 (1640) 1730	birch (*Betula*)	–26.9	Pit 1, charcoal Band 1, Box 11
Beta-168517	1730 + 40	1540 (1630) 1720	birch (*Betula*)	–26.0	Pit 1, charcoal Band 2, Box 6
Beta-168518	970 + 60	1440 (1565) 1690	Cockle (*Clinocardium*)	–0.7	Locale 1, Box 3

formed into a trapezoidal shape, and the top of the artifact was heavily used. The thin, shallow grooves that span the surface's length were probably employed to sharpen or shape bone, shell, or even slate implements. The bottom of the tool is unshaped and appears to have been broken off from a larger block of sandstone.

A basalt stone knife (LACL-125-1661) was associated with charcoal Band 1 (Fig. 8). The artifact is not quite symmetrical, and both edges are sinuous and relatively thick. Because it lacks a pointed tip, it is unlikely to have served as a piercing or thrusting tool. It seems more likely to have been a general-purpose knife with its durable edges. The stone knife resembles a chipped stone blade collected by de Laguna (1934: Plate 30-16) from Yukon Island I and a chipped stone blade from Afognak Island (Clark 1984:138, Figure 3-t).

The collection also contains a broken flake (LACL-125-1662) that shows unifacial retouch on one edge. The straight edge could have been used for fine cutting. This artifact is likely the remnant of a once-larger flake tool. Another basalt flake (LACL-125-1666) has a reddish inclusion that could be ocher or an iron mineral.

A total of 38 chipped basalt flakes (LACL-125-1665–1668) and one sandstone flake (LACL-125-1666) were

Figure 8. Photograph of basalt knife, associated with charcoal Band 1, Clam Cove.

Figure 7. Photograph of whetstone found at Clam Cove.

found in pits 1 and 2. Townsend (1969:3) reported the material as flint. Three noncultural stones were excluded from our counts. Only one flake (LACL-125-1668) contained cortex, and all chipped stone flakes lacked platforms. This flake debitage was sorted into different grades: ⅛ inch, ¼ inch, ½ inch, one inch, and greater than 1 inch (Baird 2003:128). Most flakes (58%) were one inch or longer, supporting the idea that the archaeological deposits were not screened. Although the chipped stone debitage is not technologically or temporally diagnostic, it does indicate that people were making stone tools at Clam Cove.

SHELL ANALYSIS

Shellfish remains that were recovered from subsurface deposits demonstrate the use of nearshore intertidal habitats. Table 4 lists the shellfish taxa Moss identified from the Clam Cove samples. The analyzed shell shows no sign of having been modified or burned.

The four bivalves and one gastropod identified to genus or species make up 67% of the samples' total weight (212.1 g). Of that identified to genus or species, gaper clams (*Tresus*) account for 36% of the shell weight, razor clams (*Siliqua*) make up 27%, cockles (*Clinocardium*) contribute 26%, while butter clams (*Saxidomus*) and dogwinkles (*Nucella*) are of lesser abundance. However, we resist overinterpreting these data on relative abundance since the sample is so small.

Table 4. Shellfish taxa identified.

Catalog Number	Taxon	g
LACL-125-1670	Cockle (*Clinocardium nuttallii*)	9.2
	Dogwinkle (*Nucella* spp.)	5.8
	Razor clam (*Siliqua* cf. *patula*)	11.6
	Gaper clam (*Tresus capax*)	15.9
	unidentifiable clam	21.5
	unidentifiable gastropod	28.0
	Total	**92.0**
LACL-125-1669	Cockle (*Clinocardium nuttallii*)*	28.2
	Butter clam (*Saxidomus giganteus*)	8.8
	Razor clam (*Siliqua* cf. *patula*)	26.4
	Gaper clam (*Tresus capax*)	35.5
	unidentifiable clam	20.9
	unidentifiable gastropod	0.3
	Total	**120.1**

*Weight includes 23.5 grams removed for ^{14}C dating.

Nevertheless, the three most abundant species in the archaeological sample are taxa that continue to be preferred by clam diggers in the region today. The bivalves are found in similar intertidal habitats of sands and gravels, typically close to shore (Foster 1991). The area is well known for its razor clams, and the archaeological data suggest that this species was also important in the past. There is no evidence that the distribution of intertidal habitats at the time of the site occupation 1700 radiocarbon years ago was different from that of today.

GEOCHEMICAL ANALYSIS OF PIGMENT SAMPLE

Elemental Analysis Corporation used PIXE (proton-induced X-ray emission) analysis to determine the geochemical composition of the pigment sample used. Briefly, PIXE analysis is a nondestructive technique that detects elemental concentrations within a 95% confidence level to parts per million (Pillay 2001:593; Rowe 2001:204). The PIXE technique involves bombarding a sample with a proton beam that excites the electrons and allows characteristic X-rays to be detected, identified, and quantified. This technique has been successfully used to analyze pigments on pottery from archaeological contexts (Bollong et al. 1997) and has been instrumental in sourcing ocher to particular geological areas (David et al. 1993; Erlandson et al. 1999). In rock-art contexts, PIXE can, in some cases, provide information on the elemental compositions, chronologies of pigment recipes, and measurements of paint thickness (Rowe 2001:204).

In June 2002, Moss and Baird submitted one pigment sample to Element Analysis Corporation (EAC) for testing. One side of the sample has traces of pigment used in making the pictographs. By studying both sides of the sample, we hoped to characterize the pigment. The lab provided numerical data on the elemental composition of both sides of a paint chip from Townsend's collection, but we did not know which series related to which side. EAC offered to provide two PIXE runs and to rerun the sample. Moss and Baird selected the samples in consultation with Monica Shah. We submitted microphotographs with the samples illustrating the areas we wanted to be tested. We resubmitted paint-chip samples to EAC in December 2002 for two PIXE runs, and EAC provided a report of their analyses (Baird 2003: Appendix 5).

Table 5 compares the elemental concentrations from three PIXE tests of two rock chips with paint stains from Townsend's collection. PIXE Run 14 was on the smaller

Table 5. Percent concentration mass of elements.

Element	PIXE Run 14 (partial pigment) Bag 1	PIXE Run 15 (pigment) Bag 3a	PIXE Run 16 (nonpigment) Bag 3b
Oxygen	63.984	60.439	70.312
Sodium		2.954	
Magnesium	0.449	0.765	0.917
Aluminum	5.688	5.601	5.755
Silicon	26.192	23.98	15.48
Phosphorus			0.0941124
Sulphur	0.17	0.159	0.0656717
Chlorine	0.32	1.597	0.645
Potassium	0.47	0.47	0.525
Calcium	1.437	2.988	3.012
Titanium	0.0671345	0.0821083	0.203
Manganese	0.0185612	0.0163997	0.0635616
Iron	1.106	0.891	2.844
Copper	0.0017521	0.0030289	0.0058111
Zinc	0.0050163	0.001897	0.0066222
Barium	0.000891		
Strontium	0.0312921	0.050619	0.0689217
Bromine		0.001415	0.0030761
Gallium	0.000891		
Barium	0.05839839		

rock fragment identified as "Bag 1," using EAC's smallest beam (⅛ inch). The lab technician concentrated the scan on the partially pigmented surface of the sample. PIXE Run 15 was on the larger rock fragment identified as "Bag 3a," also irradiated with a ⅛-inch beam. Again, the proton beam was focused entirely on the pigment surface. PIXE Run 16, "Bag 3b," is the reverse side of the larger rock fragment, identified as sample "Bag 3a" in an attempt to characterize the rock on which pigment was applied.

The results of the PIXE analyses were unexpected. We had assumed that the pictographs were created using a paint recipe made with red ocher (Fe_2O_3). However, the PIXE results indicate that the sample did not contain significant iron (Fe) amounts. By comparison, Erlandson et al. (1999) found that their ocher samples included between 4% and 64% iron, whereas the Clam Cove samples tested by runs 14 and 15 ranged from only 0.89% to 1.1% iron. The results also exclude vermilion (HgS) and realgar (As_2S_3) as pigment constituents. In general, all three samples' chemical composition was consistent with sandstone, high in silicon oxide, calcium oxide, and aluminum oxide.

These results could indicate that the particle accelerator could not discriminate between the pigment and the rock surface. Figure 9 presents PIXE data for runs 14, 15, and 16 and illustrates the samples' fairly consistent geochemical composition. In Run 14, the beam was too wide to hit just the pigmented area, so the results reflect both the pigmented surface and the adjacent, nonpigmented surface. Figure 10 presents PIXE data from Run 15 and Run 16, representing the pigmented and nonpigmented surfaces of the larger rock fragment. In Run 15, the pigment surface may be too thin and discontinuous, leading to a result that combines both pigmented and nonpigmented surfaces. In addition, after the analysis was completed, we learned that the beam hits the pigment and the surface layer of the rock below the pigment. The X-rays are attenuated through the pigment, so the elements that comprise the rock itself show up in slightly lower concentrations on the pigment side than they do on the nonpigment side.

It is possible that the Clam Cove pigment does not contain much iron. In nearby Kachemak Bay, based on ethnohistorical sources, Janet Klein (1996:24 and

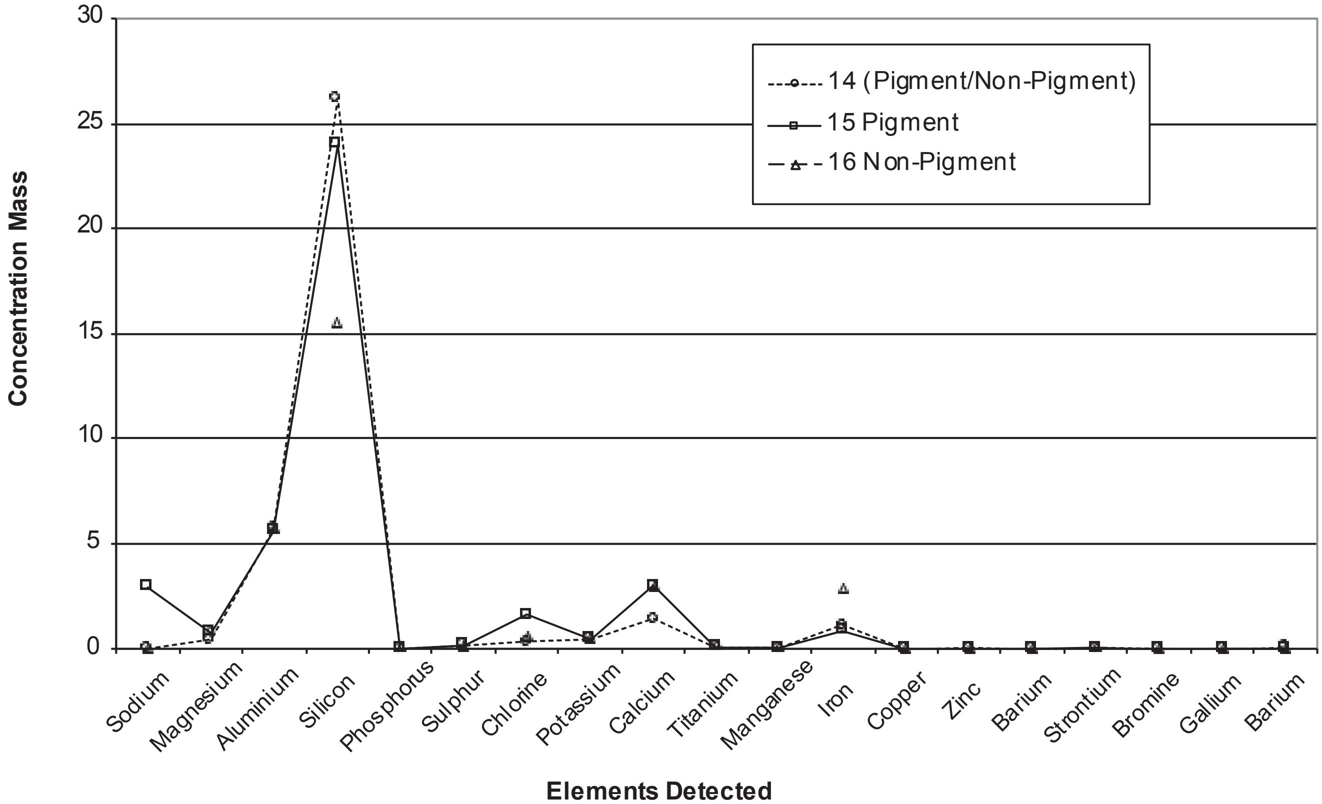

Figure 9: Percent concentration mass of elements detected by PIXE analysis of samples from Clam Cove.

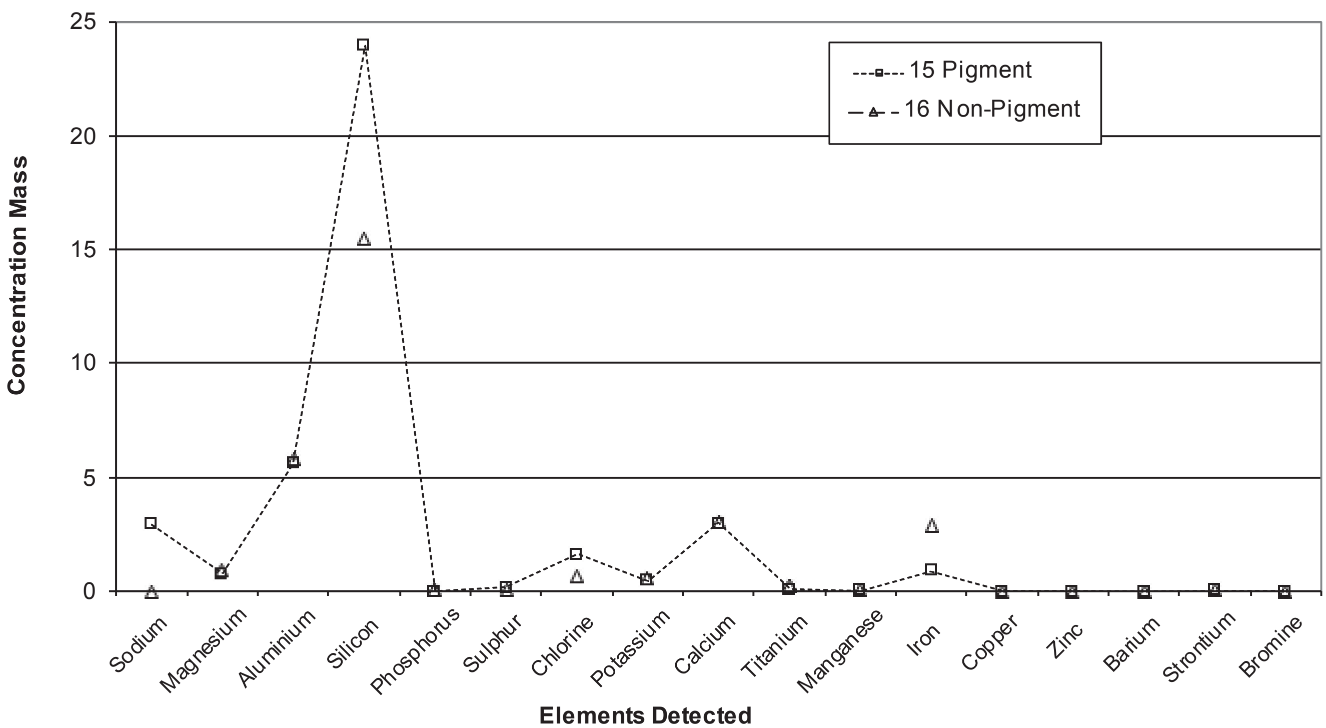

Figure 10: Percent concentration mass of elements detected by PIXE analysis of pigmented versus nonpigmented side of a larger rock fragment.

pers. comm. to Perrot-Minnot, 2019) thinks that the reddish pigment used for the pictographs was produced from a particular claystone present on the north shore of the bay. It is conceivable that the Clam Cove pigment had a similar origin.

We learned from this analysis that to determine the paint's chemical composition, it would be necessary to obtain a larger sample of pigment, uncontaminated by particles of the rock onto which it was applied. Thus, while the PIXE analysis did not provide the results we anticipated, our study did provide a "cautionary tale" that could be of use to other investigators who are interested in the PIXE technique.

THE PICTOGRAPHS

This section integrates analysis of the rock art into our study of the Clam Cove site. The images painted on the walls of the Clam Cove rockshelter have already been inventoried (Baird 2003; Griffin 1989; Shah 2006), and Baird's interpretations are presented elsewhere (Baird 2003). This discussion does not assume that the pictographs are associated with the subsurface cultural deposits. Nevertheless, we doubt that the pictographs are older than the buried deposits, so we will assume that the pictographs are no older than 1700 radiocarbon years before present.

The Clam Cove pictographs are brick red in color (as are most pictographs known in Southcentral Alaska). They are small and distributed on two walls; on the south wall, they occur over a 5 m x 4 m area, and on the west wall, they are found over a 6 m x 4.5 m area. Of the 75 registered images, Baird (2003:157) grouped these into six motif types to allow comparison: anthropomorphic (51%), zoomorphic (12%), abstract (7%), boat (3%), geometric (1%), and unidentified (26%). In general, the reading of imagery is difficult, but some associations of motifs and small scenes can be identified. The images depict umiak boats, weapons (e.g., harpoons), sea mammals (especially whales), and people engaged in activities, such as possibly whale hunting and the use of boats (Baird 2003:172, 2006:139, 143–144). The closest ethnographic parallels Baird found were with representations drawn from Alutiiq and Unangax̂ material culture. Her working opinion was that Clam Cove site residents were "economically, ideologically, and symbolically invested in seafaring and maritime activities" (Baird 2003:174). However, her analyses did not include discussions with descendant communities, which could have provided additional insights and evidence (see Fig. 5 and 6).

DISCUSSION

The Clam Cove pictographs share characteristics with other rock-art sites of Cook Inlet. The whales are reminiscent of some motifs painted at Sadie Cove (SEL-005) and Bear Island (SEL-036) in Kachemak Bay. The paintings of Clam Cove, Sadie Cove, Bear Island, and Tuxedni Bay depict "the same general style, with predominantly figurative, schematic, silhouetted and modest-sized representations, but also simple geometric signs" (Perrot-Minnot 2018:29). In 2005, Baird (2006) visited pictograph sites throughout Prince William Sound to follow up on de Laguna's (1956:107–108) hypothesis of connections between the two regions, and found that noted representations of people, boats, and sea mammals at Clam Cove are similar to those in Prince William Sound pictographs in Southcentral Alaska. The pictographs also find commonalities with the Pegtymel petroglyphs in Chukotka, northeastern Siberia (cf. Dikov 1999: 87–88). The images of anthropomorphs and boats found at Clam Cove also appear similar to the Moose Creek pictographs, near Fairbanks in Interior Alaska (FAI-00072, Giddings 1941).

The cultural antecedents and affiliations of Southcentral Alaska's rock art remain unclear. In Prince William Sound, the associated archaeological record refers to the Chugach Alutiit (Baird 2006; de Laguna 1956). In Cook Inlet, ethnographic accounts attribute the pictographs alternatively to the Alutiit and the Dena'ina (de Laguna 1975:153–154; Klein 1996:25; Osgood 1937:118). One version of a Dena'ina legend from Cook Inlet ("Jaconestus, Born of Mulja, the Spirit") refers to a chief named Jaconestus "and his men" who left red paintings picturing "their deeds and exploits" on rock walls in Tuxedni Bay (Alexan et al. 1981: 48–50; Aaron Leggett, pers. comm. to Perrot-Minnot 2019). The teacher heard the story from Cook Inlet elders and published another version. This version does not explicitly refer to Tuxedni Bay but mentions "Takasitna Harbor," which may be the same place (Fall 1987). However, these sources do not necessarily mean that Dena'ina were the authors of the Tuxedni Bay pictographs. What we do know is that the archaeological context of Cook Inlet rock art is still unclear, although growing evidence suggests links with the Kachemak Tradition (Perrot-Minnot 2018). This cultural entity is attributed to the ancestors of modern Alutiit (Boraas 2002). At the Tuxedni Bay pictograph site, an archaeological deposit tested by Jeanne Schaaf in 2002 yielded uncalibrated AMS radiocarbon dates of 490 ± 40 BP (Beta-186616, wood), or cal AD 1400 to AD 1460, and 460 ± 50 BP (Beta-186617, wood), or cal AD 1410 to AD 1500. Still, we cannot definitively associate this deposit with the rock paintings (Baird 2006:138).

The images of whaling, human–animal connections, and human–spirit transformation at Clam Cove and other pictograph sites in Southcentral Alaska seem most closely associated with Alutiiq worldviews, imagery, and oral traditions (Baird 2003:192, 2006:143). Baird concluded that, like the images painted or carved on hunting headgear, masks, kayaks, paddles, and bowls, the pictographs likely played a central role in Alutiiq religious and spiritual traditions, performances, and stories, judging from the ethnographic sources and the importance of rock art in the ancestral Alutiiq territories of Cook Inlet, Prince William Sound, and the Kodiak archipelago (Baird 2003:194, 2006:144; de Laguna 1933, 1934, 1956, 1975). Based on this analysis, Baird suggested that the Alutiit or their ancestors occupied the Clam Cove site before the late precontact Dena'ina occupation of the area. However, this does not preclude Dena'ina connections to the site.

Even though the archaeological data are limited, the dating of wood charcoal and marine shell from the Clam Cove site demonstrates an occupation dating to 1700 years ago. The buried deposits indicate that these people camped, collected driftwood and other fuelwood in the site vicinity, made basalt tools, and dug clams and cockles. Historically, abundant razor clam beds were exposed on the beach at low tides. Tectonic activity, as mentioned earlier, could impact these clam beds. Nevertheless, ethnographically, we do know that shellfish were harvested year-round but were more intensively collected in early spring and summer (Crowell and Laktonen 2001:139, 181). The small size of the rockshelter and absence of archaeological features within the buried deposits, such as hearths and caches, suggest that the site was used seasonally, possibly as a short-term camp while traveling through the waters of Cook Inlet. We also know that the buried deposits in the rockshelter predate Dena'ina residency in house sites located nearby.

The subsurface deposits at Clam Cove date to Kachemak III times (2000–1200 cal BP) as defined by Workman and Workman (1988:342). The harvesting of shellfish is consistent with resource-use trends during this phase. Still, we must be cautious in our interpretations as the artifact assemblage is too meager to make any conclusive comparisons to the procurement technologies, trade items, and ornaments found at other Kachemak sites. The period is characterized as a time of increased cross-cultural contact, trade, conflict, and artistic practices, in the general context of the Kachemak Tradition (Boraas 2002; Clark 2001:73; Crowell and Luhrmann 2001:26; Workman 1980, 1998). Although the ethnic affinities of the people who left behind the archaeological deposits at Clam Cove are impossible to ascertain, we suspect they relate to the ancestors of modern Alutiit. One can imagine people from Kodiak Island, the Alaska Peninsula, and groups around the perimeter of Cook Inlet traveling along the shores of lower Cook Inlet and finding Clam Cove with easy access and shelter.

In Southcentral Alaska and the Kodiak archipelago, a consistent body of ethnographic data regarding the Alutiit and the Dena'ina suggests a relationship between hunting rituals and rock-painting practice (de Laguna 1933, 1934, 1956, 1975; Perrot-Minnot 2021). This does provide some insights into the Clam Cove pictographs, which also depict whales and boats in a marine environment. Equally, it may be significant that this site (just like the Tuxedni Bay pictograph site) is in a region that is known archaeologically and ethnographically to be a major cultural crossroads during the last 3000 years (Boraas 2002, 2004). At the time of the first European contact, it was positioned in the southern corner of the Dena'ina territory and was remarkably close to where Yup'ik, Alutiiq, and Dena'ina territories intersect. Therefore, one could speculate that the Clam Cove pictographs served as territorial markers, as documented for rock-art sites on the Northwest Coast (Lundy 1974:295–296). While we may not ever know the original intent of the images, we do know that the images figured prominently in the rockshelter. We also know that the Clam Cove site is located in a bay with the Dena'ina placename *Niłghenk'enulyun*.

CONCLUSION

This article presented fieldwork results from the Clam Cove site and analyses of materials collected by Joan Townsend in 1969. We have provided the first chronological data for the Clam Cove rockshelter, demonstrating that its buried deposits date to 1700 radiocarbon years ago during the Kachemak III phase of the Kachemak Tradition. Study of the paleobotanical remains shows that people gathered fuelwood from both the forest and the beach. Analyses of the artifacts and shellfish remains indicate that site residents manufactured basalt and other tools and collected clams and cockles from the intertidal zone. Unfortunately, our study has not conclusively determined whether the pictographs painted on the rockshelter walls are temporally associated with the subsurface deposits. A contextual analysis of the imagery suggests their closest affiliation with the Alutiit (Baird 2003, 2004, 2006). Our study of a pigment sample was inconclusive, but we hope others can benefit from our experience with the PIXE technique. Although many unanswered questions remain, we believe we have taken full advantage of the data collected by Joan Townsend in her pioneering work at Clam Cove.

As many as three different groups may have occupied or visited Clam Cove and its vicinity over the past 2000 years: (1) people of unknown ethnicity, but probably ancestors of modern Alutiit, who left behind the buried deposits dated to 1700 radiocarbon years ago, (2) Alutiiq ancestors who likely painted the pictographs at some point, probably since 1700 radiocarbon years ago, and (3) the Dena'ina who are known to have occupied the larger region in the late precontact period and into the early twentieth century, and who have indicated a connection to the site. It seems probable that the Clam Cove site was occupied and visited by more than one ethnic group at a particular time in the site's history. People across the region may have widely known the presence of a rockshelter and abundant clam beds. If the pictographs are contemporaneous with the subsurface deposit, then the Clam Cove site has revealed an aspect of Kachemak III life that has been underdocumented previously.

As documented elsewhere, the condition of the Clam Cove pictographs is poor. Conservator Monica Shah (2006) developed a preservation plan to consider any new methods that might be used to preserve the pictographs. Although the evidence presented here, particularly the marine orientation, use of boats, and whale hunting, seems to link the pictographs to the Alutiit, Dena'ina groups likely knew of and visited this site during the late precontact period and into the nineteenth and twentieth centuries. We also know that this site is of importance today: Cook Inlet Region, Inc. selected the site as a historical place under the Alaska Native Claims Settlement Act. In light of this, and its cultural significance to both groups, the Clam Cove pictograph site was listed in the National Register of Historic Places in 2017.

Further deterioration of the Clam Cove site is inevitable. Degradation is a result of multiple causes and natural processes. The site's remote location and physical environment essentially preclude any attempts at interventions to alter or stabilize the rock surface physically. As Shah (2006) noted, human actions that are thought to be beneficial can cause far greater damage than the gradual natural processes currently at work. In keeping with the conservation strategy described in Shah (2006), the National Park Service will continue monitoring the site. Additional research regarding site history, cultural significance, and regional connections are essential. Work with descendant communities and knowledge keepers is essential to these engagements. A dialogical and ethical approach that integrates expertise and knowledge and active partnerships would contribute to sound management decisions and practices (see, e.g., Atalay 2006; Baird 2003; Colwell 2016; Ferguson 1996). A critical management tool available is site documentation, and Lake Clark National Park and Preserve conducts regular monitoring visits. It is clear that the management and stewardship of the Clam Cove site would benefit from active partnerships between managers and descendant communities.

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