CHAPTER 2

Archaeological Petroforms of the Lower Fraser River Canyon

Kisha Supernant
Department of Anthropology, University of Alberta

Introduction and Background

For the past 5000 years, dense vegetation has dominated the coastal temperate rainforest of the Pacific Northwest Coast, providing past inhabitants with an abundance of building material for housing, tools, clothing, and transportation (Ames and Maschner 1999; Moss 2011). Shell, collected from shellfish-abundant intertidal zones, was purposefully deposited to create stable, well-drained base for building large village locations (Martindale et al. 2009) and foundations for multi-family plank houses. Building with stone was limited, being primarily restricted to intertidal cobble and boulder petroforms related to fishing, shellfish gathering, and other beach clearing activity (Caldwell et al. 2010; Lepofsky et al. 2015; Menzies and Butler 2007). Recent work (Schaepe 2000, 2001, 2006) has identified a series of pre-contact petroforms built from stone in the Lower Fraser River Canyon (LFRC) (Figure 1) that differ from petroforms found in coastal intertidal zones and are unusual in the archaeological record of the entire Pacific Northwest. Petroforms in the LFRC are built from large angular cobbles and boulders, stacked in multiple courses, and occur throughout the Lower Fraser Canyon region of the upper Fraser River valley (Figure 1). When first discovered, these petroforms were hypothesised to be defensive fortifications within a broader socio-political system in the Canyon (Schaepe 2006). However, since the initial research, a comprehensive survey of the Canyon was undertaken to gain insight into the full complex of petroforms in the region.

This chapter presents the results of a 2008 survey of the Lower Fraser River Canyon, which identified 82 petroforms located between Lady Franklin Rock and Sawmill Creek, building on Schaepe's previous research (Figure 2). Here, the range of possible uses for petroforms is evaluated by exploring a sample of 30 built petroforms located via survey in the Canyon.

First, the survey objectives are presented, including a discussion of how petroforms were identified and some of the limitations of the survey results. Second, the primary descriptive characteristics of the petroform complex are described and the results of an exploratory statistical analysis of data collected on various attributes are presented. These data are summarized into a consideration of a possible range of uses of the petroforms, from their role in the day-to-day activities of life in the Canyon, such as fishing and house construction, to the specialized role of some petroforms for defense. Some implications of these petroforms for building practice, landscape modification, and social activities in the Lower Fraser River Canyon are then discussed.

Figure 1. Location of the study area in the Lower Fraser Canyon, southwestern B.C.

Objectives and Methods

Survey Area

During the summer of 2008, a ground survey was conducted from Lady Franklin Rock to Sawmill Creek on both the east and west bank of the Fraser River, between the current railways and the high water mark, whenever feasible (Figure 2). Three factors influenced the decision to limit the survey to the area between Lady Franklin Rock and Sawmill Creek:

Archaeology of the Lower Fraser River Region
Edited by Mike K. Rousseau, pp. 13-24
Archaeology Press, Simon Fraser University, 2017

(1) no petroforms had ever been recorded downstream from Lady Franklin Rock; (2) previous research indicated the ethnographic significance of the region, including a cultural boundary between Coast and Interior Salish peoples at Sawmill Creek (Carlson 2010; Harris 1998) and (3) the limited time and resources available. Although other surveys had been done in this area, some of the petroforms had been dismissed as products of either mining or railway activity and therefore were not considered to be components of the archaeological landscape (Kidd 1968:229). The pre-contact nature of petroforms in the Canyon was established by Schaepe (2006) and many of the existing petroforms were heavily lichen covered and associated with non-European material culture, such as lithic flakes. The primary goal of the survey was to inventory pre-contact culturally constructed petroforms and develop a standard method of field recording to produce data for comparative and analytical purposes.

The east bank of the Fraser has been less impacted by post-contact settlement and construction than the west bank, where both the current highway and the Canadian Pacific Railway are located. The greater number of petroforms found on the east bank of the Fraser River may be due to the more intensive historic disturbance on the west bank. Much of the area surveyed consisted of steep rocky bluffs. Petroforms appear to occur with greater frequency atop these bluffs within 50 m of the Fraser River. Previous research by Schaepe (2006) suggests that petroforms were located on bluffs for defensive purposes and clustered around known winter pit house village locations, so bluffs and winter village areas were targeted during the survey.

Survey Methodology

The landscape within the study area was systematically inspected by a crew of four people. Petroforms were located visually, a process hampered by thick moss covering large portions of the forest floor and low brush that impeded movement and visual inspection. Natural rock formations were distinguished from cultural petroforms based on several criteria, including a lack of organized stacking patterns and presence of bedrock cracking in angular patterns. Cultural petroforms had clear artificial characteristics such as cap stones, stacking, and chinking. Each cultural petroform was flagged and labelled sequentially using temporary numbers (e.g. RF-T01), plotted on a map, and where possible, recorded with a GPS. Basic data metric and descriptive data was collected for the cultural petroforms, including length, width, and height.

A total of 82 built petroforms were identified in the study area, although likely more existed prior to historic impacts on the landscape. The majority of the petroforms are terrace-like, consisting of a low retaining wall with a flat surface extending back from the top of the wall (Figure 3a, 3b). Freestanding walls exist but are rare. Many petroforms showed signs of visible disturbance, suggesting some degree of collapse of petroforms in the past.

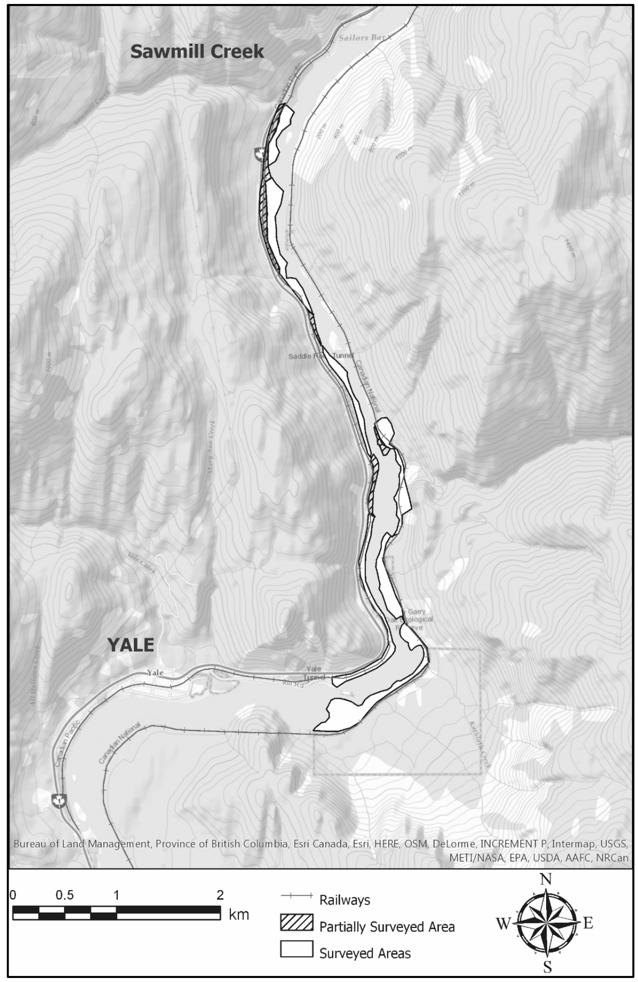

Figure 2. Lower Fraser River Canyon from Yale to Sawmill Creek, showing survey areas.

The survey results indicated many more petroforms throughout this landscape than previously recorded (Schaepe 2006). A judgemental sample of the petroforms were selected for further analysis. The selection was made on the following criteria: (1) to represent the range of petroform types in the region; (2) to represent areas where petroforms were clustered together in a complex; (3) accessibility of petro-forms; and (4) to represent a range of sizes of petroforms. Areas with relatively easy access from the river, a variety of petroform types, and with less overgrowth (to allow for total station mapping) were favoured. Qualitative and quantitative attributes were recorded for 37% (n=30) of cultural petroforms in the region. To standardize analysis of the petroforms, a form was created, based in part on previous work by Mathews (2006) on rock cairn petroforms at Rocky Point on Vancouver Island, supplemented with examples of recording of other types of stone petroforms or terraces in other areas of the world (Johansen 2008). The form laid out a set of common attributes for recording.

Figure 3a. RF-T73a: This is the south edge of an L-shaped terrace petroform. Large angular rocks are strategically placed on the top of the petroform to create a flat surface. Some disturbance is visible.

Figure 3b. RF-T73b: This is the west edge of an L-shaped terrace petroform. Large angular rocks are strategically placed on the top of the petroform to create a flat surface but some have slid down off the top.

Exploratory Data Analysis

> "EDA is…a flexible, data-centred approach which is open to alternative models of relationships and alternative scales for expressing variables, and which emphasizes visual representations of data and resistant statistics." (Hartwig and Dearing 1991:12-13).

The analysis of the petroform data was exploratory, designed to find potential patterns within the attribute data. Due to the small sample size, confirmatory statistics were not applied to the petroform data at this time. EDA is an approach to analysis that uses a set of techniques to graphically examine and manipulate data in order to expose underlying structure, assumptions and anomalies (Tukey 1977). Graphical exploration of data is effective "when it forces us to notice what we never expected to see" (Tukey 1977:vi). Viewing and manipulating the data was used to reveal meaningful patterns to define petroform types and uses. EDA is based on the assumption that "…the more we know about the data, the more effectively it can be used to develop, test and refine theory." (Hartwig and Dearing 1991:9). Four themes are important in EDA: (1) resistance, or insensitivity to localized small changes in data; (2) residuals, or what remains after a model has been fit to the data; (3) re-expression, or transformation of the scale of the data to simplify analysis; and (4) revelation, or use of visual displays to reveal patterns in the data (Hoaglin et al. 1983). This approach is a good first step to identify and describe possible relationships between categories of archaeological data.

Frequencies, bar-charts, and boxplots were used to display and analyze the data, since these graphics provided visual displays of both discrete and continuous variables to check for errors, assess where data were "smooth" (showing regularity in the underlying structure of the data) or "rough"(deviations from the smooth data showing no pattern) (Hartwig and Dearing 1991). For continuous data, boxplots reveal symmetry and skewness. Much of the data were nominal or ordinal measurements summarized in frequency tables to explore patterns within the data (Supernant 2011). Summary measures illuminated meaningful patterns and deviations, indicating rough areas where transformations or data clustering were required for analysis. The exploration of differences and patterns within these data has the potential help understand how and why petroforms were constructed throughout the landscape of the Lower Fraser River Canyon.

Petroform Data Analysis Results

Discrete Variables

The majority of the petroform attributes recorded were categorical, designed to capture the presence or absence of materials and characteristics, or placing petroforms into categories. Some attributes (e.g., relative number of rocks, infill) are ordinal measurements. Each variable in the database is summarized and patterning in the data is described. Where data are rough, further discussion of the variable is presented.

Petroform types recorded in the field were: (1) terraces and platforms, defined as linear or rectangular petroforms creating surfaces filled in with stone and earth (Figure 4); (2) walls defined as linear petroforms that are partially or completely freestanding and consisting of multiple courses; (3) retaining walls, defined as linear petroforms placed on slopes; (4) linear stone alignments, defined as petroforms consisting of one course of stones; and (5) semi-circular or crescent stone enclosures defined as multi-sided petroforms creating an open area in the centre. Within the study sample, 20 (67%) are terraces, five (16.7%) are walls, three are retaining walls (10%), with one linear stone alignment and one semi-circular stone enclosure (Table 1).

Table 1. Summary of Sampled Petroforms Indicating Site Name and Type.

Petroform Number	Site (Borden)	Petroform Type
RF-T01	DjRi-2(S)	Terrace/platform
RF-T02	DjRi-2(S)	Terrace/platform
RF-T03	DjRi-2(S)	Terrace/platform
RF-T04	DjRi-2(S)	Terrace/platform
RF-T05	DjRi-2 (N)	Terrace/platform
RF-T06	DjRi-2 (N)	Terrace/platform
RF-T07	DjRi-2 (N)	Terrace/platform
RF-T10	Unassigned	Retaining Wall
RF-T11	Unassigned	Retaining Wall
RF-T14	Unassigned	Terrace/platform
RF-T16	Unassigned	Wall
RF-T17	Unassigned	Semi-circular stone enclosure
RF-T18a	DjRi-46	Wall
RF-T18b	DjRi-46	Wall
RF-T21	DjRi-14	Terrace/platform
RF-T29	DjRi-14	Terrace/platform
RF-T35	DjRi-14	Terrace/platform
RF-T63	DjRi-13	Linear stone alignment
RF-T64	DjRi-13	Retaining Wall
RF-T66	DjRi-13	Terrace/platform
RF-T68	DjRi-13	Terrace/platform
RF-T69	DjRi-13	Terrace/platform
RF-T73a	DjRi-62	Terrace/platform
RF-T73b	DjRi-62	Terrace/platform
RF-T74	DjRi-62	Terrace/platform
RF-T75	DjRi-62	Terrace/platform
RF-T76	DjRi-62	Terrace/platform
RF-T85a	DjRi-46	Wall
RF-T85b	DjRi-46	Wall
RF-T89	DjRi-62	Terrace/platform

Most petroforms (n=22, 73%) had some form of river visibility, with 9 (30%) having a downriver view only and 4 (13%) having an upriver view only. More petroforms had some form of view downriver (40%, n=12) than some form of upriver view (23%, n=7) (see Supernant 2014 for a greater discussion of visibility of petroforms). Since the primary direction of travel into the region would be from downstream, having more petroforms with a downriver view was expected. Petroforms were constructed out of a range of clasts and numbers of stones. For primary building materials, 93% (n=27) of the sampled petroforms were constructed out of angular boulders, suggesting they were a preferred construction material (Figure 4).

Figure 4. An example of a petroform constructed using angular boulders and cobbles.

Thirteen petroforms (43%) had between 50-99 stones as part of the visible construction, while 10 (33.3%) had less than 20, and the remaining 7 (23.3%) had 100 or more stones. Portions of petroforms still covered in soil or vegetation were not included in this count, so for some petroform types, the count was an underestimation of the full extent. Most petroforms contained mainly boulders (n=26, 87%), and petroforms that did not have a majority of boulders were equal amounts of boulders and cobbles (n=4, 13%). This indicates that boulders were the preferred material for constructing all petroforms, with 50% of petroforms (n=15) falling into categories that were majority boulders or large boulders.

Twenty-eight petroforms were constructed of primarily angular stones (93%), while an equal number of petroforms (n=28) were constructed of stones with a secondary angular shape (93%). For roundedness, there was a slight emphasis on low sphericity (flatness), which indicates rocks are more flat than round overall. In a cross tabulation of primary and secondary sphericity, a few patterns emerge, suggesting that angularity was an important consideration when selecting rocks with which to build petroforms. Stone in the environment surrounding the petroforms was more angular than rounded, but both types are present, so it appears the selection of angular rocks was deliberate.

Table 2. Cross-tabulation of Primary and Secondary Sphericity of rocks in petroforms.

		Secondary Sphericity								Total
Sphericity		4	5	6	7	9	10	11	12	
2	Count	-	-	-	1	-	-	-	-	**1**
	%	-	-	-	100%	-	-	-	-	**100%**
3	Count	-	-	-	-	1	-	-	-	**1**
	%	-	-	-	-	100%	-	-	-	**100%**
5	Count	-	-	-	-	-	3	6	2	**11**
	%	-	-	-	-	-	27.3%	54.5%	18.2%	**100%**
6	Count	-	-	-	-	-	-	-	1	**1**
	%	-	-	-	-	-	-	-	100%	**100%**
10	Count	1	2	-	-	-	-	3	1	7
	%	14.3%	28.6%	-	-	-	-	42.9%	14.3%	**100%**
11	Count	-	3	-	-	-	1	-	2	**6**
	%	-	50%	-	-	-	16.7%	-	33.3%	**100%**
12	Count	-	1	1	-	-	-	-	-	**2**
	%	-	50%	50%	-	-	-	-	-	**100%**
Total	Count	1	6	1	1	1	4	9	6	**29**
	%	**3.4%**	**20.7%**	**3.4%**	**3.4%**	**3.4%**	**13.8%**	**31.0%**	**20.7%**	**100%**

Only two petroforms (7%) were more than 50% freestanding. The one completely freestanding petroform was RF-T64, the only linear boulder alignment in the sample. Whether or not a petroform was freestanding helped determine whether these petroforms could have served defensive purposes, because if there was no space to stand or crouch behind the petroform, it would not have protected people from oncoming attackers unless enhanced by other materials such as wood, brush, or other perishable construction materials. Within the sample of petroforms, 60% (n=18) were completely infilled. Only five petroforms (17%) had less than 25% infill. The nature of the infill is unknown, as most terrace petroforms were covered in soil overlaying stone, but without excavation, it is unclear whether infill was intentional.

Figure 5. A portion of RF-T14; a small, unusually situated petroform with very tight stacking.

A large majority of petroforms (n=24, 80%) showed chinking, where small stones created stability and filled in gaps between larger stones. Many rocks used for chinking were cobble sized. Most petroforms show medium-loose to medium-tight stacking patterns (n=25, 83%), with looser stacking indicating more space between individual rocks in the petroform. The one petroform with the greatest tightness of stacking was RF-T14 (Figure 5), with virtually no space between rocks. Stacking may be related to size of the overall petroform, as well as sphericity. Angular boulders, for example, are easier to stack strategically, lessening the need for chinking.

Twelve petroforms (40%) were associated with pre-contact period artifacts, including chipped, ground, or pecked lithics. Most artifacts were located within the face of the petroform, uncovered during clearing, or directly on the surface of the petroform itself and were not recovered from controlled excavations. Associating fire-altered rock (FAR) with pre-contact period cultural activity was more difficult than artifacts, considering that historic or modern activity could lead to FAR on the surface of petroforms. The presence of FAR within the petroform can point to possible uses, so it was recorded when FAR was not just on the surface, but also coming out of the petroform itself. Eight petroforms (27%) had FAR present within the petroform.

In addition to pre-contact cultural material, petroforms with historic material were recorded. Historic materials were determined by the amount of discolouration on metal objects and the shape, colour, opacity, and visible wear on glass objects. As with artifacts and FAR, this was based on surface materials observed during the clearing of petroforms, so excavation of the petroforms may change this frequency. The majority of petroforms (60%, n=18) were not directly associated with historical material.

Continuous Variables

Several of the measurements collected for the petroforms provided continuous data for analysis. The measures of centre and spread for each variable are presented in Table 3. General trends within each variable, including smoothness or roughness, are discussed in the following section. In Table 4, five number summaries are presented for all continuous variables. These data show some patterns that suggest possible groupings of the petroforms based on their dimensions.

Table 3. Summary Measures of Level and Spread for Continuous Variables.

	Length (m)	Width (m)	Height (m)	Area (m^2)	Volume (m^3)
Mean	8.73	5.81	1.70	58.68	107.58
Median	8.50	2.61	1.71	26.04	53.07
Range	16.42	18.80	2.49	283.99	381.13
IQ Range	6.15	7.32	0.89	85.08	189.05
SD	4.38	5.25	0.69	70.4	122.47

Table 4. Five-number Summaries for Continuous Variables.

	Length (m)	Width (m)	Height (m)	Area (m^2)	Volume (m^3)
Upper Hinge	11.52	9.2	2.1	94.86	201.9
Upper IQR	3.02	6.59	0.39	68.82	148.83
Median	8.50	2.61	1.71	26.04	53.07
Lower IQR	3.19	0.73	0.51	16.26	40.22
Lower Hinge	5.31	1.88	1.2	9.78	12.85

Length

Lengths of petroforms, measured as the longest horizontal dimension, ranged from 2.54 m to 18.87 m. The boxplot (Figure 6) lacks outliers or far outliers, although the upper whisker is longer than at the lower one, indicating substantial spread around the centre and a positive skew.

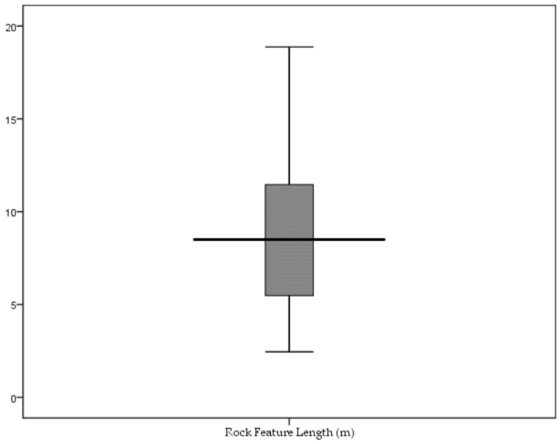

Figure 6. Boxplot of petroform length.

The median value falls in the centre of the interquartile range, indicating that the centre of the distribution does not show a positive skew, so the distribution is being affected by a few large values. For petroform length, the mean value is 8.73 m, while the median is 8.50 m and standard deviation is 4.38 m. The mean and median values are similar, with the mean slightly higher. The mean is not overly affected by the higher values, so can be considered a good measure of the centre for the distribution of petroform length. In addition, the more resistant median and inter-quartile range indicate a fairly equal split between the two middle quartiles of the data, with an upper IQR of 3.02 m and a lower IQR of 3.19 m (Table 4). In this case, the distribution appears fairly normal, a point that is supported by the relatively small standard deviation and the data can be considered smooth.

Width

Width, measured as the shortest horizontal dimension, had a minimum value of 0.74 m and a maximum value of 19.54 m. For terrace petroforms, the width of the flat surface created by the petroform was included, even if rock was not visible on the surface. Four petroforms were tested with a soil probe throughout the flat areas and all tests encountered rocks at 15-40 cm below the surface, indicating that measuring the full extent of the flat area on top is a reasonable measure of width. Additionally, a test excavation atop one petroform encoun-tered rock at 35-40 cm below the surface. The boxplot of petroform width (Figure 7) has the upper whisker noticeably longer than the lower one, showing a positively skewed distribution. The lower quartile of the inter-quartile range is quite small (0.73 m) and the upper quartile is more than eight times larger (6.59 m) (Table 3), emphasising that the skewness of the data is inherent throughout and not just caused by large outlying values.

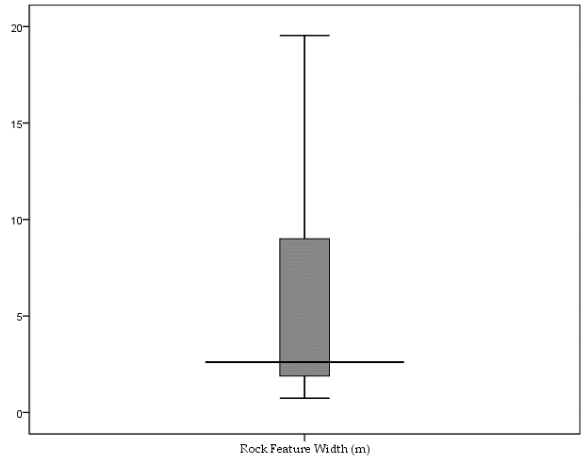

Figure 7. Boxplot of petroform width.

The skewness of the data is supported by looking at measures of the centre (Table 3), where the median is 2.61 m and the mean is 5.81 m. The mean is more than twice the size of the median, and is skewed by high values. In this case, even the resistant measures of median and inter-quartile range point to an overall positive skew to the data, with a much larger range in the upper 50% of the data. Width is rougher than length, with some large values skewing the distribution, suggesting that dividing the data by area (m^2) or volume (m^3) might be a useful way to look at patterning.

Height

Height had a smaller range, 0.49 m to 2.98 m, than either width or length. The boxplot (Figure 8) shows nearly equal whiskers and the median falling in the centre of the inter-quartile range.

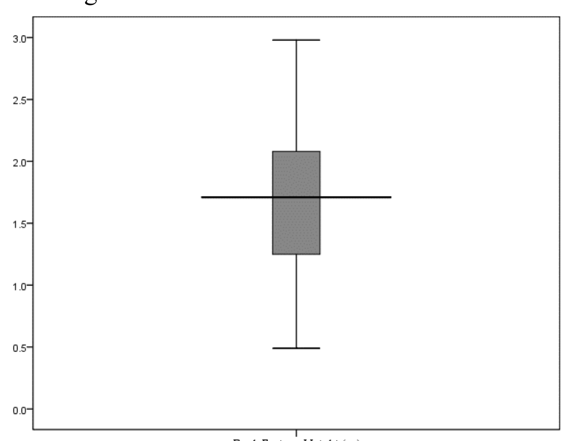

Figure 8. Boxplot of petroform height.

For measures of the centre for this variable in Table 3, the mean is 1.71 cm, while the median in 1.70 cm. The spread is concentrated around the median and mean, indicated by the relatively small value of the inter-quartile range (Table 4). Overall, the data approximates a normal distribution, indicated by the relatively small standard deviation of 0.69

m. In this case, the mean is a good measure of the centre, and height can be considered a smooth variable.

Area

Area, calculated by multiplying the width and length variables, had a range of 2.3 m^2 to 286.0 m^2. Unlike boxplots of the continuous variables explored above, area is very rough, with two outliers and a long upper whisker (Figure 9). This shows that some large cases are skewing the distribution. The mean area of petroforms (58.7 m^2) is more than twice the median (26 m^2). The median is near the very bottom of the inter-quartile range, showing an uneven distribution between the two middle quartiles, with an upper inter-quartile range of 68.8 m^2 compared to a lower inter-quartile of 16.3 m^2 (Table 4).

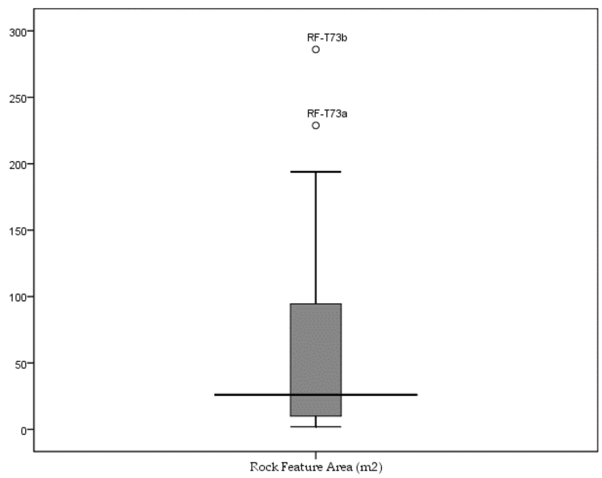

Figure 9. Boxplot of petroform area.

The standard deviation is 70.4 m^2, larger than the mean, while the distribution has an interquartile range of 85.1 m^2, as seen in Table 3. With a standard deviation larger than the mean, the data are rough. The first steps with these data are to see if grouping them into categories based on some of the categorical attributes for comparison makes for smoother patterns within the continuous variables. For example, grouping the petroforms based on size and re-exploring the continuous variables in batches might account for some of the skewness.

Volume

The overall volume of petroforms, measured by multiplying length by width by height, ranged from 0.99 m^3 to 382.12 m^3. Volume is likely an over estimate, especially for terraces, as it assumes the height of the face is consistent throughout the whole feature The boxplot shows a strong positive skew, with a long upper whisker (Figure 10). Based on skewness of the spread, the data cannot be considered smooth. Numeric summaries of level and spread show some evidence of roughness in the data, with a mean of 107.6 m^3, twice as much as the median at 53.1 m^3 (Table 3). The standard deviation for volume is 122.5 m^3, larger than the mean, indicating considerable variation around the mean. The shape of the spread is illustrated by the relationship between the median and the inter-quartile range. The lower quartile range is 40.2 m^3, while the upper quartile range is 148.8 m^3, emphasising the positive skewness in the dataset as a whole (Table 4). Even within the resistant measure of the inter-quartile range, therefore, the data are positively skewed, with a much larger range seen in the upper half of the data.

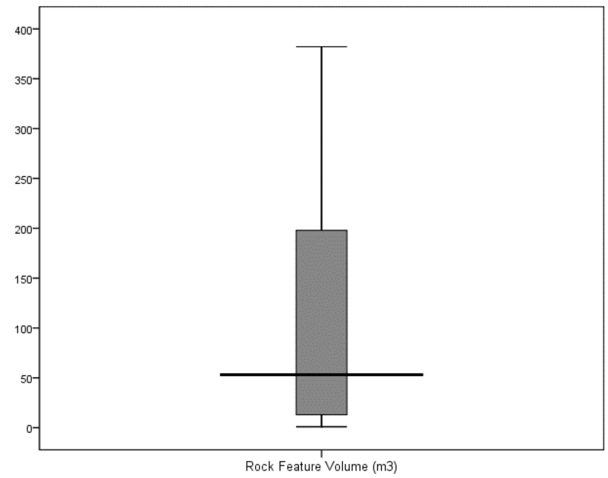

Figure 10. Boxplot of petroform volume.

Courses

Another attribute measured was the visible intact courses for each petroform, ranging from one course to 12 courses. The boxplot (Figure 11) shows two outliers at the upper end of the scale and roughness in the data.

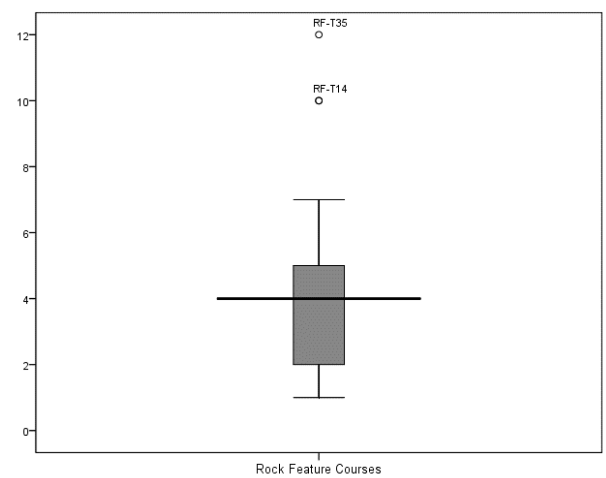

Figure 11. Boxplot of petroform courses.

The mean value for petroform courses is 4.2, with a median of 4.0, a standard deviation of 2.6, and an inter-quartile range of 3. The distribution is not even, with the median showing that the upper quartile of the midspread has a smaller range than the lower quartile of the midspread, suggesting a negative skew, but the large values at the upper end of the scale are creating an overall impression of a positive skew in the data.

Aspect
The main aspect, or the cardinal direction the longest dimension of the petroform was facing, was measured, but after initial exploration of this attribute did not reveal patterns, the aspect variable was represented via the degrees of a compass in a circle, divided into eight wedges, each representing 45°. Counts of petroforms that fall within each wedge were added and shading was used to emphasize differences between those counts (Figure 12). Figure 12 shows that 5 petroforms had an aspect between 0-45° (North-northeast), while 7 had an aspect between 46-90° (Northeast-east). Only one petroform had an aspect between 316-360°.

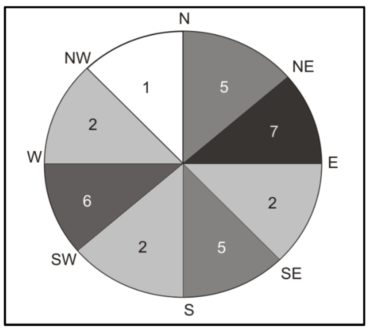

Figure 12. Aspect (cardinal direction facing) of petroforms. Values in each 45°circle interval indicate the number of petroforms within that range. Cardinal direction is indicated at the junction of each wedge and wedges with darker shading indicate a great number of petroforms falling within that range.

Overall, the aspect range with the greatest number of petroforms is 0-90°. This pattern is interesting because the northern direction is upriver for many sites. If petroforms were placed to have views of the river, the aspect should be roughly equal between east and west. Figure 12 shows that 19 (64%) of the petroforms had more easterly aspect, while 11 (37%) had a more westerly aspect. This difference may reflect the variation in direction of the river view.

Summary
EDA techniques indicate some trends in the sample of petroforms in the Lower Fraser River Canyon, as well as some areas where data deviate from the main patterns. Most petroforms had a view of the river, although more petroforms had a view downriver than a view upriver. A large portion of the petroforms were not at all freestanding; only two were over 50% freestanding, and most showed some portion of infill. In variables related to construction methods, most petroforms showed stacking patterns that ranged from medium-loose to medium-tight, and 80% showed evidence of chinking to increase petroform stability. Most petroforms were constructed out of 50 to 99 angular boulders, although these ranged in size from small boulders to very large boulders. Some petroforms were built of large boulders with individual volumes up to 4 m^3 and weights above 10 tonnes. On average, rocks used in these petroforms ranged from 0.5 to 1 m in diameter and generally were found breaking off from local bedrock outcrops. The angular boulders selected to build the petroforms are closer to flat than round in most cases. Only two petroforms were built out of rounded boulders, and none were cobble-dominant. Examining some of the patterns within these attributes can illuminate potential uses, construction patterns, and social activities embedded in these petroforms.

Hypothesising Petroform Function
Understanding the use of the petroforms in the Lower Fraser River Canyon requires a historically-situated analysis of what people were doing, the types of technology used, and what these petroforms meant to people. Drawing on the historical context of the Lower Fraser River Canyon, a possible range of functional uses of the petroforms is presented. To speak only of function in terms of behavioural aspects of society (e.g. fishing or defending against raiders) is to underplay the ways in which these objects impacted the experiences of people in the landscape on a much broader scale, but this is a necessary step in interpretation.

The uses proposed here are designed to help explain some of the patterns observed in the data exploration that are not well captured by the size distinction. In addition, they are based on a reading of the literature and conversations with people on the ground. Three major categories of use of petroforms are proposed: (1) salmon fishing and fish processing; (2) defense; and (3) bases for the construction of plank houses. There may have been additional uses, including burial mounds, spiritual markers, lookouts, etc., so the uses described below can only describe elements of the sampled petroforms and may not be representative of all petroforms.

Distinguishing between the three uses is not based on a single variable but instead considers differences in a range of variables. These are not mutually exclusive or exhaustive categories – a terrace built for a dry rack could become a useful place for defense and vice versa. However, the purpose here is to attempt to uncover possible intentions. What did people in the past anticipate as a primary use for these petroforms? While this is a challenging task, some aspects of the petroforms may point to certain uses, including how far they are from the river, which direction they face, how big they are, and whether they are high enough to physically protect members of the community from attack. After examining several different possibilities for use, the petroforms in the sample that do not meet any of the expected criteria are identified and what this means for analysis based on strictly physical characteristics is discussed.

The petroforms are grouped into five different usage categories and are compared based on the following variables: size, freestanding, terrace/non-terrace, river view and river view direction, infill, fire-altered rock, artifacts, historic materials, cap stones, and association with pit house village locations. Graphs and charts in each usage section to illustrate patterns and examine whether or not usage categories were effective in smoothing some of the roughness in the continuous data of width, area, and volume.

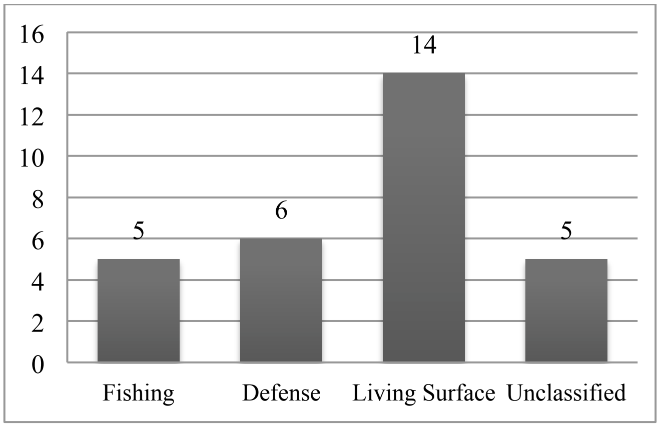

Figure 13. Bar chart of proposed petroform use.

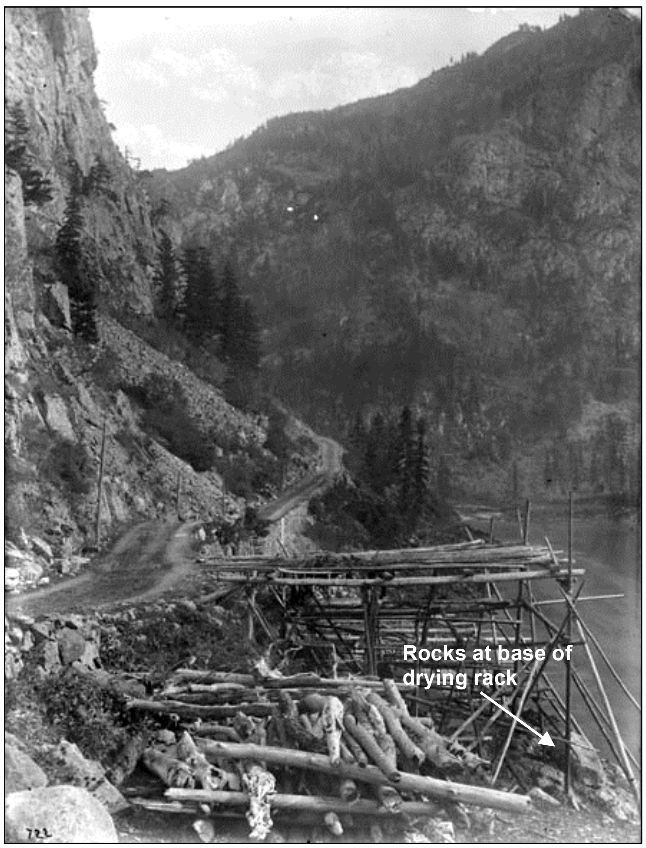

Figure 14. Photo showing a dry-rack in the Canyon in 1879. Note the rocks used to stabilize posts at the base of the dry-rack petroform. **Canada Archives (PA-009216).**

Fishing and Fish Processing

Fishing is a dominant theme for the entire Canyon. Two explanations are possible for the specific relationship between these petroforms and the fishery: first, these could have been the base for the construction of drying racks (Figure 14); and second, these could have been designed to create flat areas (terraces or platforms) near the river on which to stand while fishing.

Fishing with a dip net is dangerous at the best of times, so creating a stable, level surface is desirable, since much of the landscape directly adjacent to the river is steep and treacherous. Dry rack platforms require a flat area up to 30 m^2, must be stable enough to support posts that formed the rack frame, and should be situated adjacent to the river where there is enough wind to dry the salmon. Modern drying racks are constructed on high points near the river, often at the top of steep slopes. Petroforms set back away from the river, and out of the wind, would be poor places to build a drying rack.

Only four out of the sample of 30 terraces have characteristics suggesting they could have been bases for dry racks. RF-T03, RF-T06, RF-T07, and RF-T04 (Table 5) are all small terraces at exposed points ranging from 15-35 m above mean river level. None are at obstructed locations, so the areas would be sufficiently windy, and all of these locations have access to the river to bring fish up for drying. While there do not appear to be any petroforms in the sample that created flat areas for dip net fishing, there is one known petroform at DjRi-14, discussed in Schaepe (2006) that could have served the dual purpose of both a defensive structure and a fishing platform. Future research should include this petroform in the sample to allow for comparison.

Table 5. Fishing Petroforms.

Petroform	Type	Area (m^2)	Free-standing	River View	Meters Above River
RF-T06	Terrace	2.45	26-50%	Yes	21.72
RF-T03	Terrace	3.62	0%	Yes	15.23
RF-T07	Terrace	8.48	0%	Yes	21.73
RF-T04	Terrace	17.38	0%	Yes	26.1

While all of these petroforms have a river view, those views are either upriver or across the river – no fishing petroforms have downriver views. Most have less than 75% infill and are less than 49% freestanding. Four of five (80%) fishing petroforms are associated with pit house village locations, but most do not have cap stones. None are associated with fire-altered rock; however, the majority of fishing-related petroforms are associated with both pre-contact and post-contact artifacts, indicating potential continuity of use of fishing locations through time.

Defense

Whether petroforms were built to protect the community from attack can be evaluated by exploring their physical characteristics - the direction they face, their proximity to other petroforms, whether or not they are freestanding, and how far they are from the mean river level. This indicates whether the petroforms actually work to ensure the safety of members of the community based on the types of warfare that were practiced. Unfortunately, this does not take into account the use of these structures as the base for wooden palisades or fences, since this part of a defensive structure would not preserve.

Table 6. Defensive Petroforms.

Petro-form	Type	Free-standing	River View	Meters Above River	Direct Association with other Petroforms
RF-T18a	Wall	Partial	Down and across river	18.67	Yes
RF-T18b	Wall	Partial	Downriver	17.95	Yes
RF-T63	Linear Alignment	Yes	Down and across river	16.05	Yes
RF-T64	Retaining Wall	Partial	Downriver	14.44	Yes
RF-T85a	Retaining Wall	Partial	Downriver	11.04	Yes
RF-T85b	Retaining Wall	No	Downriver	11.93	Yes

Five petroforms (17%) were identified whose primary function was likely defensive: RF-T63, RF-T18a, RF-T18b, RF-T85a/RF-T85b and RF-T64 (Table 6). RF-T85b, while not freestanding today, is in direct association, and was once connected to, RF-T85a, so it is included as a potential defensive structure, bringing the total number of defensive petroforms to six. One interesting characteristic of all of these petroforms is their direct association (<5 m distance) with other petroforms.

Most defensive petroforms tend to be at least partially freestanding, although the level of infill varies. All defensive petroforms have a river view, face either downriver or down and across the river, and are associated with pit house village locations. Cap stones are not found on most defensive petroforms, with only one (20%) showing the use of cap stones as part of the construction. This pattern supports the idea that these petroforms would be used to observe activity downriver from village locations, potentially to warn inhabitants of oncoming attacks. Very little cultural material was found in association with these petroforms: only one (17%) has a pre-contact artifact, while none have post-contact material or FAR.

RF-T63 is unusual and unique among the sample of potential defensive petroforms because it consists of nine large boulders ranging in diameter from approximately .9 m-1.3 m, and forms a line across the top of a steep bluff (Figure 15).

Figure 15. Petroform RF-T63 showing linear boulder alignment. View is downriver.

These large boulders are chinked with small rocks for stability and have a maximum height of 1.75 m. If this location was used as a lookout, the person on watch would have to crouch or lay down to be completely concealed, but there would still be space to see downriver between the large rocks. The location and design of this petroform make it the most clearly defensive petroform in the entire sample.

Living Surfaces

Another possible function for many of the petroforms is as a base for a plank house or simply to create flat living surfaces in very steep topography. This can be evaluated by exploring whether petroforms create flat surfaces suitable for a range of living activities. Comparison of terrace surface dimensions with those of known plank houses might indicate whether or not the terraces were built and used as house platforms. On the Columbia River, the average size of a plank house at different sites from the area averages from 27-135 m^2 (Hedja in Ames et al. 1992). Other archaeological examples from the area include the Mauer house, measuring 38.5 m^2, and a house at Scowlitz, measuring 187 m^2 (Lepofsky et al. 2009; Schaepe et al. 2001:40-42). In addition, Simon Fraser describes a house at Yale in 1808 measuring 14 m by 7 m, which would have covered an area of 98 m^2 (Lamb and Fraser 2007:119). Any terrace petroform with an area greater than 30 m^2 is considered as a possible house platform (Table 7).

Table 7. Living Surfaces.

Petro-form	Type	Width (m)	Area (m^2)	Volume (m^3)	Free-stand	Arti-facts
RF-T66	Terrace	6.8	39.17	68.94	No	No
RF-T89	Terrace	0.79	42.00	33.18	No	Yes
RF-T74	Terrace	2.54	47.93	59.91	No	Yes
RF-T69	Terrace	7.02	59.46	97.51	No	No
RF-T68	Terrace	10.84	92.47	197.88	No	No
RF-T05	Terrace	9	94.5	172.94	No	No
RF-T35	Terrace	8.2	95.94	48.67	No	No
RF-T01/RF-T02	Terrace	14.3	102.5	277.78	No	Yes
RF-T21	Terrace	9.8	104.37	30.57	No	No
RF-T75	Terrace	11.11	193.87	354.78	No	Yes
RF-T73a/b	Terrace	19.54	336.47	561.91	No	Yes

Fourteen petroforms (47%) are terraces with areas measuring greater than 30 m^2. All of these petroforms are associated with pit house villages, and RF-T66, RF-T68, RF-T69, and RF-T01/02 "front" a pit house village. This pattern was seen with plank house depressions elsewhere along the Fraser River (Schaepe 2009). RF-T01/02, located on the east bank of the river at DjRi-2(S), is very similar in dimension (98 m^2 versus 102.5 m^2) to the plank house noted by Simon Fraser in 1808 in this same area, so it is possible that this petroform could have formed the base of a house of similar size.

Several patterns emerge when data from living platforms are compared with the other categories. All of these petroforms are terraces and many of them do not have a river view (n=8, 57%). Those with river views show an equal division of upriver (n=3, 21%) and downriver (n=3, 21%) views. FAR is found at 50% of living platforms (n=7), comprising 88% of all petroforms associated with FAR in the overall sample. Association of living petroforms with artifacts and historic materials is less common than with FAR, at 43% (n=6) and 36% (n=5) respectively. The presence of cap stones is far greater among living platforms than other types of petroforms (n=10, 72%), supporting the hypothesis that living petroforms were designed to have a flat, even, stable top. All living petroforms are associated with village locations, an expected pattern if they were used as bases for plank houses.

Ownership Markers

There are still five petroforms in the sample (16.7%) whose possible primary function does not fit into patterns in the data (Table 8).

Table 8. Unclassified Petroforms.

Petroform	Type	River View	Freestanding
RF-T10	Retaining wall	Downriver	No
RF-T11	Wall	Downriver	No
RF-T14	Terrace	Up and across river	No
RF-T16	Retaining wall	Downriver	No
RF-T76	Terrace	Up and across river	No

Petroforms could have served as markers, displaying the rights of families where houses were not necessarily visible from the river. Marking the landscape in prominent and enduring ways, whether or not an intentional outcome of the building a petroform such as a house platform, is legacy of all petroforms in the region. The five unclassified petroforms have several characteristics that distinguish them. First, they are generally small terraces, walls, or retaining walls. All have a river view of some kind, with little preference for down or upriver. Two (40%) have almost no infill, while 3 (60%) have 100% infill. One petroform (20%) is associated with FAR, two (40%) are associated with pre-contact artifacts, while four (80%) are associated with post-contact material. Eighty percent of these petroforms (n=4) are not associated with village locations and only one (20%) has a cap stone.

RF-T10 and RF-T11 are on a steep slope below a modern dry rack and surrounded by modern refuse. There is a limited downriver view from this location, and the petroforms are far enough above the river and not on an obvious pathway to restrict access to a site. They are not associated with an ancient village and do not create a flat area where a dry rack or house platform could be built. However, they do permit navigation along a rocky slope, perhaps forming trail routes. Of all of the "unexplained" petroforms, RF-T76 (Figure 16) is the largest, constructed of the largest boulders of any petroform in the sample; some weighing an estimated 10 tonnes. This petroform would have required a large, coordinated labour force to construct. It is not a house platform because the overall area is not large enough based on the criteria established; it is not freestanding, and the placement of the rocks flush with bedrock behind indicates that the petroform was not likely built to be freestanding. It provides a restricted upriver view, lacks a downriver view, and does not have the width nor is situated in a windy enough location to have functioned as a dry rack.

Figure 16. RF-T76 - a possible ownership marker.

What, therefore, is a monumental wall doing here? This 3 m tall, immense petroform might have had a major impact on a visitor to this location, whether friendly or hostile. It is possible that people who built the village and managed access to it created a marker that any visitor could not miss when they landed their canoe on the beach and made their way up the path to the village above. RF-T76 best exemplifies the role of these petroforms in marking territory and declaring permanent ownership.

Discussion and Implications

The extent and range of petroforms in the Lower Fraser River Canyon indicates that building with stone in this landscape was not uncommon. Based on the variability in location, form, and construction patterns within the petroform complex, it is likely they were used for many different purposes. Defensibility was a probable role for some of these petroforms, especially ones which were partially or mostly freestanding and were not terraces. Freestanding petroforms also tended to have a downriver view, indicating they may have been purposefully placed to maximise visibility in the event of a raid. Many of the large terraces, however, had area measures that were similar to dimensions of plank houses in other parts of the Coast Salish world, including the Fraser River drainage (Lepofsky et al. 2009). Further excavation and testing would be required to evaluate this hypothesis, but in a steep canyon landscape where flat surfaces are at a premium, petroforms could have been used as a form of landscaping. Other rock structures close to the river, including small terraces without the requisite dimensions for a plank house base, may have been related to fishing activities (i.e. catching, processing, wind-drying). Based on the exploratory analysis, however, there were some petroforms which stood out from the sample. These petroforms tend to be retaining walls or other petroforms which are not terraces but are also not freestanding. Outlying petroforms suggest building of large rock structures may have had an impact on visitors to a landscape that is the central focus of major seasonal aggregation and also home to a smaller population year round (Carlson 2001, 2007; Schaepe 2006). Their visibility from the river or at entrances to villages suggests that many petroforms, regardless of their intended function, could have played a role in marking durability or permanence on a culturally valuable landscape. Further research on these petroforms is required to clarify issues around when these petroforms were built and used.

Conclusions

Petroforms are common on the landscape of the Lower Fraser River Canyon. Built in ways that modified the landscape, likely in practical ways for fishing, defense, and living surfaces, these petroforms had the consequence of marking this space as distinct from other areas of the Coast Salish world. This statement alone has implications for how the archaeology of this region is viewed, as these structures were not merely specialized fortifications, but played a role in many aspects of ancient cultures. They appear to have been a part of the day to day activities of people living in this area. Living in a plank house, even if it only occurred for part of the year, involved a broader range of the experience of people living in the Canyon than protecting communities from attack. They may also be a durable marker of a history of identity making, ownership, and belonging in the Fraser River Canyon, with many petroforms situated at fishing stations used for thousands of years, seeing the coming and going of thousands of people. The petroforms stand at those very spots that have been important to people since time immemorial, attesting to the power of this landscape, past and present.