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# Cultural macroevolution in the Pacific Northwest: a phylogenetic test of the diversification and decimation model

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ABSTRACT

A number of scholars have proposed models of cultural evolution whereby entities defined by socio-economic variables held at group levels evolve in a branching or cladogenetic process. The Diversification and Decimation model seeks to explain temporally short-lived patterns of cladogenetic diversification and subsequent decline in the range of such cultural variants during the Middle Holocene of North America's Pacific Northwest region. This paper uses cladistic and network techniques to examine core predictions of the model – that cultural entities evolved in a branching process, not significantly impacted by tokogenetic processes; and that the pattern of evolution was as predicted by the model. Outcomes suggest that while major tenets of the model are supported, some aspects require minor refinement. Implications are considered for future studies of this nature.



## 1. Introduction

Recent theorizing on cultural evolution favors a hierarchical model whereby evolutionary forces act on cultural entities ranging in scale from simple technological characters (Buchanan and Collard, 2007; O'Brien et al., 2001; Prentiss et al., 2011) to more complex packages that include broader technological traditions (Jordan and Shennan, 2009; Larsen, 2011; Shennan, 2011; Tehrani et al., 2010), languages (Gray and Jordan, 2000; Holden and Gray, 2006; Mace and Holden, 2005), and other cultural practices (Coward et al., 2008; Currie and Mace, 2011; Guglielmino et al., 1995; Holden and Mace, 2003; Mace and Holden, 2005). An important implication of this work is that those more complex cultural characters such as inheritance traditions (Holden and Mace, 2003) and socio-economic strategies (Coward et al., 2008) are held and operated at the group level. Transmission of such complex structures would rely upon vertical processes as parents taught younger generations the organizational logic of such practices (Coward et al., 2008; Hewlett et al., 2011). Some cultural traditions within traditional societies may also be passed on in a non-vertical fashion as older children and young adults learn from their relatives and peers (Tehrani and Collard, 2009). If such strategies offered economic and reproductive benefits to their users we would logically also expect group selection to play an important role in the evolutionary process over the longer term (Boyd and Richerson, 2002; Soltis et al., 1995) and that this could under the right conditions lead to divergence in cultural practices between groups (Boyd and Richerson, 1985; Foley and Lahr, 2011; Mace and Jordan, 2011).

Scholars have initiated a discussion of macroevolutionary processes that could affect variability in rates of divergence in cultures ("cultures" as defined by Foley and Lahr, 2011). Recent efforts at modeling these processes have implicated demographic, social and ecological processes as critical factors. Drawing from earlier studies (Collard and Foley, 2002; Foley, 1994, 2004), Foley and Lahr (2011) recognize that diversity in ethnographic cultures correlates positively with rainfall and temperature, along with latitude. They suggest that this diversity could be explained as a social process by which boundaries form that prevent or at least reduce the incidence of cultural hybridization. Boundaries are marked by a range of cultural traits that can evolve through adaptive or neutral mechanisms including language, artifacts, and features (e.g. rock art). Foley and Lahr (2011) note that the essential question concerns the conditions by which such boundaries are likely to emerge. They suggest that geographic barriers are an obvious choice but that socio-demographic barriers could be important as well. A series of distinctive mother and daughter cultures could consequently evolve through processes of demographic fissioning and subsequent evolution under conditions of social or geographical isolation. Logically, one could also expect times when rates of diversification were so reduced that they could be overcome by

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more rapid extinction rates brought on by limited options for divergence under competitive socio-economic and demographic conditions. Theoretically, these processes should form a cultural phylogeny that could be tracked with appropriate analytical methods. Such studies would permit archaeologists to recognize periods of diversification and contraction in the range of cultures (Foley and Lahr, 2011). Foley and Lahr's (2011) model is substantially in line with recent thinking regarding human macroevolutionary process. Recent research in paleoanthropology has identified habitat diversity during periods of variable climate as essential to increased rates of speciation and thus diversification processes on that scale (Grove, 2011a, 2011b; Potts, 1998; Trauth et al., 2007, 2010).

Prentiss and Chatters (2003; Chatters and Prentiss, 2005; Chatters, 2009; Prentiss, 2009, 2011) outlined a model they termed "diversification and decimation" (D&D model) borrowing terminology from Gould (1989). The model proposed that macroscale cultural evolution occurs by virtue of evolution of packages specifying the internal logic of such practices as technologies, subsistence and mobility strategies (resource management strategies), and some forms of social organization. Change in the logic of organization could rearrange schedules, foraging tasks, technologies and the like. Much like Foley and Lahr (2011), their model proposed that certain conditions would favor particularly high rates of change. Under the D&D model, cultural diversification is expected to occur under conditions of high habitat productivity (in relation to population densities) and diversity that allows groups to operate effectively with greater degrees of separation from other such groups at lower levels of competition. This separation reduces impacts of inter-group cultural transmission, which would increase inter-group diversity in cultural practices. Periods of cultural diversification are expected to be relatively a short-lived as ecological conditions inevitably become less variable and/or favorable and effective population densities rise, triggering competition between groups. The Decimation phase occurs when previously successful cultural variants fail or are outcompeted by those held by more successful neighbors. This leads to regional cultural homogeneity as measured on scales of socio-economic strategies. Some important implications of the model are that cultural evolution should be a branching process leading to the formation of phylogenies when associated with divergence in group-held socio-economic strategies and that the process would unfold as groups become at least semi-isolated, subsequently crossing adaptive valleys in a process analogous to speciation (e.g. Wright, 1932; see also Bettinger, 2009). This could also be accompanied by changes in group identity marking, as predicted by Foley and Lahr (2011).

As argued by Mace and Holden (2005), phylogenetic analysis is an appropriate approach for increasing our understanding of cultural evolution, whether the target of study is on the scale of artifact or broader cultural tradition. The cultural diversification models promoted by Foley and Lahr and Prentiss and Chatters implicate phyletic branching of organizational strategies in human populations. Consequently, specific model predictions should be testable with empirical research. In this paper we present a phylogenetic test of the cultural diversification and decimation model as applied to Pacific Northwest prehistory. We develop measures for socio-economic variability using sites as taxa or put differently, as reflective of the operation of archaeologically identifiable resource management strategies. We then conduct a cladistic and network analysis of these data to explore the degree to which phylogenies conform to predictions inherent in the model. Since mosaic evolution is known to impact cultural and biological phylogenies (Prentiss, et al., 2013a,b; Skelton and McHenry, 1998) we develop Middle Holocene cultural phylogenies drawing from multiple data sets.

## 2. Cultural diversification and decimation in the Pacific Northwest region

The D&D model when applied to the Pacific Northwest region of North America (Figs. 1 and 2) recognizes an archaeologically brief period of rapid cultural diversification during the Middle Holocene when measured from the standpoint of socio-economic or resource management strategies, per Prentiss and Chatters (2003) This occurred during the climate transition between the warm and dry Hypsithermal and the cool and moist Neoglacial (ca. 5500 to 3500 cal. B.P.) when terrestrial habitats were in a high degree of geographic and temporal flux as measured by a range of studies (e.g. Chatters, 1995; Hallett and Walker, 2000; Mohr et al., 2000; Osborn et al., 2012; Potito et al., 2006; Tunnicliffe et al., 2001; see also Chatters, 1995, 1998). This period favored the widest array of hunter-gatherer resource management strategies recognized in the Pleistocene–Holocene sequence of the region. Peak diversity did not last more than several hundred years and was subsequently replaced by homogeneity under the more extreme climatic conditions of the Neoglacial period (Chatters and Prentiss, 2005).

According to the D&D model, Old Cordilleran foragers (Chatters et al., 2012), typified by high rates of residential mobility, daily or diurnal foraging, generally immediate return subsistence, and periodic aggregations for fishing (e.g. Ames, 1998) branched into two to three distinctly different strategies. Pithouse I groups on the Columbia Plateau engaged in multi-seasonal sedentism supported by diurnal foraging and immediate return subsistence during short and benign winters (Chatters, 1995). Occasional logistical mobility was practiced when resources were too distant from base camps or information gathering required longer travel (e.g. Whallon, 2012). Charles Culture groups of the St. Mungo phase on the Central Northwest Coast (especially Gulf Islands and Fraser Delta areas) engaged in lengthier stays at critical resource harvesting locales leaving extensive midden sites. However, there is to date little evidence that critical food resources (e.g. salmon) were processed for anything other than immediate consumption. Further, there is virtually no evidence for residential permanence (e.g. house structures) as might occur under conditions of storage based sedentism. In contrast, the similarly dated Eayem Phase (sometimes also identified as Fraser Valley phase (Ormerod, 2002)) of the Charles Culture, offers above-ground house structures and some evidence for residential permanence in the form of interior and exterior pit features and large artifact assemblages (Ormerod, 2002). Questions remain as to the degree to which these residential sites were supported by a delayed return subsistence strategy (Prentiss and Chatters, 2003; Prentiss, 2009). Only one site (Hatzic Rock) has features that could be interpreted as food caches (Ormerod, 2002) but preservation of faunal remains is poor and the question of delayed return consumption remains difficult to address.

Fully developed logistically organized collectors (*sensu* Binford, 1980) are not easily recognized on the Central Coast until the appearance of the Locarno Beach Phase by ca. 3700 cal. B.P. While archaeologists believe that Locarno Beach is a direct outgrowth of the Charles Culture (Matson and Coupland, 1995), the D&D model suggests that collector organization may also have evolved outside this region with critical elements transmitted to the region via inter-group contact. Logistically organized collectors on the Plateau, typified by small housepit villages, intensive salmon oriented subsistence, and extensive use of food storage are recognized archaeologically as the Shuswap horizon and the Pithouse II culture. The D&D model predicts that they are primarily descendant from an expansion of early Locarno Beach groups possessing collector organization acquired on the coast, taking advantage of a nearly empty landscape after the breakdown of Plateau societies