THE CULTURAL EVOLUTION OF MATERIAL WEALTH-BASED INEQUALITY AT BRIDGE RIVER, BRITISH COLUMBIA

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A fundamental problem for anthropological archaeology lies in defining and explaining the evolutionary origins of social inequality. Researchers have offered a range of models emphasizing variability in the roles of managers, aggrandizers, ecological variability, and historical contexts. Recent studies suggest that the form of emergent inequality may have varied significantly between groups, implying that pathways to inequality may have varied as well. Unfortunately it has been difficult to test many of these models using archaeological data given their requirements for fine-grained assessments of spatiotemporal variability in many data classes. Recent research at the Bridge River site in British Columbia provides the opportunity to explore the utility of a range of explanatory models associated with early social inequality. Results of the study suggest that inequality, measured as significant variability in accumulation of a range of material wealth items, came late to the Bridge River site (ca. 1200–1300 cal. B.P.) and was associated with a period of demographic packing and apparent declining access to some critical subsistence resources. Assessment of interhousehold variability in demography, wealth accumulation, and occupational longevity suggests that markers of significant affluence manifested only in newly established houses. An important implication is that material wealth-based inequality may not have been hereditary in nature at Bridge River during the period prior to 1100 cal. B.P.

La definición y explicación de los orígenes evolutivos de la desigualdad social son problemas fundamentales para la arqueología antropológica. Diferentes investigadores han proporcionado una gama de modelos que enfatizan la variabilidad en los roles de administradores y aggrandizers*, versatilidad ecológica, y de los contextos históricos. Estudios recientes sugieren que la forma de desigualdad emergente pudo haber variado notablemente entre los grupos, lo cual implica que los caminos hacia la desigualdad pudieron haber variado también. Desafortunadamente ha sido difícil probar estos modelos usando datos arqueológicos, debido a que estos requieren detalladas evaluaciones sobre variabilidad espacio-temporal en diferentes clases de datos. Investigaciones recientes en el sitio Bridge River (Columbia Británica) ofrecen la oportunidad de explorar la utilidad de un rango de modelos explicativos asociados a desigualdad social temprana. Los resultados sugieren que la desigualdad, medida como variabilidad significativa en cuanto a acumulación de artículos de lujo, se presentó de forma tardía en Bridge River (1200–1300 AP); y que ésta es asociada a un periodo de concentración demográfica y a una aparente declinación en el acceso a recursos de subsistencia. La evaluación de variabilidad demográfica entre viviendas, acumulación de riquezas y longevidad ocupacional sugieren que los marcadores de afluencia se manifestaron solamente en casas recién establecidas. Una implicación importante es que la desigualdad basada en riqueza material pudo no haber sido hereditaria en el sitio Bridge River durante el periodo anterior a 1100 AP.*

Social inequality evolved in the Middle Fraser (Mid-Fraser) Canyon of British Columbia prior to European contact (Teit 1906). Long before the coming of Europeans, the ancient people of the Mid-Fraser Canyon constructed large villages (or towns) and their chiefs presided over massive households of sometimes 50 or more persons. Archaeological research in the Mid-Fraser villages offers the opportunity to develop and test theoretical models of emergent inequality (Prentiss and Kuijt 2012; Prentiss et al. 2007).

Our research is concerned with the emergence of material wealth-based inequality. By emergence we mean development of a new or previ-

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ously unknown sociocultural configuration manifested on the scale of a village (Prentiss 2009). Inequality accepts that individuals and/or groups seek to accumulate differential material wealth for self-serving reasons, particularly for economic and reproductive advantage (Ames 2008). The concept of wealth can include relational wealth (one's position in social networks) and embodied wealth (biological manifestation of opportunity as in immune function, strength, weight, etc.) (Bowles et al. 2010). Here, we focus on material wealth—things that "store" wealth such as land, food resources, household possessions, and items of adornment or jewelry (Bowles et al. 2010:9).

Material wealth can be acquired through individual or group achievements (Hayden 1995) or it can be inherited arrangements (Ames 2008; e.g., Matson and Coupland 1995). Achievement-based inequality in material wealth is theoretically possible in virtually any ranked society, but inherited wealth is more tricky. Recent comparative ethnography suggests that material wealth is most easily inherited when it occurs in recognizable and defensible packages like field systems, livestock herds, or fishing sites (Mulder et al. 2009). Among hunter-gatherers, these packages commonly include seasonal access to concentrated food resources such as fish or sea mammals (Binford 2001). While ecological heterogeneity may be optimal for such a system to develop and persist, it does not explain the historical process by which inequality develops (e.g., Wiessner 2002). Indeed, there may be quite different pathways to the different forms of inequality depending upon whether one is measuring simple wealth-based inequality or an inherited status system. Here, we offer data that provides information on this process in one case study from the Pacific Northwest.

Recent excavations at the Bridge River housepit village (EeRl4 in the Canadian system) in southern British Columbia (Prentiss et al. 2008) record a complex historical process that led to wealth-based and eventually hereditary inequality. We use evolutionary models to help understand this process, assuming that any evolutionary history includes both deterministic law-like processes but also by incidents of historical contingency (Prentiss 2011). Our initial review explores a range of theoretical approaches to inequality. Then we provide a detailed case study of village growth and socioeconomic and political change at Bridge River. We use a multivariate analysis of indices to measure interhousehold variability in subsistence, material wealth, and population density.

One significant outcome is recognizing that wealth-based inequality evolved here without obvious indicators of inherited status. If material wealth were inherited, we would expect to see greatest wealth developing in the most long-lived and economically and demographically successful houses (e.g., Ames 2006). However, our data suggest greatest wealth accumulations occurred in late houses that were only briefly occupied. This result implies that the evolution of the ethnographically observed form of inequality in the Pacific Northwest may have involved an intermediate step that retained elements of socioeconomic egalitarianism (e.g., no inheritance of material wealth). The simple ability to accumulate wealth may have been a historical prerequisite for a culture of ascribed inequality recognized ethnographically in the region.

Theoretical Views of Emergent Inequality

The evolution of material wealth-based inequality (henceforth, inequality) has been approached from a wide range of theoretical viewpoints, some generalizing and others more particularistic in scope. Processualists have sought general explanations and have emphasized adaptive solutions to such conditions as population growth and information management (Ames 1985; Johnson 1982), ecological variability, population packing, territoriality and access to nonlocal goods (Kelly 1991), and resource heterogeneity, population packing, and labor management (Binford 2001). Models favoring socioeconomic and political advantage of controlling resource hot-spots have been popular in the Pacific Northwest (Coupland 1988; Matson 1983, 1989; Matson and Coupland 1995).

Another school of thought implicates personality type as a general force in emergent inequality (Hayden 1994, 1995, 1998; Maschner and Patton 1996). To Clark and Blake (1994), it is the competition between self-promoters (aggrandizers) for prestige that is most critical to building cadres of followers, intensifying production, expanding social networks, and increasing numbers of marriages and children. Arnold (1993) favors a similar scenario but implicates adverse conditions as optimal for development of institutionalized inequality.

Human behavioral ecologists have also offered a range of general models. Smith and Choi (2007) recast population growth and information management as managerial mutualism. Boone (1992; see also Henrich and Gil-White 2001) suggests that patron-client relationships develop under conditions of differential access to critical resources. Mulder et al. (2009) and E.A. Smith et al. (2010), drawing from cross-cultural ethnographic data, agree that control of optimal resource patches must be significant to the emergence of inequality. Kennett et al. (2009) offer a mathematically sophisticated retake on economic and political payoffs of controlling the best resource patches.

A number of general models have also been offered by evolutionary anthropologists (e.g., Richerson and Boyd 1999, 2005; Richerson et al. 2003). Henrich and Gil-While (2001) favor a general social learning model in which inequality develops from the cultural transmission process (e.g., people imitate those who are most successful and in essence become their clientele; the most successful persons compete for such groups of followers). Costly signaling theorists (e.g., Bird et al. 2001; Boone 1998; Gurven et al. 2000) provide general models of the competitive process. Boone (1998) argues that the competitive signaling via altruism with food (e.g., feasting) should most readily occur under conditions whereby competition for access to food within the group is severe, establishing cooperating groups (as in for territory defense) offers significant payoffs, and that there is some long-term fitness payoff for altruists as might occur during periods of anticipated resource short-fall.

Not all scholars have favored generalizing explanations. Political economists and social theorists recognize that historical contingency plays a significant role in the development of social institutions, particularly when considered in the context of the intended and unintended outcomes of actions taken by individuals and groups (e.g., Bender 1985; Pauketat 2007; Saitta 1997; Sassaman 2011). This perspective is also appropriate to a Darwinian evolutionary theory that promotes evolutionary explanations as historical narratives incorporating general processes like natural selection and the effects of historically contingent events (e.g., Mayr 1982).

Cultural macroevolutionists (Prentiss et al. 2009) use the concept of exaptation to describe a situation where a trait that evolves for one reason (whether adaptive or not) is later co-opted for some other use, for example, spandrels in gothic churches (Gould and Vrba 1982; Gould and Lewontin 1979). With its emphasis on unintended outcomes the concept of exaptation may also help explain the origin of inequality as an adaptive strategy that does not directly benefit most users.

Rosenberg (2009) explains the development of coercive social inequality as the consequence of elected leaders taking on coercive roles in conflict resolution. Inequality becomes institutionalized when such social systems are extrapolated (e.g., Spencer 1997) on to other groups in new areas leading to greater distinctions in power and potential differential access to resources by the original delegated leader and immediate followers. Prentiss (2011) addresses first development of non-equals in a different way suggesting that inequality is incipiently coded into some otherwise egalitarian living arrangements. For example, house size evolves to solve problems to do with labor management, kin relations, and defense, but once house-size inequality is present it can come to represent differences in social standing and evolve further in that direction under altered socioeconomic conditions. Such a scenario, whereby a built environment designed to solve one problem is instrumental in triggering new concepts including institutionalized inequality, could apply to ideology and monument construction.

Although not originally couched in evolutionary terms, Sassaman and Heckenberger (2004) outline a scenario whereby anthropogenic landscapes of earthen mounds were created to celebrate or reify new socio-religious beliefs but eventually came to provide the blueprint for a new society featuring inequality. Theoretically, the concept of dualities (sacred and profane, earth and sky) evolved first and was later co-opted to frame relationships between human groups (e.g., nonelite and elite as manifestations of earth and sky [e.g., Marcus and Flannery 1996]).

Other models of emergent inequality can be reworked in evolutionary terms employing exapta-

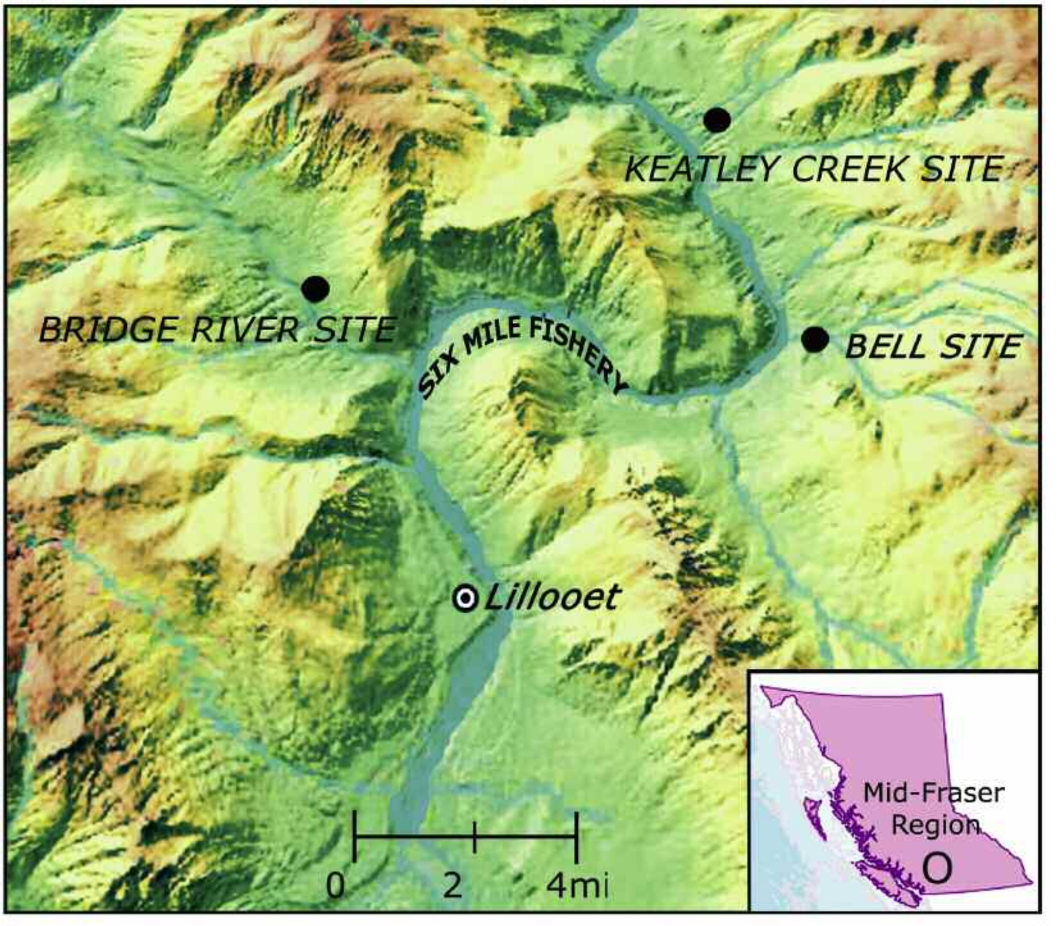

Figure 1. The Middle Fraser Canyon in context with key sites.

tion. Clark and Blake's (1994) model is a particularly good fit since it asserts that institutionalized inequality in human societies is an unexpected outcome of competition between individuals. This interesting scenario implies that social rules for structuring inequality come about as a by-product of struggles for wealth, influence, and reproductive success by individuals within emerging transegalitarian communities. Under many scenarios this process would develop under more adverse resource conditions implying fitness reductions during the transition period (e.g., Arnold 1993). This presents the possibility that inequality could come about in a maladaptive or at best, non-aptive (per Gould and Vrba 1982) process. Once stabilized it could conceivably have group beneficial effects (e.g., Henrich and Boyd 2008), for example, if it permitted one group to better organize economically and/or militarily against neighbors (e.g., Oliver 1962). Initial appearance through a competition for prestige, mates, and resources followed by further evolution under say group selection for military advantage implies an exaptive process.

The Bridge River Site and Mid-Fraser Archaeology

The Middle Fraser (Mid-Fraser) Canyon of British Columbia (Figure 1) contains a number of large and well-preserved winter villages that provide abundant evidence for an *in situ* development of wealth-based inequality during the past 2,000 years (Prentiss and Kuijt 2012). The major sites include Keatley Creek, Bridge River, Bell, Seton Lake, McKay Creek, and Kelly Lake

(Morin et al. 2008/2009). The most extensive excavations have been conducted at Bridge River (Prentiss et al. 2008), Keatley Creek (Hayden 1994, 1997a, 1997b, 1998, 2000a, 2005; Hayden et al. 1996; Hayden and Mathewes 2009; Hayden and Schulting 1997; Prentiss et al. 2003; Prentiss et al. 2005; Prentiss et al. 2007), and Bell (Stryd 1973), located near the rich 6-Mile salmon fishery (Figure 1). This work provides a platform for further developing ideas about processes of emergent inequality.

Keatley Creek

Our dating sequence at the large village of Keatley Creek suggested a primary occupational history spanning ca. 1700–900 cal. B.P. (Prentiss et al. 2003; Prentiss et al. 2005). We argued that *material-wealth based ranking* did not characterize interhousehold relationships at the village until immediately prior to abandonment (Prentiss et al. 2007; Prentiss et al. 2011). We also argued that *hereditary inequality* may have also been present at Keatley Creek during the latter time frame (Prentiss et al. 2007). Kuijt (2001) and Kuijt and Prentiss (2004) highlighted regional ecological changes and population growth as contributing factors in the development of inequality and subsequent village abandonments after ca. 1200–1300 cal. B.P. Prentiss et al. (2007; see also Prentiss 2009, 2011) hypothesized that inequality may have emerged at Keatley Creek through a competitive process to attract new members into demographically stressed households under increasingly harsh foraging conditions.

Bridge River

The Bridge River site is one of the largest villages in the Mid-Fraser area (Figure 2) consisting of approximately 80 housepits and numerous external pit features that include roasting ovens and cache pits (Prentiss et al. 2008). The occupational history of Bridge River is similar to nearby Keatley Creek. Earliest housepit occupations occurred at ca. 1800 cal. B.P. followed by steady growth in housepit numbers from the initial occupational period (Period BR 1, ca. 1600–1800 cal. B.P.), through the second period (Period BR 2, ca. 1600–1300 cal. B.P.). Village size peaked at ca. 1300–1100 cal. B.P. during a third occupational period (Period BR 3) (Figure 3). The village was subsequently abandoned and then reoccupied after about 500–600 cal. B.P. during the fourth period (Period BR 4).

During the BR 2 and 3 periods housepit groups were arranged in arcuate patterns that became particularly distinct during BR 3 times (Figure 3) (Prentiss et al. 2008). The exact meaning and cultural implications of the arcuate and ring-shaped patterns are still being considered, but we know that similar ring-like arrangements of housepits are present in other village sites, including Bell and Kelly Creek (Sheppard and Muir 2010). It seems likely that these could reflect occupations by distinct social groups like lineages and clans as are known from the ethnographic period (Teit 1906). They do not necessarily imply formal interhousehold or inter-individual ranking.

Radiocarbon evidence does tell us that there was substantial growth in the Bridge River village between ca. 1800 and 1100 cal. B.P. Indeed, plotting of cumulative probability distributions of radiocarbon dates from Bridge River households (91 dates; see Prentiss et al. 2008; Prentiss et al. 2010) and external cooking features (13 dates; see Prentiss et al. 2004) using the CalPal calibration program and the CalPal-Hulu 2007 calibration data (Weninger and Jöris 2003; Weninger et al. 2010) demonstrate that the Bridge River village developed in a punctuated fashion with brief plateaus during the periods we identify as BR 1, 2, and 3 (Figure 4). BR 3 may have been characterized by a potential doubling of the population that was short lived as the village was largely abandoned by ca. 1100 cal. B.P. An interesting implication here is that normal practices for curtailing excess population growth (e.g., Hayden 1981) could have been relaxed under very good economic conditions as was evidently the case at ca. 1300–1400 cal. B.P. Interestingly, external cooking ovens first appear in BR 3 times and reappear during BR 4.

Zooarchaeological research conducted to date suggests two major trends. First, frequency of salmon remains decline in most houses between BR 2 and 3 times suggesting the possibility of declining access to this critical food resource (Carlson 2010; Smith, Prentiss, Lepofsky, Carlson, and Endo 2010; Ward 2011). This is very similar to what Prentiss et al. (2007) recognized at Keatley Creek at similar dates. Independent paleoe-

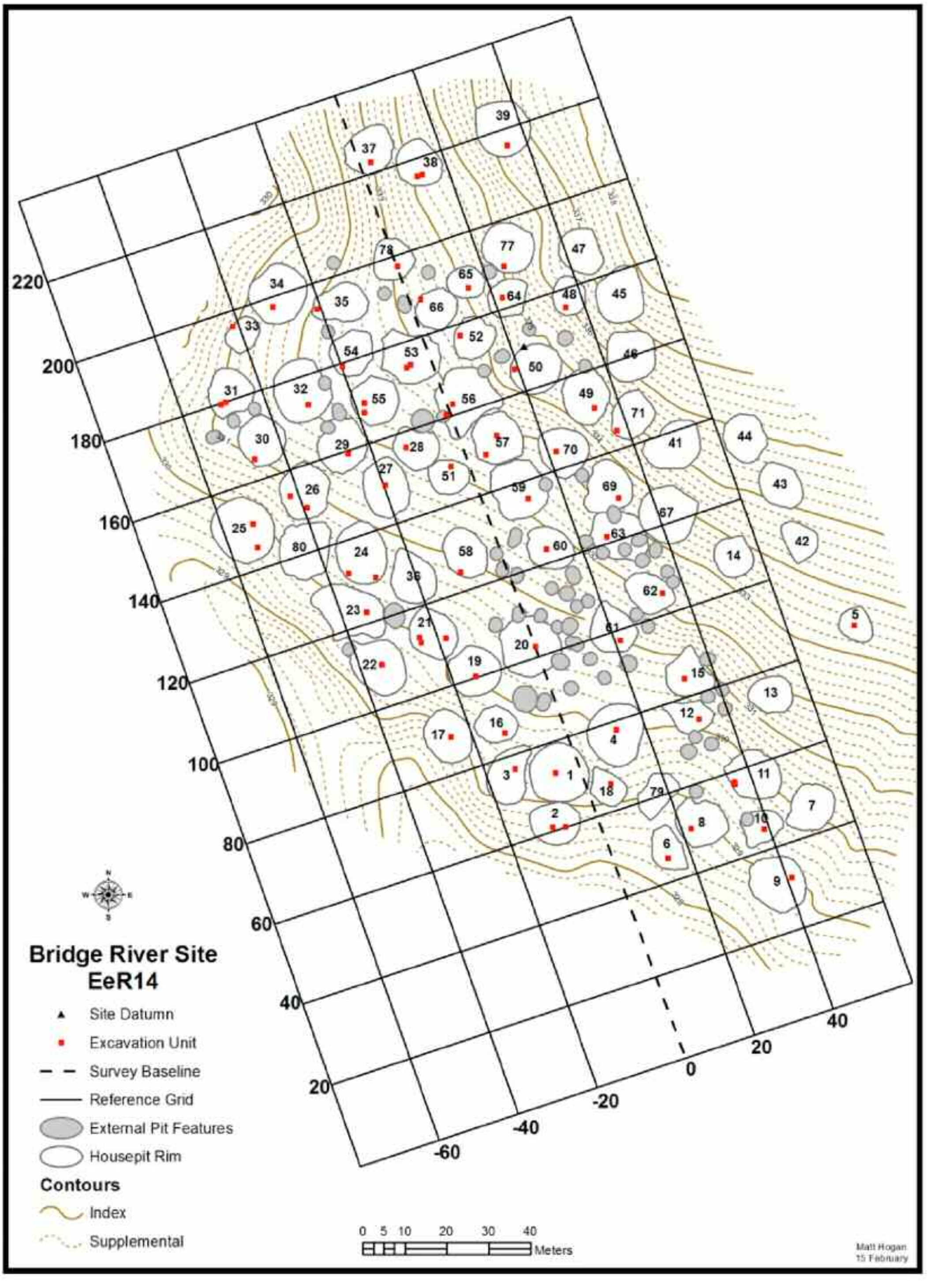

Figure 2. Bridge River site map illustrating site grid, generalized contours, housepits, external pit features (EPFs), and test excavation units from initial testing in 2003–2004 (Prentiss et al. 2008). EPFs are only in approximate positions and multiple EPFs west of Housepit 25 were unfortunately not included in the GIS map.

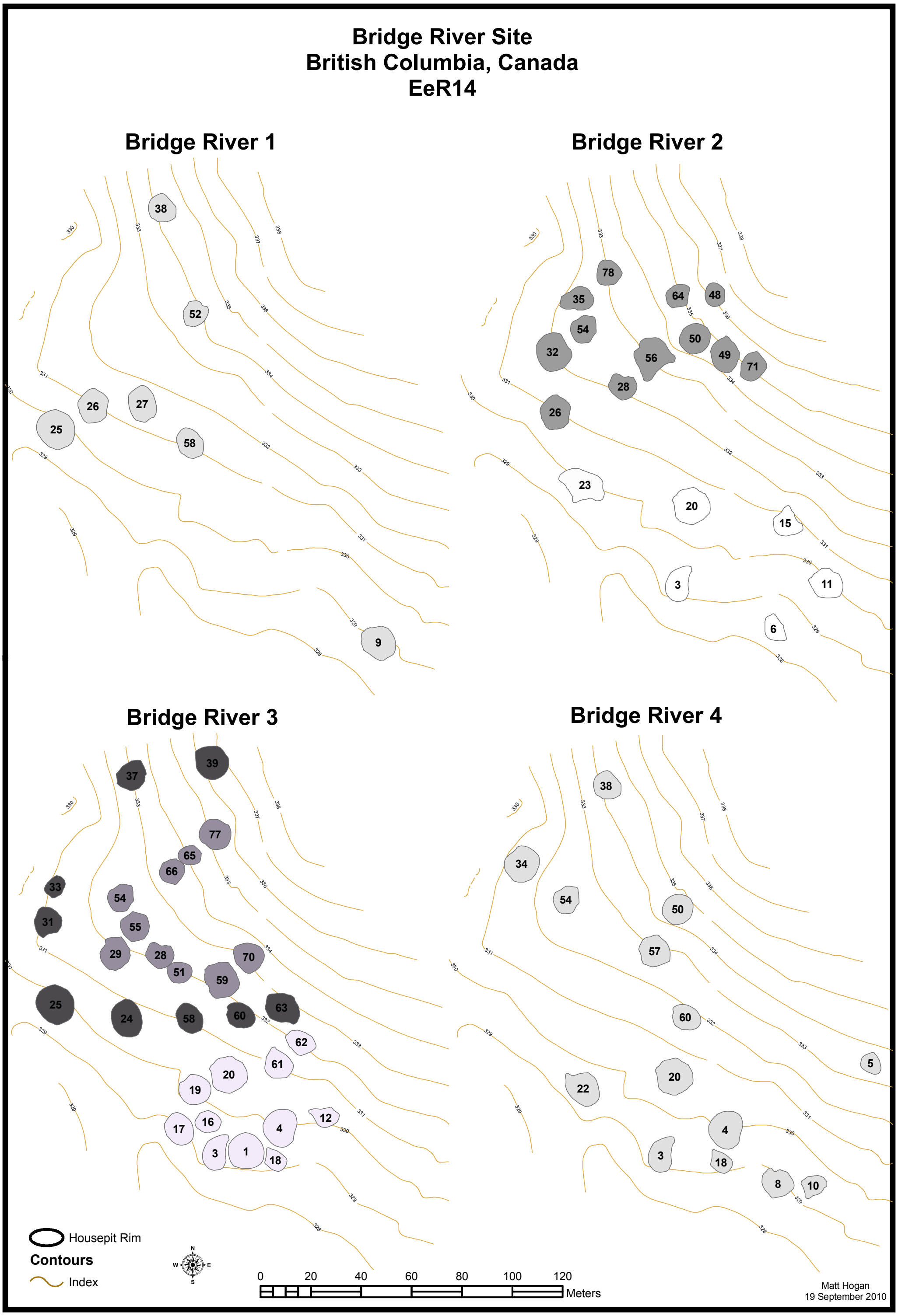

Figure 3. Map of occupation patterns at the Bridge River site including updates from Prentiss et al. (2008) based upon radiocarbon dating results of 2008–2009 field investigations (Table 3). Note in particular addition of Housepit 20 to BR 2, Housepit 25 to BR 3 and Housepit 54 to BR 4.

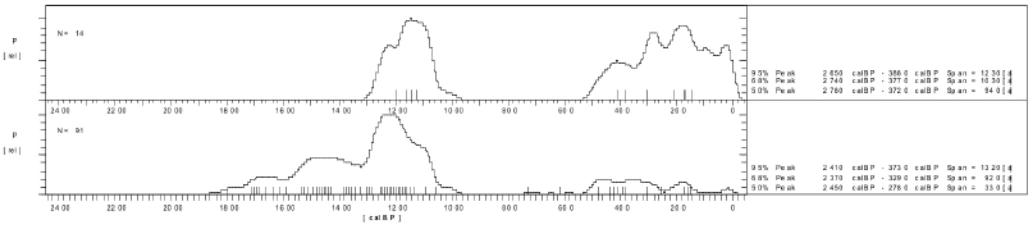

Figure 4. Cumulative probability distributions for all housepit (lower) and external pit feature (upper) radiocarbon dates.

cological research suggests that declining salmon in the eastern Pacific during the Medieval Warm period (ca. 1200–700 cal. B.P.) was a consequence of natural processes operating beyond human control (e.g., Chatters et al. 1995; Finney et al. 2002; Patterson et al. 2005). Second, deer remains shift in nearly all houses from a pattern of largely complete skeletal representation to a pattern dominated by lower limbs (Carlson 2010; Ward 2011), also similar to patterns recognized at Keatley Creek for these dates and considered to be a likely consequence of intense local predation and resource depression (Prentiss et al. 2007). Normally this kind of change in foraging practice implies a local population facing reduced local access to its critical food sources, in this case salmon and deer (e.g., Broughton 1994). Further work is required to fully understand change in plant harvesting practices.

All told, it would appear that the Bridge River village grew significantly, developed geometric arrangements of houses, and eventually suffered some forms of subsistence stress between 1800 and 1100 cal. B.P. The history of nearby Keatley Creek (Prentiss et al. 2007) implies the possibility of social evolution favoring expanding material wealth-based inequality during this time. But we cannot consider this without further analysis of inter-household variability in wealth/status markers.

Inequality at Bridge River

The 2007–2009 excavations at Bridge River were designed to develop data permitting us to assess the evolution of inequality in BR 2 and 3 households (excavation details are outlined in Prentiss et al. 2010). Briefly our approach was to use geophysical methods (Cross 2004, 2005, 2010; Prentiss et al. 2008; Prentiss et al. 2010) to identify domestic activity areas (places where families conducted household work associated with artifact manufacture and use, cooking, and food storage) in a sample of BR 2 and 3 houses of different sizes from northern and southern areas of the village (Figure 5–7; Table 1). Excavations in these areas were highly successful and typically resulted in identification of complex stratified sequences of buried floors (often with domestic activity areas include cache pits filled with refuse). Stratified floor/roof sequences (Figures 8–10) were highly variable and ranged from very thin single floors (Housepits 24 and 25) to stratified floor sequences (Housepits 11, 16, 20, 54), some interspersed with buried roof deposits (Housepits 16, 20, and 54). While only a limited sample of houses was investigated, we are satisfied that the range of contexts identified with aid of geophysical reconnaissance yielded sufficient data for an initial examination of the timing and process of emergent inequality at Bridge River.

Ethnographic Framework

Ethnographies provide substantial detail regarding inequality in traditional societies in the Mid-Fraser area (Kennedy and Bouchard 1977, 1978, 1998; Teit 1900, 1906). Archaeologists have drawn from these records to develop ethnoarchaeological frames of reference for interpreting the archaeological record (Alexander 1992, 2000; Prentiss 2000; Prentiss and Kuijt 2012). In brief, traditional villages occupied by *St'át'imc* (Upper Lillooet) and other ethnographic groups functioned economically as classic collectors (per Binford 1980) harvesting salmon, deer, roots, and other items for winter survival and use in sociopolitical ventures. *St'át'imc* villages were organized socially using a system of inherited and achieved statuses. Hereditary chiefs were the

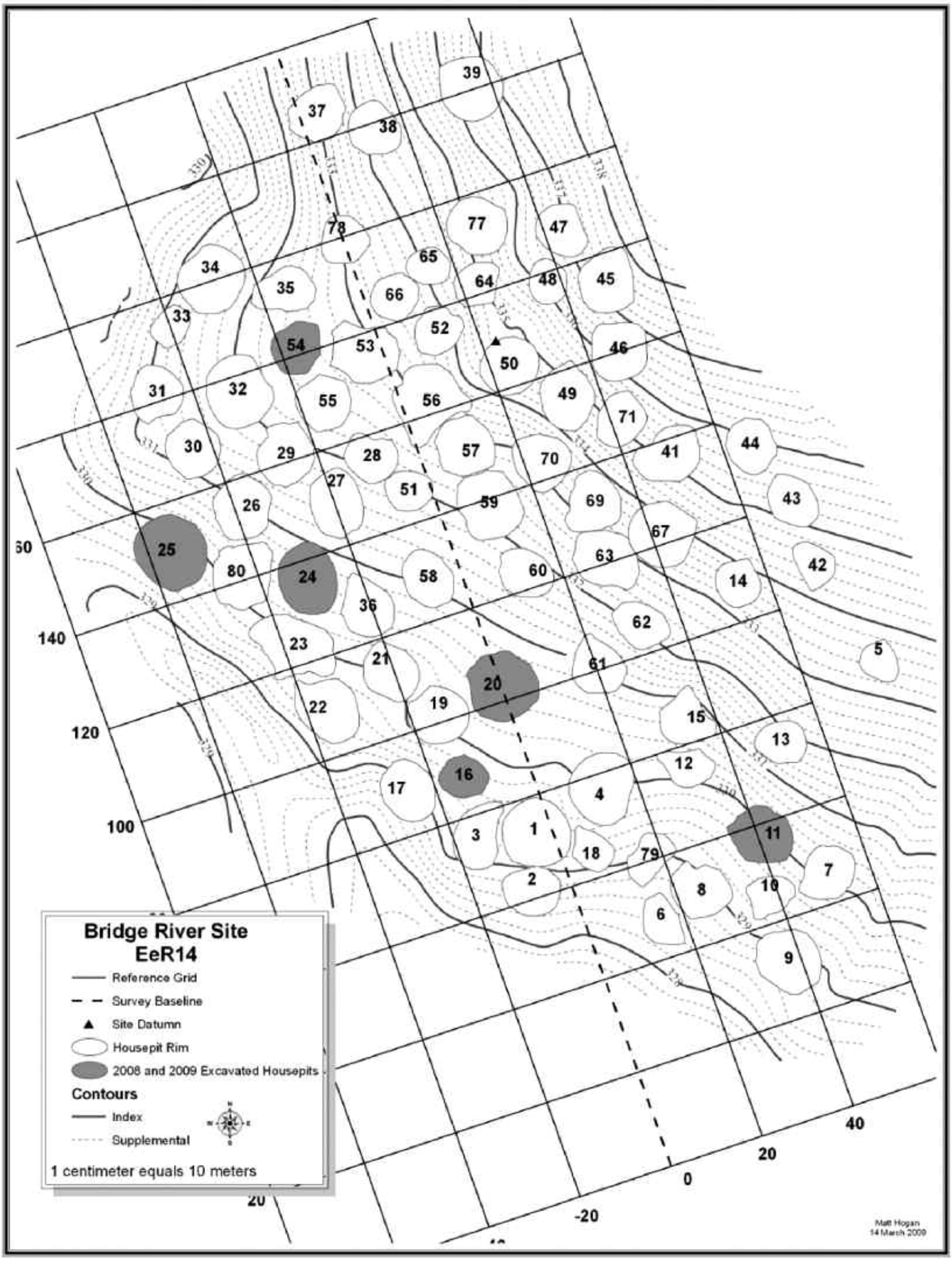

Figure 5. Bridge River site highlighting housepits excavated in 2008–2009 field seasons.

heads of descent groups, termed "clans" by Teit (1906), which could make up an entire village or could be dispersed over multiple villages (Kennedy and Bouchard 1978). Achieved status chiefs served such roles as war chief, hunt chief, etc. Elite (hereditary and achieved) families owned critical fishing rocks and likely controlled access to other segments of the landscape like

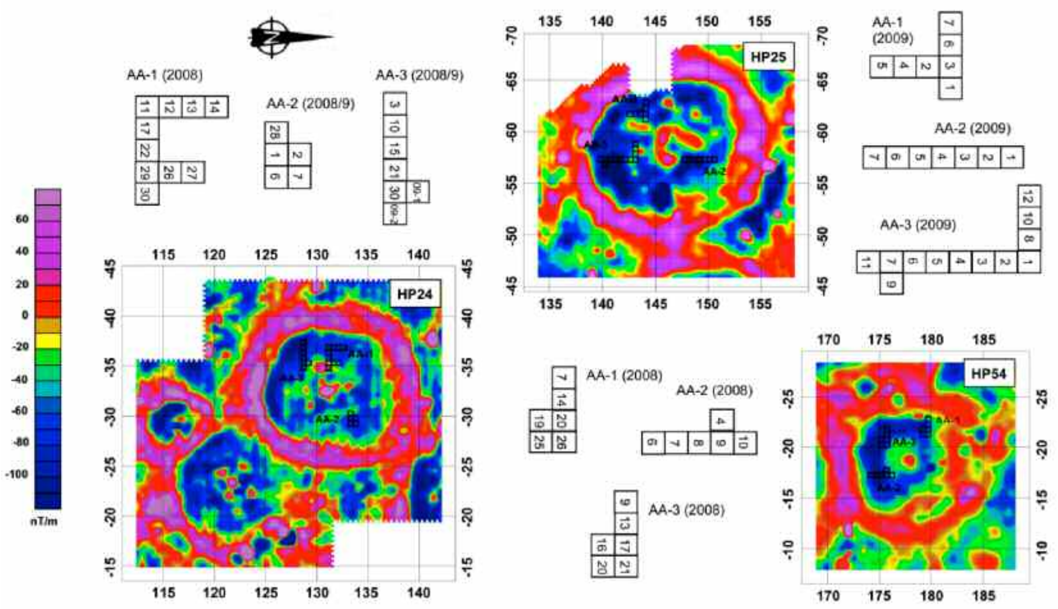

Figure 6. Surface measured vertical magnetic gradient for northern "neighborhood" pithouses. Indicated gradients levels are approximate and based on interpolation/extrapolation from discrete measurements at .5 m x .5 m intervals. Approximate distribution and designation of investigated excavation units are as indicated. Depression directly south of Housepit 24 is External Pit Feature (EPF) 13, a BR 3 roasting oven (Dietz 2004). Depression to the northeast of Housepit 25 is another large EPF, though not excavated.

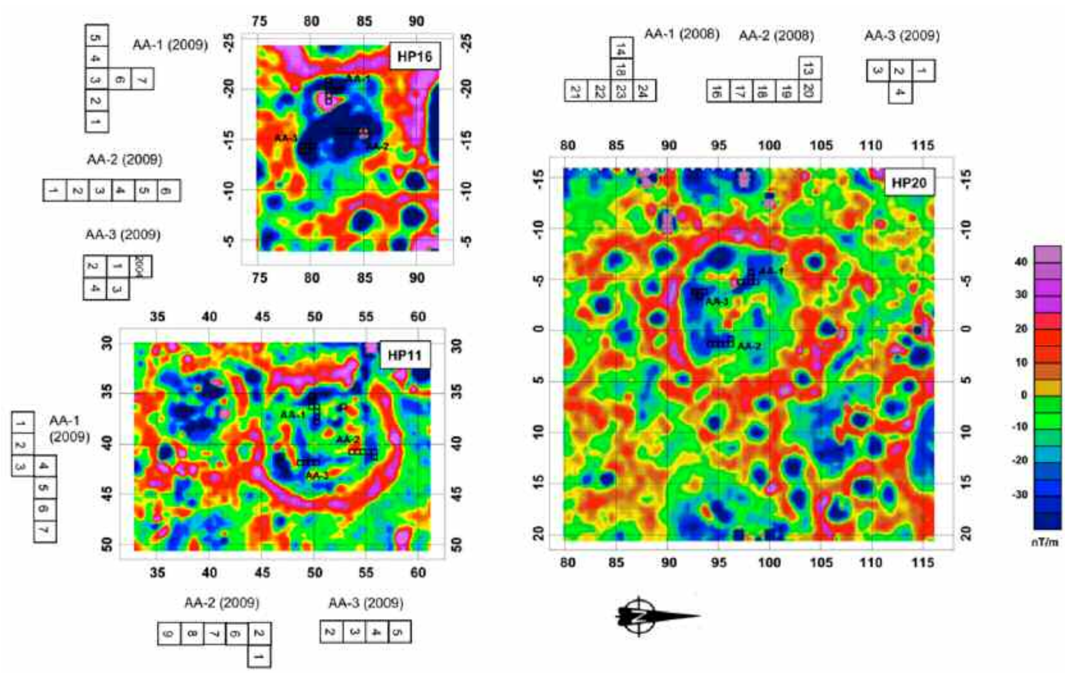

Figure 7. Surface measured vertical magnetic gradient for southern neighborhood pithouses. Indicated gradients levels are approximate and based on interpolation/extrapolation from discrete measurements at .5 m x .5 m intervals. Approximate distribution and designation of investigated excavation units are as indicated.

Table 1. Excavated Housepit Components at Bridge River During 2008 and 2009.

Housepit	Occupation (Bridge River 1-4)	Neighborhood (North, South)	House Size (Medium, Large)
11	2, 4	South	Medium
16	3	South	Medium
20	2, 3, 4	South	Large
24	3	North	Large
25	1, 3	North	Large
54	2, 3, 4	North	Medium

Note: Medium 10-14.99 m. maximum diameter across rim crests; larger 15+ m. maximum diameter across rim crests.

deer hunting locales and lithic quarries (e.g., Morice 1893).

Much as described by Ames (2006) for the Northwest Coast, families sought to preserve stable households socioeconomically through household production activities and exchange partnerships. Solid household economies and good leadership could translate into effective political ventures including hosting of public ceremonies like potlatches or "scrambles" (Kennedy and Bouchard 1978). Well-functioning households were also in a better position to attract new members (whether by marriage, adoption, or establishment of patron-client relationships) as a means of preventing demographic loss.

Our challenge as archaeologists is to develop a better understanding of how these traditions varied in the past, how they evolved, and how they are reflected in material culture. The Bridge River site provides an ideal opportunity to pursue these goals. In order to accomplish this we need to create measures that replicate key elements of past organization. Drawing from ethnographic information it is clear that elite households could be successful if they maintained control of certain resource procurement localities permitting them to

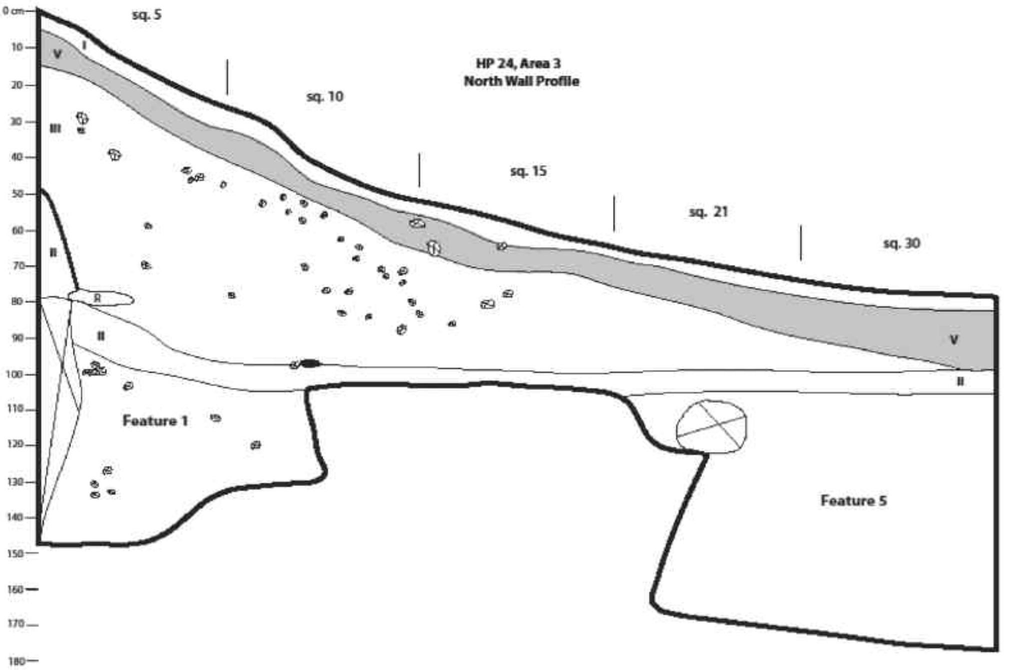

Figure 8. Housepit 24 Area 3 stratigraphic profile illustrating thin single BR 3 floor (Stratum II) capped by roof/rim and roof deposits (Strata III and V). Features 1 and 5 are cache pits containing among other things remains of two butchered domestic dogs.

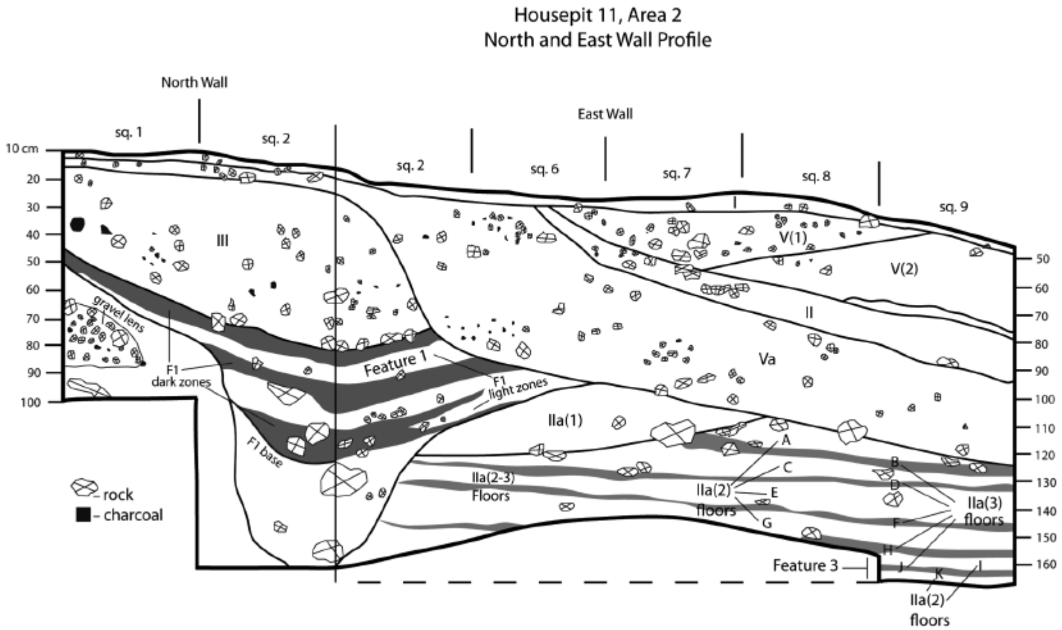

Figure 9. Housepit 11 Area 2 stratigraphic profile illustrating multiple BR 2 floors (Strata IIA sequence) capped by a single roof (Stratum Va) and subsequent BR 4 floor (Stratum II) and roof deposit (Stratum V). Note Feature 1 cache pit capped by three episodes of hearth construction.

produce excess quantities of goods for winter subsistence, exchange, and potlatching. While salmon was the core food resource, mammals were highly sought after to relieve the monotony of dried fish but also as a feasting item. Favored mammals included deer and other ungulates, but apparently could also include dogs on some occasions (e.g., Prentiss et al. 2003). Establishment of positive relationships between village groups could result in access to a variety of nonlocal goods such as rare lithic raw materials, artifacts, and foods. These in turn could be used to signify household and individual status (Teit 1906). Households needed to maintain enough members to facilitate the labor needed during critical food harvesting and processing seasons (e.g., during the late summer sockeye salmon run) but also to produce goods for give-away in potlatches or exchange contexts. Thus, there was a systemic relationship between household demographics, subsistence and goods production activities, and political ventures bringing in new goods signaling status.

If this social framework was operating in the past we should be able to measure archaeological variability in these dimensions that should correlate with one another in predictable ways. All things being equal, we could expect that if the ethnographic pattern (e.g., Teit 1906) is correct then markers for access to the most sought after foods (e.g., mammals) should correlate with indicators of other material wealth (rare or prestigious lithic raw materials and artifacts). Indices of highly sought foods and material wealth should correlate with population density and ability to house large numbers of persons (e.g., housepit size). Elite households should generate highest scores on all of these items while poorer houses would likely score lower.

Measuring Variability in Subsistence, Material Wealth, and Relative Population Density

We employed a number of indices to measure variation in subsistence, material wealth, and relative demographics (Tables 2 and 3). Subsistence variability was measured directly with a mammal index much like that of Broughton (1994) whereby total NISP taxonomically identifiable mammalian elements per housepit component were divided by the sum of total NISP mammals and NISP fish (again relying only upon specimens to which a genus level taxon could be identified). This index allows us to gain insight into access to

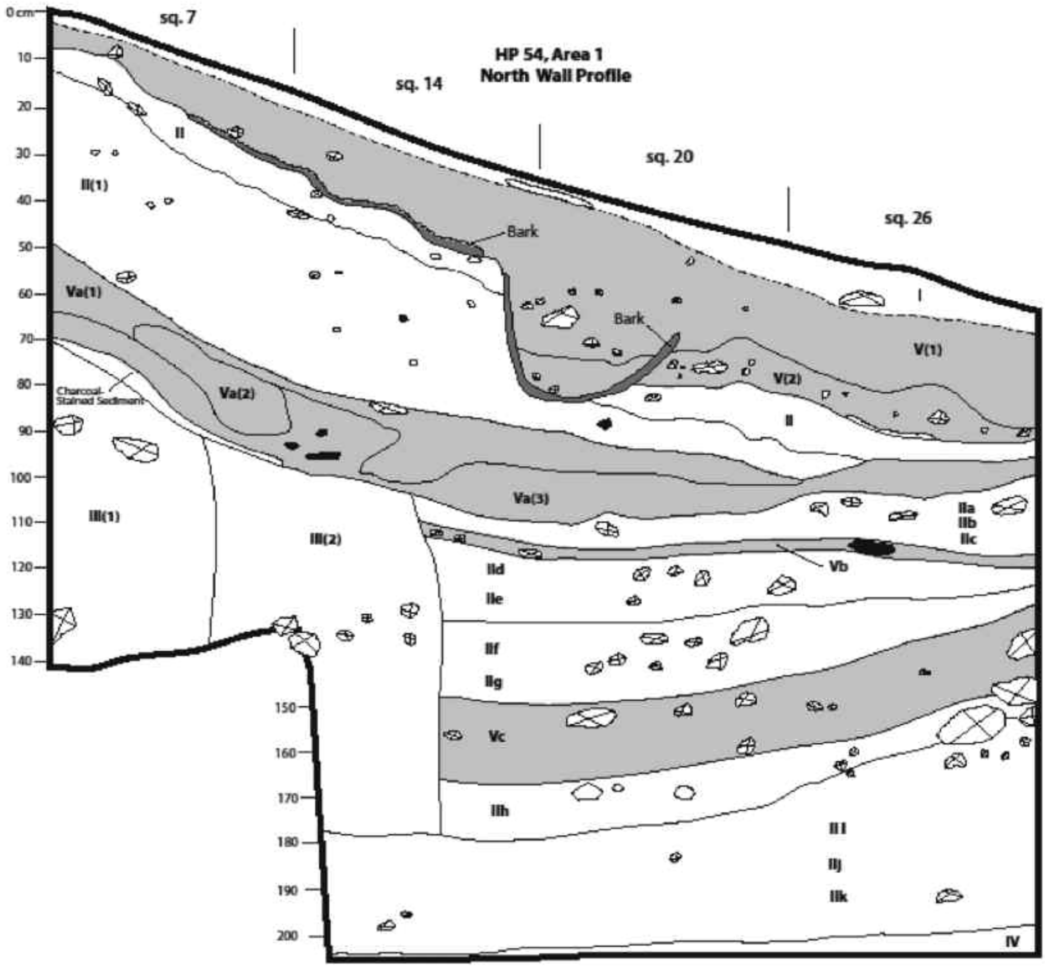

Figure 10. Housepit 54 Area 1 stratigraphic profile illustrating multiple BR 2, 3 and 4 floors (Stratum II sequence) and roofs (Stratum V sequence).

mammals in comparison to the dominant food source, salmon. Subsistence was also measured in a secondary way using a biface index whereby total formed bifaces per housepit component were divided by bifaces plus other chipped stone tools. Data from this index correlated strongly with mammal index patterns in studies at Keatley Creek where higher proportions of bifaces (compared in relation to all lithic tools) paralleled accumulation of mammalian remains (as a ratio to all faunal remains), implying greater engagement in hunting activities (Prentiss et al. 2007).

Variability in material wealth was measured in several ways in an attempt to capture different facets of prestige economies (e.g., Hayden 1998). We developed two measures of prestige items drawing from previous research by Hayden (1998, 2000b) at Keatley Creek. The prestige items index is a count of prestige items per cubic meter excavated sediment per housepit component where prestige items consist primarily of display items such as groundstone pipes, beads, pendants, vessels, and effigy-statuettes. Differing from Hayden (2000b), we exclude bifacial knives and other chipped stone items as too ambiguous even if they could have been used in ceremonies or in manufacture of prestige goods. We also measured prestige raw materials as the count of lithic artifacts (including debitage) made from prestige raw materials per cubic meter excavated sediment in each housepit component. Prestige raw materials are defined per Hayden (1998,

Table 2. Raw Count Data Used to Construct Indices (see Table 3).

Component	Prest. Items	N-L RM	Prest. RM	Bifaces Total tools	M/ M+F	CP/ sq.cm[a]	FCR	Exc. Cubic Meters
HP25/3	5	105	9	11/172	73/464		1756	2.34
HP 24/3	40	173	29	27/265	101/388	833/55	3933	1.87
HP 20/3	6	12	6	6/127	26/201	447/40	2972	1.76
HP 54/3	4	97	38	48/294	35/274	641/42.5	2179	2.5
HP 16/3	3	26	7	11/277	18/1201	704/42.5	4078	1.82
HP 20/2	7	17	14	21/200	103/1754	927/40	2340	.88
HP 54/2		10		4/33	15/163	27/22.5	411	.7
HP11/2	10	29	16	22/210	70/942	638/43	3219	2.77

[a]thousands.

Note: Prest. = Prestige; N-L = Non-Local; RM = Raw Material; CP = Cache pit volume in cm^3; sq. cm = square centimeters excavated; M = Mammal NISP for taxonomically identifiable elements; F = Fish NISP for taxonomically identifiable elements; FCR = Fire-Cracked Rock; sq. cm. = square centimeters; Exc. = Excavated.

Table 3. Data Measuring Variability in Material Wealth and Relative Population Density.

Housepit/ Component	Max. Diam.	Prest. Items	N-L RM	Prest. RM	Biface Index	Mam. Index	CP Vol.	FCR Index
HP25/3	17.3	2.1	44.9	3.8	.06	.16		751
HP 24/3	15.1	21.4	92.5	15.7	.1	.26	15.2	2103
HP 20/3	16.6	3.4	6.8	3.4	.05	.12	11.17	1689
HP 54/3	12.2	1.6	38.8	15.2	.16	.13	15.1	872
HP 16/3	13.4	1.7	14.3	3.9	.04	.01	16.56	2247
HP 20/2	16.6	8.	19.3	15.9	.11	.06	23.17	2659
HP 54/2	12.2		15.2		.12	.09	1.2	555
HP11/2	13.9	3.6	10.5	5.8	.1	.07	15.	1162

Note: Prest. = Prestige; N-L = Non-Local; RM = Raw Material; CP = Cache pit; Mam. = Mammal; FCR = Fire-Cracked Rock.

2000b) as those raw materials recognized ethnographically to have special value for performance characteristics but also other factors (e.g., color, luster, etc.). For purposes of our analysis we include copper, obsidian, nephrite, and steatite.[1] Another potential measure of wealth could be access to lithic raw material that is highly useful in manufacturing chipped stone tools but that do not occur in the Bridge River valley or immediately adjacent mountains. There are many lithic raw material types present in the Bridge River site lithic assemblages, but very few can be confidently associated with extralocal sources requiring trade, travel to other valleys, and in some cases probably some kind of sociopolitical or economic agreements with neighboring village groups. Three of these are obsidian, Fountain Valley pisolite, and Hat Creek jasper (Hayden et al. 1996). Our final wealth measure is the count of these three raw material types per cubic meter of each excavated housepit component.

We employ three indirect measures of relative housepit demographics (numbers and densities of persons per house). Housepit diameter (measured as maximum diameter between rim crests) has often been considered to be a good marker of demographics assuming that the larger the house the greater number of inhabitants (Binford 1990). Indeed, large houses are routinely assumed to not only reflect highest numbers of inhabitants but generally, highest status in Mid-Fraser archaeology (Sheppard and Muir 2010). Measuring density of persons per housepit is probably impossible for archaeologists but we can gain some idea of potential variability in relative density using two additional measures. We developed a cache pit index consisting of excavated cache pit volume (cubic cm) per square meter of excavated floor as a crude measure of storage capacity assuming greater storage capacity reflects greater numbers of consumers. Performance of this index could be adversely af-

Table 4. Correlation Matrix with Associated Significance Matrix Employed in PCA Analysis of Prestige, Predation and Food Storage/Preparation.

		Prestige Items	Non-Local Raw Mats.	Prestige Raw Mats.	Biface	Mammal	Cache Pit	FCR
Correlation	Prestige Items	1.000	.799	.636	.068	.697	.380	.529
	Non-Local Raw Mats.	.799	1.000	.560	.205	.877	-.015	.084
	Prestige Raw Mats.	.636	.560	1.000	.540	.379	.695	.471
	Biface	.068	.205	.540	1.000	.185	.152	-.314
	Mammal	.697	.877	.379	.185	1.000	-.238	-.141
	Cache Pit	.380	-.015	.695	.152	-.238	1.000	.798
	FCR	.529	.084	.471	-.314	-.141	.798	1.000
Sig. (1-tailed)	Prestige Items		.009	.045	.436	.027	.177	.089
	Non-Local Raw Materials	.009		.074	.313	.002	.486	.422
	Prestige Raw Materials	.045	.074		.084	.177	.028	.119
	Biface	.436	.313	.084		.330	.360	.225
	Mammal	.027	.002	.177	.330		.285	.370
	Cache Pit	.177	.486	.028	.360	.285		.009
	FCR	.089	.422	.119	.225	.370	.009	

Note: FCR = Fire-Cracked Rock Index.

fected by a number of variables. Sampling is one possibility since we did not excavate entire floors. Another scenario is surplus production; if cache pit volume reflects production for exchange along with winter subsistence then it cannot be a direct indicator of variability in density of household consumers. A final scenario concerns actual storage tactics. For example, a small house with a premium on floor space could have chosen to store some food in baskets on racks or in household rafters. Thus, it is important to also measure variability in numbers of potential consumers in a different way. To do this we developed a fire-cracked rock (FCR) index consisting of FCR count (including only pebble and more rare cobble sized clasts [Wentworth scale]) per cubic meter of excavated sediment in each housepit component. All things being equal, variability in FCR output should reflect cooking frequency and this should be most strongly affected by number of occupants per house and average length of winter seasons. We can hold the latter constant when comparing simultaneously occupied houses since all would have been affected to a similar degree by persistence of winter weather preventing advent of spring time mobility. If we achieve a strong positive correlation between FCR and cache pit volume we can interpret these measures as good relative indicators of variability in housepit occupation density.

Data Analysis

Prior to multivariate statistical analysis we assessed the performance of the variables by looking for significant inter-correlations assuming that if any variable failed to produce at least one then it was probably not relevant for further multivariate analysis. We rejected housepit diameter on these grounds. Given its failure to significantly correlate with subsistence, wealth, or demographic variables, housepit diameter is probably not a reliable measure of variability in household status at Bridge River.

We employed principal components analysis (PCA) to better understand variability in predation, wealth, and demography between house components. The PCA was based upon a correlation matrix (Table 4) and generated a very robust solution with the first three components capturing over 95 percent of the variance (Table 5). The three component solution was rotated using the Varimax method (Table 6). Factor scores were captured for each component and case (Table 7).

Component one has rotated component scores on prestige objects, nonlocal raw materials, prestige raw materials, and mammals near or above .5 in the positive dimension suggesting that component one is measuring variability in accumulation of different forms of material wealth. Factor scores indicate that Housepit 24 (BR 3) contributes very strongly to this component followed

Table 5. Initial PCA Statistics.

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings	
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance
1	3.350	47.854	47.854	3.350	47.854	47.854	2.763	39.469
2	2.079	29.699	77.553	2.079	29.699	77.553	2.482	35.459
3	1.274	18.203	95.756	1.274	18.203	95.756	1.458	20.827
4	.139	1.984	97.739					
5	.095	1.353	99.092					
6	.055	.779	99.871					
7	.009	.129	100.000					

to a much lesser degree by Housepit 25 (BR 3) and then the others. Component two loads most strongly on cache pit volume and FCR followed by prestige raw materials and prestige objects. This component is likely identifying variability in density of persons per housepit and this appears to have some positive effect on ability to collect some kinds of prestige goods. Cache pit volume only correlates significantly with prestige raw materials and FCR (Table 5). Housepit 20 (BR 2) contributes most strongly in the positive dimension to this component, followed by Housepits 16 (BR 3) and 24 (BR 3). Component three is less easy to interpret given its loadings on bifaces and prestige raw materials and its comparatively low variance. Housepit 54 (BR 3) is the only significant contributor in the positive dimension.

Table 6. Rotated Component Matrix.

Component Index	1	2	3
Prestige Items	.841	.047	-.017
Non-Local Raw Materials	.959	.047	.14
Prestige raw Materials	.456	.646	.571
Biface	.085	-.044	.981
Mammal	.951	-.197	.108
Cache Pit	-.09	.956	.217
Fire-Cracked Rock	.087	.937	-.3

Table 7. Factor Scores.

House/ Occupation	Component 1	Component 2	Component 3
25/3	.537	-1.29	-.712
24/3	2.249	.589	-.08
20/3	-.267	-.043	-1.018
54/3	-.1028	-.172	1.9
16/3	-.869	.736	-1.188
20/2	-.441	1.581	.489
54/2	-.48	-1.383	.35
11/2	-.625	-.018	.26

It is clear that Housepit 24 (BR 3) stands out from all other housepit components given its strong scores on virtually every measure (Table 4). Housepit 25 (BR 3) is next in line but considerably weaker, particularly in prestige goods. Significantly, despite variability in demographic signals there do not seem to be strong indicators of material wealth accumulation associated with BR 2 occupations. This outcome suggests that material wealth-based status inequality, at least as quantified with these measures using current data, did not develop until Bridge River 3 times.

These results combined with additional excavation data (Table 8) permit us to conduct a preliminary test of the hypothesis that "Classic Lillooet" villages featured ascribed wealth-based inequality (e.g., Hayden 1994, 1997a; Prentiss et al. 2007). Since component one clearly measures variability in material wealth we can use the factor scores to effectively rank the house components. Then, if we plot the component one scores against occupation floor thickness,[2] we are able to test the hypothesis that prior success (reflected in longevity) played an important role in emergent inequality. Considering radiocarbon-dated floor sequences from housepits with the most stratigraphically distinctive floor sequences (Housepits 11, 16, and 54), reflooring events appear to have occurred on 15–25 year intervals, coinciding with expectations for periodic reroofing events (Alexander 2000). Thus, floor thickness and number of floors is more likely a measure of household longevity than variability in household approaches to cleanliness (e.g., Samuels 2006). Figure 11 demonstrates a significant inverse lin-

Table 8. Number of Hearth and Cache Pit Features, Excavator Identified Floors and Maximum Floor Thicknesses by Occupation Component and Housepit.

Housepit	Bridge River Occupation Component	Maximum Floor Thickness (cm)[a]	Maximum Number of Floors
25	3	25	3
24	3	10	1
20	3	35	2
54	3	40	7
16	3	70	6
20	2	20	4
54	2	50	5
11	2	40	11

[a]Rounded to the nearest 5 cm.

ear relationship between wealth ranking and floor thickness ($r = -.73, p = .04$). Since floor thickness could also be a measure of construction technique rather than occupational longevity, we also plotted a number of excavator identified occupation floors[3] against component one scores (Figure 12), recognizing the same relationship, though the correlation coefficient is slightly less than significant at the .05 level ($r = -.611, p = .108$). We interpret these results to suggest that the length of prior occupations played an inverse role in the accumulation of wealth. In other words, the greater the number of re-floorings of a housepit the less likely it was to develop significant wealth; rights to material wealth were unlikely to have been inherited within Bridge River 2–3 houses under this system.

Discussion

The Bridge River village was likely initiated around 1800 cal. B.P. and with a storage-based economy centered on salmon and supplemented by a host of other food sources, grew to substantial size in what appears to be three punctuations. Current data suggest that the final growth period was very rapid and may have effectively doubled the population. Once at peak size (ca. 1200–1250 cal. B.P.) the village declined and was apparently abandoned by sometime around 1100 cal. B.P. Zooarchaeological studies tentatively confirm indicators of reduced access to salmon in many BR 3 houses and a likely pattern of resource depression (e.g., Broughton 1994; Janetski 1997) in ungulates requiring longer hunting trips and more extensive field butchery at the same time. Construction of

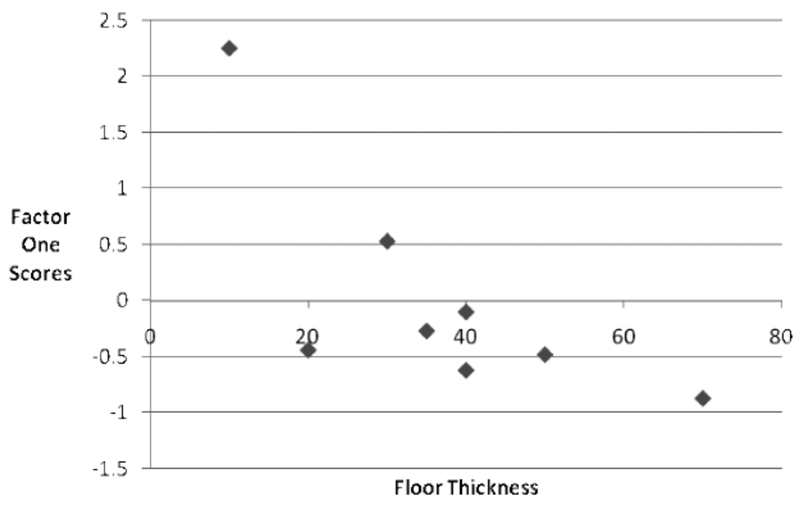

Figure 11. Plot of Factor One scores against maximum housepit floor thickness per occupation component.

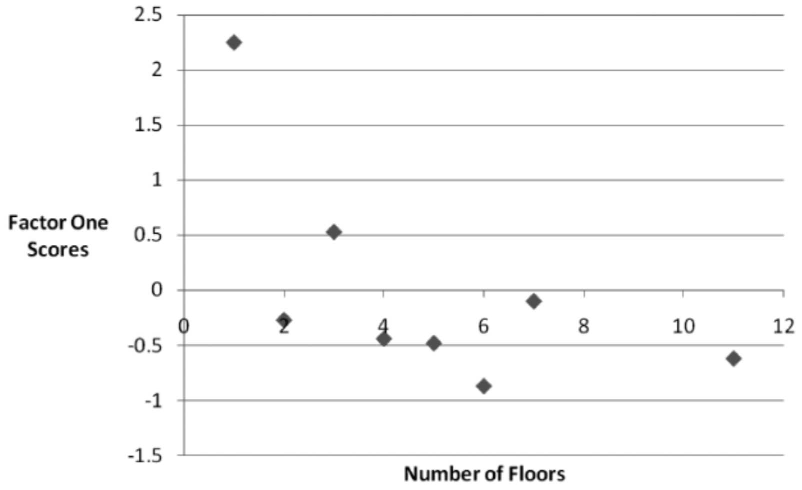

Figure 12. Plot of number of Factor one scores versus excavator identified housepit floors per occupation component.

houses in this final time (BR 3) brought with it the first appearance of quantitatively obvious material wealth-based inequality as new households (e.g., Housepits 24 and 25) apparently collected prestige objects more effectively than others and appear to have put on feasts.[4] Finally, it is also at this time that we see the first appearance of large extra-mural ovens[5] likely used for meat, fish, and berry roasts (Dietz 2004).

All things considered, it would appear that the Bridge River village followed a similar history to that of Keatley Creek where we also recognize subsistence change and emergent inequality in the same time frame. However, there are also some interesting differences. Drawing on current data, significant quantities of prestige items and other signs of affluence appear first in the newly established houses of Bridge River, not the older presumably well-established houses as seen at Keatley Creek. Outdoor cooking ovens appear after 1300 cal. B.P. at Bridge River while this is approximately the time when they disappear at Keatley Creek. Finally, Bridge River was abandoned at least a century if not earlier than Keatley Creek. Indeed, the abandonment process may have been underway even as inequality expanded.[6]

These data may imply somewhat different histories for emergent inequality in the two villages. Our current evidence suggests that population packing and the beginnings of a decline in salmon access coincided in early BR 3 times (ca. 1200–1300 cal. B.P.). It may have created the conditions whereby some family groups simply chose to leave the village while others developed new strategies for survival. One option could have been establishment of new social networks of cooperators engaged in controlling access to crucial food resources. This would help to explain why only newly established housepits like Housepits 24 and 25 would retain large salmon and ungulate assemblages, while others (Housepits 16, 20, and 54) would see declines in these items. Investment in new social arrangements could also be marked by signs of costly signaling (e.g., Boone 1998) as manifested in possible feasting in Housepits 24 and 25.

In contrast, current data from Keatley Creek (Prentiss et al. 2007) seem to indicate that greatest wealth was accumulated in large houses that had already been in existence for a number of centuries, thus implying a different competitive process whereby long-lived households perhaps took advantage of prior social standing in the community to outcompete neighbors (e.g., Boone 1992). Within this scenario it is even possible to imagine that the breakdown and final abandonment of Bridge River could have offered benefits to select households at Keatley Creek if some of the Bridge River peoples made moves to other villages and sought refuge with those large house groups.

Our understanding of the evolution of material wealth-based inequality at Bridge River offers implications for theories of emergent inequality. It is evident that simple deterministic models (resource conditions, packing, and personality types) are problematic given the possibility that emergent inequality may have taken somewhat different paths even in villages 10 km apart. To fully understand the cultural trappings of inequality we need to look beyond ecological conditions to consider underlying historical/evolutionary processes.

Historical/evolutionary pathways are always constrained by previous designs; brand new developments do not simply arise out of nothing (e.g., Goldschmidt's [1940] "hopeful monsters"), even in cultural contexts. This implies that previous developments provided structural constraints on future evolutionary pathways and that unintended consequences and cultural exaptations (Rosenberg 2009) may also have been important. Our data suggest that there had always been at least some variability in household size, foraging returns, and ability to accumulate jewelry and other so-called prestige objects. It is possible that the large houses that originally evolved as an effective way to shelter cooperating extended kin groups and to organize defense and labor, now became a tool for defining group success and wealth (Prentiss 2009, 2011). Rules for food-sharing, evolved as strategies for insuring all community members were fed (among other things), were potentially co-opted for establishing new networks of factional cooperators (e.g., Boone 1998). Jewelry originally developed as perhaps an indicator of personal and group identity could have become a marker of differential status (e.g., Hayden 2000b). Even more speculatively, perhaps some concept of private property originally evolved to mark family space and property within houses was extrapolated (e.g., Rosenberg 2009; Spencer 1997) on to a larger scale to include hunting, gathering, and fishing landscapes.

There is one more possible implication of the Bridge River data. In this new framework it is difficult to imagine inequality in BR 3 as an adaptive achievement. Indeed, it materialized in an archaeologically obvious way only after the Bridge River village had peaked demographically and was in a process of demographic decline and headed for eventual depopulation. Fascinatingly, when reoccupied centuries later the same village appears to have been characterized by the ethnographic pattern that likely included hereditary inequality (Prentiss et al. 2010; Reininghaus 2010). This prompts us to ask, was the Mid-Fraser abandonment an accident temporarily disturbing a long-lived adaptation (e.g., Hayden and Ryder 1991)? Or could it mark a more interesting historical process? If so, then future researchers will need to further consider the impacts of the events of 1100–1200 cal. B.P. on later developments in the Mid-Fraser Canyon.

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Notes

1. We used debitage in the calculation of the prestige and nonlocal raw materials indices. We cannot guarantee that flakes were not exchanged and even if they were not, debitage provide an at least crude measure of the importance of those sources relative to other items. Given that these are only two out of a series of indices we do not believe that they unduly bias the matrix.

2. Floor thickness was measured as the maximum thickness of accumulated floors excluding buried roof deposits within each house component. Some may complain that this is not an accurate measure but at Bridge River, housepit occupants routinely refloored their houses by merely covering over the old floor leading to stratified floor sequences. Rim deposits in the housepits with the thinnest floors (HPs 24 and 25) are relatively shallow, homogeneous, and roof-like and thus very different from the complexly stratified rims of Keatley Creek where floors and roofs were excavated and discarded on rims by original occupants. Thus we believe that floor thickness and number of floors actually do measure occupational longevity.

3. Field identification of floors was supported by micromorphological assessments (Goldberg 2010).

4. Evidence for feasting includes butchery and discard of two domesticated dogs in two similarly dated adjacent pits in Housepit 24 accompanied by a bear canine tooth and other items (Cail et al. 2010). Additional evidence for possible feasting comes from Housepit 25 where extensive numbers of minimally butchered deer remains were recovered in one sector of the floor. The center of the house also featured a unique large depression containing evidence for fires and resembling feasting contexts at Ozette, House 1 (Samuels 2005).

5. Two of the largest of these are located immediately adjacent to Housepits 24 and 25.

6. Our understanding of dispersal processes associated with the depopulation of the dense aggregate Mid-Fraser villages remains inadequate and will be the subject of future research (Kuijt 2001). Lepofsky and Peacock (2004) offer provocative evidence for expansion in the use of upland geophyte resources during the period post-dating the depopulation of the Mid-Fraser villages. This evidence could mark a temporary return to more residentially mobile lifestyles. This would not be surprising; semi-sedentary hunter-gatherers have often resorted to enhanced residential mobility during reductions in productivity of critical subsistence resources (e.g., Amsden 1977; Chatters 1995; Kuijt and Prentiss 2009).

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