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Least cost path analysis of early maritime movement on the Pacific Northwest Coast

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ABSTRACT

In this paper, we present a new method for modeling past maritime movement events using least cost path analysis. Nontraditional measures of movement cost, including cultural, environmental, and physiological variables, were calculated. Using multiple cost-weighting scenarios, spatial resolutions, and different considerations of overland travel, movement routes were predicted for five Pacific Northwest Coast study areas. This work uses a new application of least cost path analysis to seascapes and marine movement and the results have led to a better understanding of migration during the Late Pleistocene and Holocene. The resulting routes were systematically analyzed and compared to determine which produced the results most likely to predict high-use coastal movement corridors. We found that modeling scenarios where culturally derived costs of movement were highly weighted and in which overland travel was very costly produced the best predictions of possible past movement events. These models show that predicted routes cluster in distinct patterns which are influenced by the geography of the seascape through which the movement event is taking place and that areas of high traffic are most likely to be located immediately offshore and to the south of islands as well as in the spaces between landmasses. This knowledge increases our ability to predict the location of drowned sites on the Northwest Coast and is important in contemporary archaeology because it can help locate new sites in a landscape that has radically changed over the last 20,000 years. GIS analysis can reveal new sites hidden by changing sea levels, which may not be easily located using traditional forms of site prospection. Accurate modeling of maritime movement opens many coastal areas to increased archaeological exploration and has the potential for the discovery of new sites in drowned locations.

1. Introduction

Archaeologists have extensively studied how past peoples moved through and interacted with terrestrial landscapes (Llobera, 2011; Rockman and Steele, 2003; Surface-Evans and White, 2012; Wheatley and Gillings, 2012:133). Much of this work has made use of Geographic Information System (GIS) technology, which has become the preeminent tool for modeling and displaying movement and migration (Anderson and Gillam, 2000; Hu, 2011; Judge and Sebastian, 1988; Llobera, 2001; Lock and Harris, 1992; Verhagen, 2007; Wheatley and Gillings, 2012). Less attention has been paid to how people moved through marine environments (Howey, 2007; Leidwanger, 2013), despite the fact that maritime technology has been used extensively by ancient humans across the world (Ames, 2002; Bjerck, 2008; Montenegro et al., 2006; Van de Noort, 2003). Least Cost Path analysis (LCP) in the past has been applied to overland travel along lakeshores, on rivers, and through ocean coastal environments (Bell and Lock, 2000; Carballo and Pluckhahn, 2007; Hare, 2004; Sakaguchi et al., 2010; Sherman et al., 2010; Siart et al., 2008; Taliaferro et al., 2010). Unlike Leidwanger's (2013) previous work, which estimated vessel travel speed, wind direction, and sailing conditions to predict how far a Classical Mediterranean vessel could travel in a given time, we use a multivariate weighted methodology to model areas of high travel from discrete coastal points and predict possible new site locations. Here we present a set of initial findings indicating that LCP analysis can successfully yield new and insightful information on past

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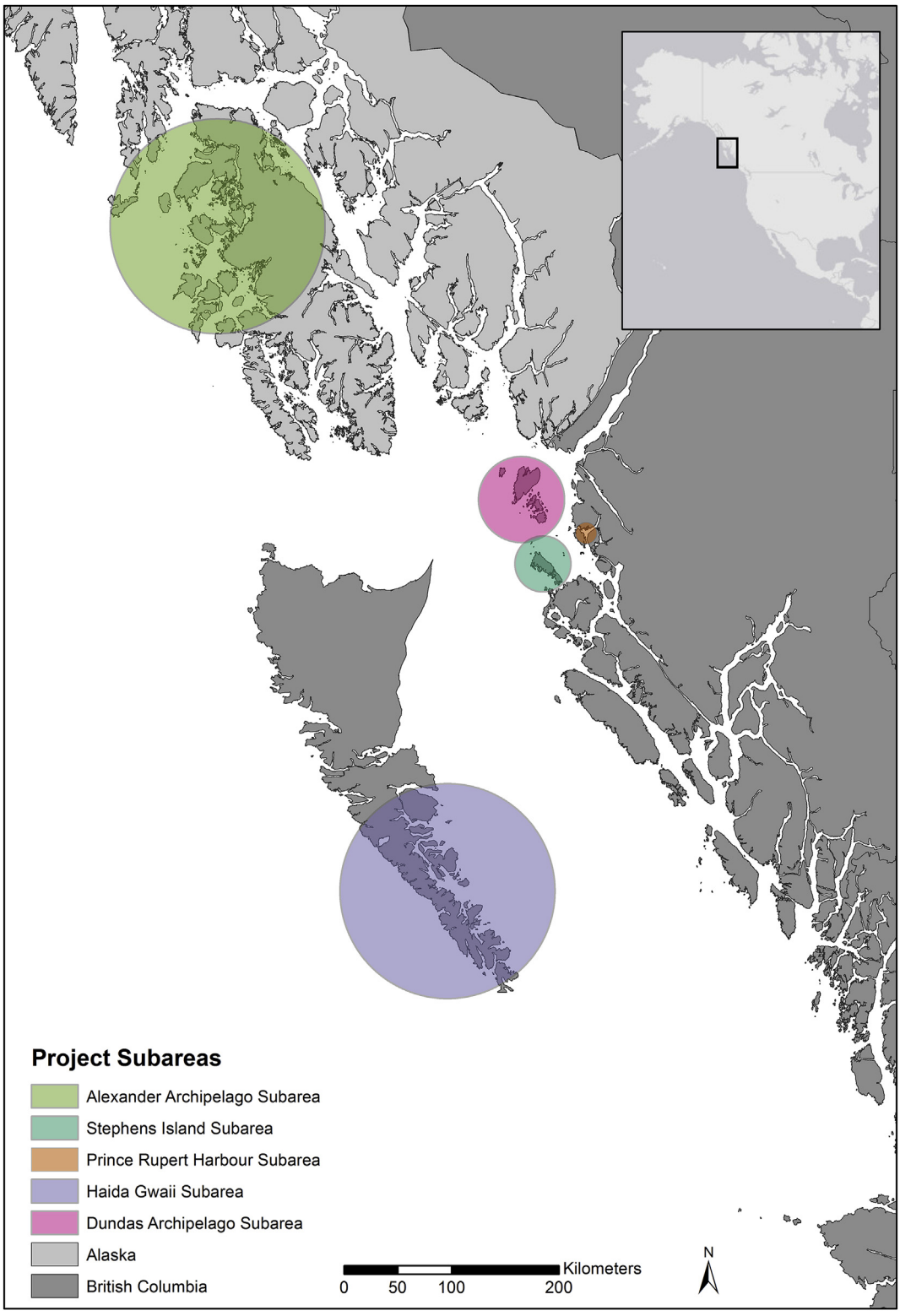

Fig. 1. Study areas on the Northwest Coast.

maritime movement events.

We applied our maritime LCP analysis to the question of the timing and method of the peopling of the New World. For much of the twentieth century, the archaeological community thought that it understood the process and timing of initial human migrations into the New World. These explanations took the form of the Clovis First and Ice-Free Corridor theories (Adovasio and Pedler, 2013:512; Arnold, 2002:437; Beck and Jones, 2013:273; Mandryk et al., 2001:301). These hypotheses stated that as the Cordilleran and Laurentide ice sheets retracted, a narrow, ecologically viable