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Emergence of persistent institutionalized inequality at the Bridge River site, British Columbia: the roles of managerial mutualism and coercion

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Persistent institutionalized inequality (PII) emerged at the Bridge River site by *ca* 1200–1300 years ago. Research confirms that PII developed at a time of population packing associated with unstable fluctuations in a critical food resource (anadromous salmon) and persisted across multiple generations. While we understand the demographic and ecological conditions under which this history unfolded, we have yet to address details of the underlying social process. In this paper, we draw on Bridge River's Housepit 54 to examine two alternative hypotheses. Hypothesis 1, mutualism, suggests that household heads signalled to maintain and attract new members as a means of supporting the demographic viability of the house. Inequality is indicated by variation in prestige markers but less obviously in economic fundamentals. Hypothesis 2, coercion, asserts that the more successful households developed control over access to critical food resources, forcing others into the choice between emigration and subjugation. Inequality is indicated by inter-family differences in prestige markers and economic fundamentals. Results suggest that inequality emerged under a mutualism scenario but persisted for subsequent generations under more coercive conditions.

This article is part of the theme issue 'Evolutionary ecology of inequality'.

1. Introduction

Evolution of persistent institutionalized social inequality (PII) has become a critical topic in anthropological research [1–3]. Consequently, we have gained significant understandings of variability in forms of inequality and their associated underlying conditions. Borgerhoff Mulder *et al*. [1] recognize that among multiple forms of wealth (material, relational and embodied), highly transmissible material wealth best predicts high levels of inequality in diverse human communities. Wealth-based inequality is common in agricultural and pastoralist societies given that these groups rely upon densely concentrated defensible economic resources [4]. However, it is also clear that certain hunter–gatherer populations (so-called complex fisher-hunter–gatherers) can fall into this category given their reliance on similarly dense resources such as anadromous salmon [5]. Archaeologists have created hypotheses about emergent inequality in hunter–gatherer contexts drawing upon these kinds of assumptions, focusing on optimal fishing (e.g. [6–9]) and hunting [10,11] locales. Despite widespread understanding of the underlying conditions favouring the development of material wealth-based inequalities, we remain challenged to fully understand the critical tipping points where institutionalized strategies of egalitarianism give way to inequalities. Two general classes of models have been widely discussed emphasizing mutualism versus coercion [12].

One collection of models predicts inequality emerging out of mutualistic arrangements between groups and individuals. Under Johnson's [13] influential model, scalar stress associated with growing population and increasingly complicated logistics for moving goods to consumers favours the establishment of new forms of leadership that benefit all by facilitating the functioning of these systems. Ames [14] argues that population growth in constrained environments of the Northwest Coast of North America favoured increasing logistical organization (per [15]), which in turn complicated household economies and created conditions whereby managers could facilitate better organization and in turn reap rewards. Friesen [16] sees benefits in the scalar stress model for understanding social changes in Inuit societies during the rise of umialiit (whaling boat owners) associated with increased hunting of bowhead whales. Smith & Choi [17] build a variant of this model that they call managerial mutualism, in which managers are permitted to profit after absorbing costs of punishing free-riders as a solution to a collective action problem. They note, however, based on modelling results, that such a scenario might be more difficult to achieve than patron–client relationships given narrow ranges on conditioning variables (one manager per group, low mortality rate, high reproductive rate, adequate value [though not too high] of collective good, low goods production cost, cost of enforcement relatively low and management fee neither too high or low). Nonetheless, the model makes sense in light of other scholarship. For example, Hooper *et al.* [18] argue that leadership can be rewarded as an alternative to lower overall productivity in an unsupervised group.

Under the coercion or patron–client scenario, highly heterogeneous environments favour inequality in access to resources thus leading to uneven local subsistence incomes and the development of potential patron and client relationships if need becomes strong enough among those in less productive patches [19]. As modelled by Smith & Choi [17], demographic and ecological factors will affect the rates by which these relationships develop. High mortality and/or low rates of reproduction allow patrons to become common and to control patches. Homogeneous environments retard rates by which patron–client relationships develop ([17], p. 111). An extreme version of the coercion model, outlined by Kennett *et al.* [20], suggests that under an Ideal Despotic Distribution model, better competitors will push less competitive groups into more marginal habitats thus favouring structural inequalities tied to extreme resource heterogeneity. Such competitive situations are also predicted by demographic ecological models examining the effects of Malthusian cycles [21]. Boone [22] notes that under heterogeneous conditions where demographic stress (impacts of imbalance between population needs and resource production leading to either a stable ceiling or catastrophic loss) impacts all populations, some better-off groups may employ signalling strategies to attract followers. These models are in line with our understanding of the demographic histories of long-lived House groups on the Northwest Coast of North America, where demographic crises occur with some regularity and require proactive strategies for recruitment and stabilization of domestic economies [23]. Similarly, these predictions appear to be confirmed in the histories of some Polynesian Islands where demographic crises lead to severe re-arrangements of social relations and periods of violence [24].

In this paper we conduct a fine-grained test of these two models drawing upon data from Housepit 54 at the Bridge River site (indigenous name: *K'etxelknaz*) in British Columbia (figure 1). The archaeological record of this house permits an examination of socio-economic and political change on an intergenerational basis during the time when village-wide inequality in material wealth appeared [25–27]. We accomplish this by developing new independent tests of material wealth and subsistence inequality. Specific to the Pacific Northwest region where inequality often manifested at the scales of inter-family relations within Houses, between houses, and even between clans [28], the coercion model reflects situations whereby established House groups accept or otherwise recognize members who are in effect tenants whose work benefits the larger group in terms of overall production of food and goods. In return, these persons receive shelter and protection while not necessarily gaining access to the most prestigious goods or highest quality food items displayed and consumed by chiefly families (e.g. [29]). By contrast, the mutualism model suggests that equally well-off families within a given House might permit one or more groups rights to acquire and display excess material wealth if their actions enhanced the general health of the overall House by organizing and managing productive ventures such as trade ventures, hunts and feasting and gifting events (e.g. [30]). Thus, our logic is that within the Mid-Fraser context, conditions of coercion would favour inequality in both wealth markers and access to food under conditions of economic stress, whereas mutualism would include inequality in wealth markers but not necessarily food under conditions of rising population though not necessarily severe economic stress. Analytical results suggest that while mutualism was important to the initiation of inequality, coercion may also have played a role in later generations.

2. Examining material wealth-based inequality in the Mid-Fraser context

The Indigenous people of the Mid-Fraser Canyon area of British Columbia are known as the St'át'imc or Upper Lillooet [31,32]. St'át'imc social life was organized across several scales. Clans were distributed across one or more villages such that a large village might include residences of House groups associated with two or more clans [32]. Clan chiefs were chosen from the highest-ranking House groups and were responsible for decisions regarding access to clan hunting, berry collecting and fishing places. Maintenance of chiefly status depended upon wisdom and generosity as provided in community potlatches and feasts [30]. House groups controlled access to specific fishing sites within clan territory. Membership of these groups generally consisted of brothers and their wives and children [32]. Within this system high status could be achieved or inherited. Thus, while some were born into high-ranking families, others could gain influence and respect through successful hunting, warfare and potlatching [30–32]. Inequality was therefore a byproduct of clan and village membership, House status and individual achievement. Thus, traditional St'át'imc society could have social distinctions based upon hereditary position and achievement in a variety of pursuits that manifested on inter-family, House and potentially clan group [33]. Patron–client scenarios could be manifested in individuals and families relying upon more wealthy families for access to food and non-food resources [30,32]. Given the foundation of the society on inter-family

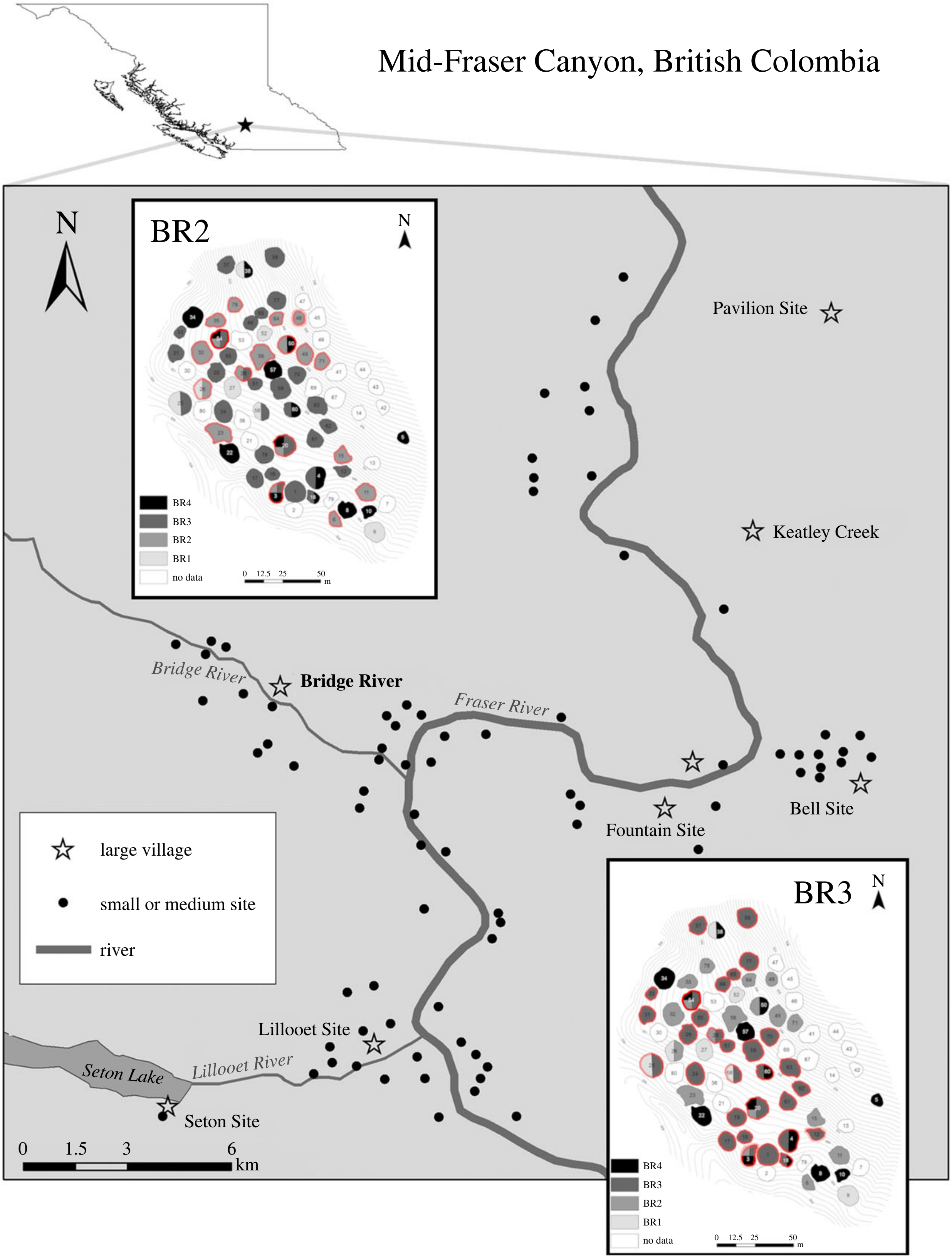

Figure 1. Map of the Mid-Fraser Canyon region. BR2 refers to occupation period of *ca* 1300–1600 cal. B.P.; BR3 refers to the occupation period of *ca* 1000–1300 cal. B.P.

relations, inequality is best understood in its manifestations within multi-family Houses. Archaeologists can measure variation between family groups based upon spatial arrangements of redundant domestic areas on house floors [34–36]. Wealth distinctions between domestic groups, when present, appear not to have been kept hidden as wealth-related items (prestige objects and raw materials) are commonly found on house floors [37]. Teit [38] provides an account of Nlaka'pamux people sitting over trap doors covering caches of food. However, it is not clear how common this practice was or if it was employed in the St'át'imc area where Bridge River and Keatley Creek are located.

Evolution of this system that included this pattern of inequality has been subject to debate and revisions by archaeologists. Hayden [34,39–41] argues that the large houses within the dense aggregate villages of the Mid-Fraser, especially at the Keatley Creek site (Indigenous name: *Tl'atl'lh*; figure 1), were built as early as *ca* 2600 cal. BP and persisted without significant change until catastrophic abandonment at *ca* 1000 cal. BP. Thus, inequality between house groups was the byproduct of a long-lived political ecological strategy predicated on a simple assumption that aggregated human groups supported by abundant resources inevitably lead some personalities to engage in self-aggrandizing strategies thus leading to the pattern of inequality documented by ethnography (e.g. [32]). Anadromous salmon (*Oncorhynchus* sp.) runs were likely very productive in the Fraser and Columbia River systems during the period of *ca* 2500–3500 cal. BP [42,43]. However, more extensive dating of deeply buried house features at Keatley Creek revealed that the village was likely less than 1800 years old [44] and that inequality developed after *ca* 1300 cal. BP [45]. This chronology of village establishment, growth and social change was confirmed at the nearby Bridge River village (figure 1) [25,46] and extrapolated to the wider Mid-Fraser area [9]. These outcomes required that we rethink the conditions and underlying causes by which inequality developed in the Mid-Fraser.

Prentiss *et al*. [45] provide data from the rim midden of Housepit 7 at Keatley Creek suggesting that at peak village population (*ca* 1200–1300 cal. BP) salmon production declined and was accompanied by subsistence strategies that sought a wider diet requiring more extensive hunting and gathering on local landscapes. Inequality thus appeared under conditions of subsistence intensification under demographic pressure. Prentiss *et al*. [45] draw from Boone [19] to argue that inequality at Keatley Creek may have developed under patron–client conditions as members of economically weaker houses sought support from economically better-off houses (Housepit 7). Prentiss *et al*. [9,25] relied upon inter-house data from the Bridge River site that recognized a similar transition to that seen at Keatley Creek. Here, salmon and artiodactyls (deer [*Odocoileus* sp.] and bighorn sheep [*Ovis canadensis*]) elements declined, while processing intensity increased between the BR2 (1300–1600 cal BP) and BR3 (1000–1300 cal BP) periods. Interhouse inequality developed during the BR3 period, as indicated by significant distinctions between houses measured in prestige artefacts (e.g. stone beads, pendants, bowls and figurines), non-local raw materials and prestige raw materials (nephrite jade, steatite and obsidian) [25]. Further, select houses (e.g. Housepit 24) raised and consumed dogs [47], maintained unique and costly tool forms (e.g. sawed and ground slate scrapers [48]) and hosted feasts, while others (e.g. Housepit 16) had no indicators of dogs, relied upon chipped slate tools and did not leave any evidence of feasting [9,25]. Prentiss *et al*. [9] argue that the Bridge River sequence is best understood in light of a Malthusian demographic model [21] in which BR3 represents a Malthusian ceiling in which significant population–resource imbalance occurred, leading to competition between Houses over rights to resources and persons to support household production activities. In this scenario, inequality is still the result of the formation of patron–client relationships within and between Houses, as facilitated by social signalling via feasts held by the larger and more successful Houses.

Prentiss *et al*. [26,27,49] add nuance to the Malthusian model at Bridge River, drawing upon the lengthy floor sequence at Housepit 54. The 15-floor sequence dated *ca* 1100–1460 cal. BP (figure 2) provides support for earlier conclusions that the village persisted through two complete Malthusian cycles [26,46]. An early slow growth (copial) period during BR1 (*ca* 1600–1800 cal BP) to mid-BR2 favoured growth of the village that was interrupted by the first Malthusian period, which led to substantial abandonment during late BR2. Rapid growth occurred during early BR3 before the second Malthusian period developed, with its pattern of subsistence resource intensification and inter-house social inequality. Housepit 54 inhabitants persisted across the first Malthusian period by engaging in higher rates of winter residential mobility, while nearly all other houses in the village were abandoned [26,49]. Housepit 54 then grew substantially during early BR3 as the rest of the village was re-populated. By *ca* 1200–1250 cal. BP intra-house inequality emerged under conditions of population packing and intensive harvest and processing of fish and artiodactyl resources and persisted for four generations. Prentiss *et al*. [27,49] argue that this pattern of PII was favoured by the socio-economically competitive conditions of the second Malthusian period. However, given that it was initiated at the BR3 demographic peak under apparently highly productive resource conditions, they are unable to reject the scalar-stress/managerial mutualism hypothesis.

3. Material and methods

Housepit 54 at the Bridge River site continues to provide opportunities for unique insights into socio-economic and political process in an Indigenous pithouse village on the western Canadian Plateau [36]. Housepit formation processes can be complex and involve cycles of construction, demolition and reconstruction [34,50]. In brief, semi-subterranean houses were often occupied across multiple generations. This required establishing floors with associated cooking, storage and sleeping features with a post and beam roof [32,51]. After about a generation (20–25 years), roofs were removed and/or burned and a new floor and roof established [52]. Some groups would remove the old roof and floor when reestablishing the house, as for example at the large housepits of Keatley Creek [34,44]. Other groups, such as at Bridge River, would remove the roof with minimal disturbance to the floor and simply add a new layer of silty-loam over the old floor, effectively starting the cycle again [37]. If the house persists across enough generations under the Bridge River formation processes model, then the housepit accumulates a record of long-term persistence and change stored on superimposed anthropogenic floors as opposed to a record of redeposited floors and roofs in middens surrounding the house. Housepit 54 at Bridge River provides the most extreme example of the former scenario.

Housepit 54 accumulated 15 intact anthropogenic floors (termed IIa-IIo) and five partial roof deposits pre-dating *ca* 1100 cal. BP [26]. Later reoccupations included a brief period of use during *ca* 900–1000 cal. BP (IIa1 floor) and a substantial Fur Trade period floor and roof dating to the mid-ninteenth century CE [53]. The IIa1 floor was largely removed by occupants of the Fur Trade floor. The earliest three floors (IIm–o) were not fully excavated as portions of each fell outside of excavation blocks. However, these earliest floors appear to have been small and thus likely representative of single family houses (probably 5–7 persons). Floors IIf–IIl reflect a larger rectangular-shaped house (occupied by populations that could have ranged between about 10 and 30), while floors IIa–IIe represent the house at full size, an approximate 13 m diameter oval, with house populations estimated between about 25 and 45 [26,37]. Prentiss *et al*. [54] provide a phylogenetic model suggesting that rules for social interactions evolved from a communalistic (IIh–III) to a more collectivist (IIa–IIg) social strategy. This suggests that over time families shifted from communal cooking and sharing of other work (communalist) to separation into distinct family work spaces (collectivist).

Prentiss *et al*. [27] tested for the emergence of material wealth-based inequality between domestic activity areas across

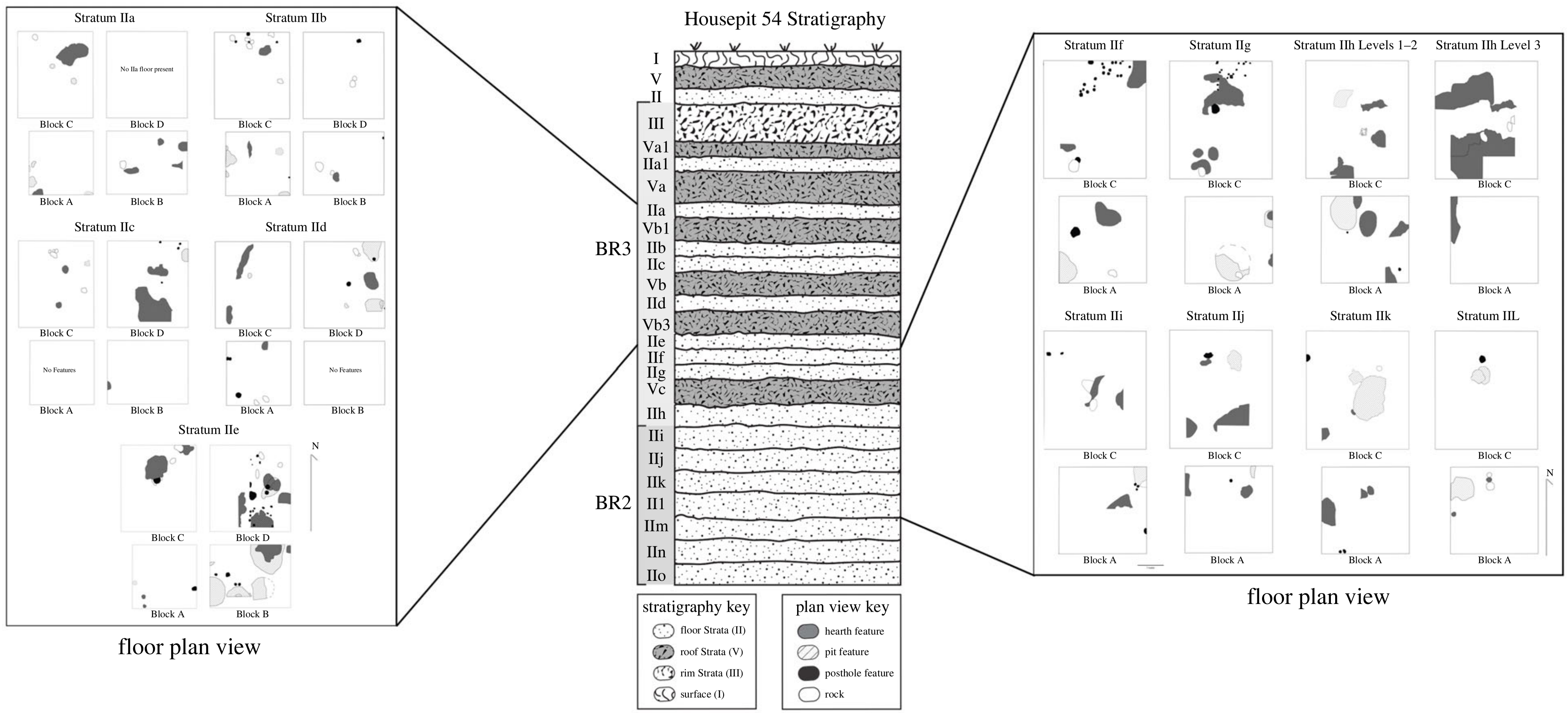

Figure 2. Housepit 54 stratigraphy and associated floors.

Table 1. Component scores and sample variances for PCA of wealth measures.

floor	block A	block B	block C	block D	sample variance
IIa	−0.56908	−0.30598	−0.43101		0.01732
IIb	−0.6795	−0.6957	1.07959	0.61277	0.820524
IIc	0.07424	0.11191	0.09938	1.52487	0.554215
IId	0.58135	0.1055	−0.35427	1.65181	1.011429
IIe	0.74064	−0.5803	0.01453	4.5187	6.256973
IIf	0.24798		−0.0227		0.025376
IIg	0.45008		0.38308		0.002245
IIh	−0.3097		0.30616		0.000627
IIi	0.52485		0.46233		0.001954
IIj	0.23557		−0.3803		0.010473
IIk	0.80381		0.24436		0.156492
IIl	0.21009		0.09691		0.006405

a 12 floor sequence (IIa–IIl). They accomplished this by first measuring inequality with three wealth-based variables (prestige-related artefact, prestige lithic raw material and non-local lithic raw material density) and two measures of hunting success (biface and hide scraper density). The latter measures are based upon ethnographic research that suggests successful hunting brought recognition and wealth to house groups [55]. A principal components analysis (PCA) was run for these five variables across the activity areas (measured as the contents of each excavation Block) for the 12 floors, resulting in a single significant component capturing 74% of the variance with significant positive loadings on all variables. Component scores were saved to measure the contribution of each case (activity areas [measured in excavation blocks] across the 12 floors) and results suggest that only the Block D floors (IIb–IIe) achieved consistently high scores, raising the possibility that the family residing in this position had not only consistently better access to food resources but also maintained consistently strong access to a variety of prestige and non-local lithic items and materials. Finally, Prentiss *et al*. calculated sample variances for the component scores for each floor, concluding that the widest variance was clearly on the IIb–IIe floors. The analysis thus suggests that material wealth-based inequality emerged and persisted across four generational floors (estimated 96 years).

Here we replicate the procedure followed by Prentiss *et al*. [27] but with some changes. Most fundamentally, we run two independent PCAs separating measures of wealth items from subsistence decision making. Wealth items include prestige item density (beads, pendants, stone bowls, nephrite jade items and figurines) and four measures of non-local and prestigious lithic raw materials (Hat Creek jasper, Fountain pisolite, obsidian and nephrite/steatite density). Subsistence measures include canid, artiodactyl, sockeye salmon and formal biface and projectile point density. Canids were an important dietary item used in Mid-Fraser villages and would have been an important resource for Housepit 54 groups [47]. Artiodactyls provided a significant alternative to fish during annual subsistence cycles [55] and were also important feasting items [30]. Bifaces and projectile points provide an independent measure of hunting preparation [25,45,49]. Sockeye salmon were the keystone food resource to all Mid-Fraser peoples [56,57]. We measure degree of inequality by assessment of component scores on domestic activity areas for each Block in all 12 floors. We further examine these relationships with sample variance scores for each floor [27]. All raw data are provided in the electronic supplementary materials.

The coercion hypothesis suggests that inequality would emerge as those worse-off in an expanding economic crisis would seek shelter with those who had better access to resources, thus establishing patron–client relationships. From the standpoint of a single multi-generational house, we could imagine scenarios where inequality is triggered by acceptance of new residents from elsewhere (Teit [32] notes brothers and their families co-resided in houses) or shifts in the social status of longer-standing residents. Therefore, at the initiation of inequality we would expect strong distinctions between residential groups within the house in terms of both wealth items and access to food. Thus, one group might mark success with investment in prestige items and non-local lithic source material while also maintaining subsistence distinctions, as might occur when lower-status people had to wait while higher-ranked families completed their use of the best fishing, hunting and/or gathering places [56,58]. By contrast, the mutualism model raises the possibility that in a growing community, people might be attracted to a new social arrangement with strong leadership and the possibility of socio-economic opportunity. In this scenario we would expect emergent inequality to be marked by material wealth distinctions but little difference in access to fundamental subsistence items. This might occur if House leadership chose to fully share subsistence resource access points while maintaining elite-associated production and exchange relationships. It was not uncommon elsewhere in the Pacific Northwest for those of chiefly status to obtain portions of returns (derived from House-owned economic landscapes) from all House members, which could in turn be used in feasts or in support of other ventures (e.g. [29,59]).

4. Results

The PCA (both PCAs run using SPSS Statistics v. 27 [60]) for wealth measures resulted in two significant components, with the first capturing 59% of the variance (see electronic supplementary materials). All variables load strongly positive on component one of the component loadings matrix (electronic supplementary materials), thus confirming this component as a strong measure of household wealth. Component scores are strongly positive in Block D for floors IIb–IIe, although an additional significant positive score is present in Block C for floor IIb (table 1). We calculated sample variances for the

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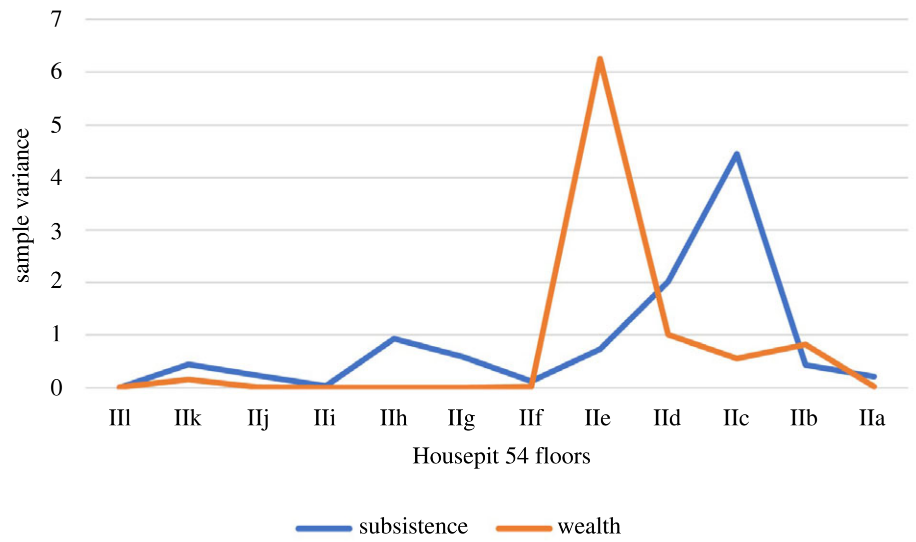

Figure 3. Sample variance for wealth and subsistence measures.

Table 2. Component scores and sample variances for PCA of subsistence measures.

floor	block A	block B	block C	block D	sample variance
IIa	−0.53296	−0.89011	0.01309		0.206916
IIb	0.57808	0.48943	0.22905	0.85254	0.434573
IIc	0.54051	0.48294	0.26112	3.78248	4.446944
IId	0.50278	0.85289	0.47889	2.20841	2.017226
IIe	0.60195	1.07744	0.70681	1.30606	0.72687
IIf	0.43373		0.06803		0.125882
IIg	0.58488		0.50143		0.590035
IIh	0.89903		0.46599		0.93164
IIi	0.58026		0.84943		0.036226
IIj	0.12154		0.81053		0.237354
IIk	0.91919		0.02566		0.446371
IIl	0.50089		0.46525		0.000635

component scores on each floor, and results (table 1, figure 3) strongly support the previous argument [27] that inequality abruptly emerged on floor IIe and persisted through IIb. The strong positive component score on Block C of floor IIb raises the possibility that egalitarianism might have been returning at this time. Indeed, by the IIa floor, inhabitants of Housepit 54 filled the Block D area with rim fill and did not permit anyone to occupy this portion of the house prior to its abandonment.

Our PCA for subsistence measures returned a single significant component capturing approximately 65% of the variance (electronic supplementary materials). The component loading vector includes significant positive loadings on all variables (electronic supplementary materials), suggesting that household wherewithal integrated multiple food sources including major mammalian and piscine prey items. The component scores matrix (table 2) includes significant positive loadings on all Block D floors (IIb–IIe), but also on Blocks B and C for IIe, Block C on IIg and Block A on IIh. Sample variance scores (table 2; figure 3) are extremely high only for floors IIc and IId. These outcomes suggest to us that inequality in subsistence is only identifiable on floors IIc and IId and thus, did not coincide with the first generation of material wealth-based inequality.

5. Discussion

We proposed two alternative models to better our understanding of the transition from relative egalitarianism to persistent material wealth-based inequality. The coercion model is widely recognized to be associated with the establishment of unequal patron–client relationships [19]. We expected that a patron–client scenario specific to the Mid-Fraser area would include wealth and subsistence differentiation. The mutualism model, in contrast, is recognized to occur in different ways but generally assumes that positive resource management would lead to attractive opportunities for supporting and growing group membership while permitting managers to retain payments and thus achieve higher wealth differentials [17]. We think this would be reflected in the Mid-Fraser context by emergent strong House groups, with material-wealthy leadership accompanied by a broadly well-fed house membership. We tested these hypotheses with data on material wealth and subsistence from 12 anthropogenic floors from Housepit 54 at the Bridge River site in British Columbia. Multivariate analysis confirms that wealth inequality appeared abruptly on the IIe floor and persisted across four generations. By contrast, subsistence inequality occurred a generation later and only lasted two generations.

We suggest that the mutualism hypothesis is the better explanation for the initial onset of material wealth-based inequality at Housepit 54. This Housepit had doubled in physical size by the start of the IIe floor. Its population had also peaked at an estimated 44 people and storage capacity measured in relatively volume of cache pits was also at its high [26]. Subsistence resources were productive, as indicated by peak returns on salmon and continued high returns on artiodactyls [49]. Thus, it would appear that during that brief generation, Housepit 54 was highly successful and that success was felt at the level of family subsistence economies throughout the house, while one family group also exhibited signs of significant material wealth. Thus, coercion seems like an unlikely scenario for growth, subsistence success and emergent wealth differentiation on floor IIe. The economic situation on the IIe floor would have been highly attractive to prospective new household members. Indeed, during the life of IIe, the spatial arrangement of features shifted from three domestic areas (Blocks A, C and D) with one area (Block B) set aside for pit storage to a situation where all block areas were structured as general domestic areas, thus implying the addition of one or more families before the close of that floor. We cannot yet determine if these new residents were kin or non-kin. The IIe floor does appear to loosely meet expectations of Smith and Choi's [17] simulation model for managerial mutualism given the apparent appearance of one higher wealth group during a time of population growth with moderate increases in the rate of goods production [37]. Unfortunately, some aspects of their model (enforcement cost and management fee, for example) are very hard to measure with archaeological data.

This leaves us with the challenge of understanding the fact of both wealth and subsistence inequality on IIc and IId. Estimated populations on IIc and IId are approximately 50% of the population on IIe and relative cache pit volume also drops by about 50% [26]. Density of salmon remains drops by 50–75%, respectively, on IIc and IId, while artiodactyl remains are down by about 25% on both floors [49]. All things considered, it would appear that the house suffered severe economic stress leading to a near catastrophic drop in population under conditions of major reductions in access to keystone resources (especially salmon). This suggests to us that mutualism gave way to competitive conditions and some degree of exclusionary resource rights between families within this collectivist House.

We can gain a better understanding of this process in light of models derived from demographic ecology [61]. In Puleston *et al.*'s [21] model, rapid growth copial periods can lead to short-lived transitions and the sudden onset of Malthusian conditions. The data from floor IIe at Housepit 54 appear to indicate a single generation demographic peak that resembles the transition stage in the Puleston *et al.* [21] model. At this point, the entire village was rapidly growing, as indicated by the multitude of new houses established after *ca* 1300 cal. BP and the growth in size of select houses such as Housepit 54. Under conditions of economic productivity and population packing there may have been a strong payoff for taking up or maintaining residence in particularly productive Houses with effective leadership. Housepit 54 was only one of three houses (current data) to persist across the BR2 to BR3 transition and that would likely have been widely known. The rapid demographic downturn under conditions of resource scarcity are exactly what we would expect if the House (and likely village [9]) experienced the onset of a Malthusian period. Within that scenario, mutualism could have given way to coercion as resources grew tight for all House groups. Thus, now packed residents may have had to wait for access to best fishing, hunting and gathering places, virtually guaranteeing lowered returns. Poor or at least unpredictable subsistence returns would have been disastrous, especially during late winter when stores ran low [51,56,58,62]. This in turn would have led to loss of life and/or risky movement away from the aggregated village. If this model is correct then inequality at Bridge River began in a voluntary situation predicted by mutualism, but evolved into more of a coercion scenario under a persistent Malthusian period.

These outcomes offer implications for other contexts of emergent inequality. For example, Ritchie & Lepofsky [63] document a similar process of social change in Coast Salish settlement and social relationships during the period of *ca* 1000–1500 cal. BP. These cases provide likely scenarios where mutualistic arrangements may have facilitated social changes that included persistent institutionalized inequality. Future research is required to assess such developments in enough spatio-temporal detail that models can actually be tested. Critically, scholars need to explore options that include not just cooperation but the effects of competition and coercion as in the Bridge River case where this clearly played a role over time.

Data accessibility. Raw data and additional data representing outcomes of multivariate statistical analyses are available as electronic supplementary material [64].

Authors' contributions. A.M.P.: conceptualization, data curation, formal analysis, funding acquisition, investigation, methodology, project administration, supervision, validation, visualization, writing—original draft, writing—review and editing; T.A.F.: conceptualization, formal analysis, methodology, writing—review and editing; A.H.: conceptualization, investigation, writing—review and editing; M.J.W.: conceptualization, methodology, writing—review and editing; M.D.: investigation, writing—review and editing; A.E.: investigation, writing—review and editing.

All authors gave final approval for publication and agreed to be held accountable for the work performed therein.

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