Knowing Place: Predictive Modelling, Palaeo-Landscapes and the Knowledge of Lost or Hidden Places

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Recent advances in the availability of high-resolution LiDAR and sea level reconstruction curves have made it possible to generate localised and regional palaeo-landform models that incorporate many formerly important landforms and features, such as lakes, islands and wetlands, that have changed or become muted over time. These models are of especial use for archaeological predictive modelling, impact assessments and for clarifying spatial relationships between contemporary archaeological sites. A palaeo-landform model created for the Province of New Brunswick, Canada, has been in use for over a decade and has been subject to continuous improvement and refinement over that period. It spans from a time of deglaciation of the landscape, c. 14,100 years ago, to the present-day. The model now also incorporates future climate change data that together can be used to predict the effects of modelled climate change on cultural sites and landscapes, a useful tool for resource management planning (Suttie & Nicholas 2011).

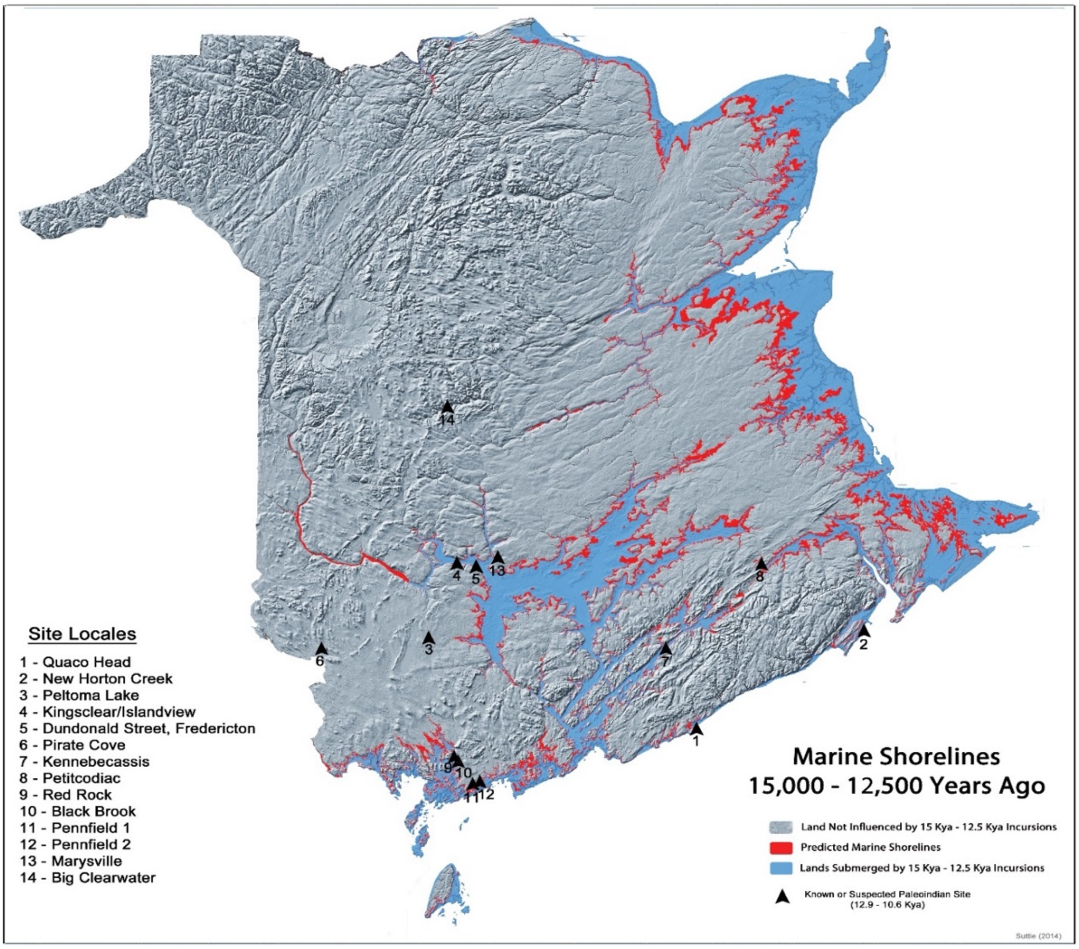

Figure 1. Landscape model showing the coast and shorelines of New Brunswick between 15,000 to 12,500 years ago. After deglaciation, as the land slowly rose, the coastline retreated until it attained it present reaches. The locations of Paleoindian (12,900–10,600 cal BP) archaeological sites are also shown; many are located near former shorelines.

The palaeo-landform reconstructions generated by the model are based on LiDAR data, sea level reconstruction curves and measurements of isostatic rebound. The Maritime Peninsula of northeastern North America was subject to intense glaciation during the Wisconsinian glaciation (75,000–11,000 years ago). The Laurentide Ice Sheet, which covered this region at the time, was between 3–4 km thick at its maximum depth and extended as far south as Long Island in New York State (c. 18,000 years ago; Lewis & Stone 1991). Relatively rapid deglaciation occurred in the region after c. 20,000 years ago (Shaw 2014), with parts of what is now the Province of New Brunswick becoming ice-free by around c. 14,100 years ago (Vacchi et al. 2018). The extreme weight of the ice had the effect of depressing the Earth's crust, making it lower relative to global mean sea-level. As the ice melted, the ground slowly rose especially over the course of the next 6000 years, through a process called 'isostatic rebound'. While the terrain was depressed, the waters of the Bay of Fundy, Northumberland Straight and Bay de Chaleur streamed in to inundate the land. This appears to have happened when ice was still covering parts of the Maritime Peninsula, as evident by the presence of deltaic deposits and remnant shorelines at an elevation of 75–80 m above sea level (a.s.l.) (Figure 1).

Currently, the earliest evidence of human occupation of the Maritime Provinces (New Brunswick, Nova Scotia and Prince Edward Island) is attributed to a series of contemporary archaeological sites in southwestern New Brunswick dating to between 13,500–12,700 cal BP. These sites, which are located along palaeo-shorelines, were dated using radiometric dating of features (primarily hearths containing archaeological materials) and palaeosols immediately above and below levels containing cultural materials considered stylistically diagnostic of the wider region. These radiocarbon dates are calibrated here to make them comparable to the temporalities of the published and modelled landscapes and sea-level reconstructions from the region.

The presence and ages of ancient shorelines were also informed by palaeontological evidence such as dated fossil shells (*Hiatella arctica* and *Portlandia sp.*) now found 40–42 m a.s.l. and immediately surrounding shorelines upon which early archaeological sites have been found. The fine, silty-sand matrix in which these shells were found testifies that a shallow marine environment had washed against these landforms until c. 14,000 years ago. These fossil shells are no longer endemic to the region, preferring colder waters, but have been identified from Late Pleistocene palaeo-shoreline sediments across the region (Miller & McAlpine 1991; Rampton et al. 1984). Over the following several hundred years, isostatic rebound resulted in a relative drop of local sea-levels, exposing the recent seabed composed of silt-dominated marine sediments which, based on coring and stratigraphic observations, then became basins for brackish or freshwater wetlands (Suttie et. al. 2013).

In the Pennfield area of southwestern New Brunswick, four archaeological sites were found along this landform in 2009. The sites were investigated between 2010 and 2011, two of which— sites BgDq-38 and BhDr-4—were interpreted as a large occupation site and a secondary, satellite site that functioned primarily as a hide-processing area (Suttie et al. 2013).

Archaeological excavation of these places indicated that Indigenous peoples began to occupy this former marine shoreline by around 13,500 cal BP, at a time when the area was a well-drained terrace elevated above a brackish or freshwater wetland. This wetland stretched to the contemporary shoreline, which was then located some 2 km from the site (Figure 2). The use of elevated, well-drained former shorelines adjacent to wetland resource habitats has been observed and reported at many other sites of similar antiquity in the Far Northeast of North America (e.g. Chapdelaine & Richard 2017; Ellis & Deller 1990; Speiss & Wilson 1987).

The palaeo-shorelines identified by LiDAR coupled with field confirmations were incorporated into the GIS model of former shorelines, taking into account the differential levels of isostatic rebound. The polygons generated to reflect the former shorelines were incorporated into the official Archaeological Predictive Model for New Brunswick (Suttie & Nicholas 2014). This inclusion highlighted the projected location of the former shorelines, to inform further research and impact assessments across the region. Over the course of the past decade, the combined work of archaeological research and cultural resource management (CRM) has identified localised variations in the modelled paleo-shorelines, which has in turn enabled amendments to the improving model.

A significant impact of the modelling of palaeo-landforms was the identification of a number of other Late Pleistocene and Early Holocene archaeological sites associated with palaeo-shoreline features (Archaeological Services Branch 2018; Hamilton & Jarrett 2015; Stantec 2010). This has improved archaeological understanding of the earliest periods of human occupation in the changing landscape of northeastern North America. Each new finding has informed subsequent research, and improved the continually developing Archaeological Predictive Model for New Brunswick.

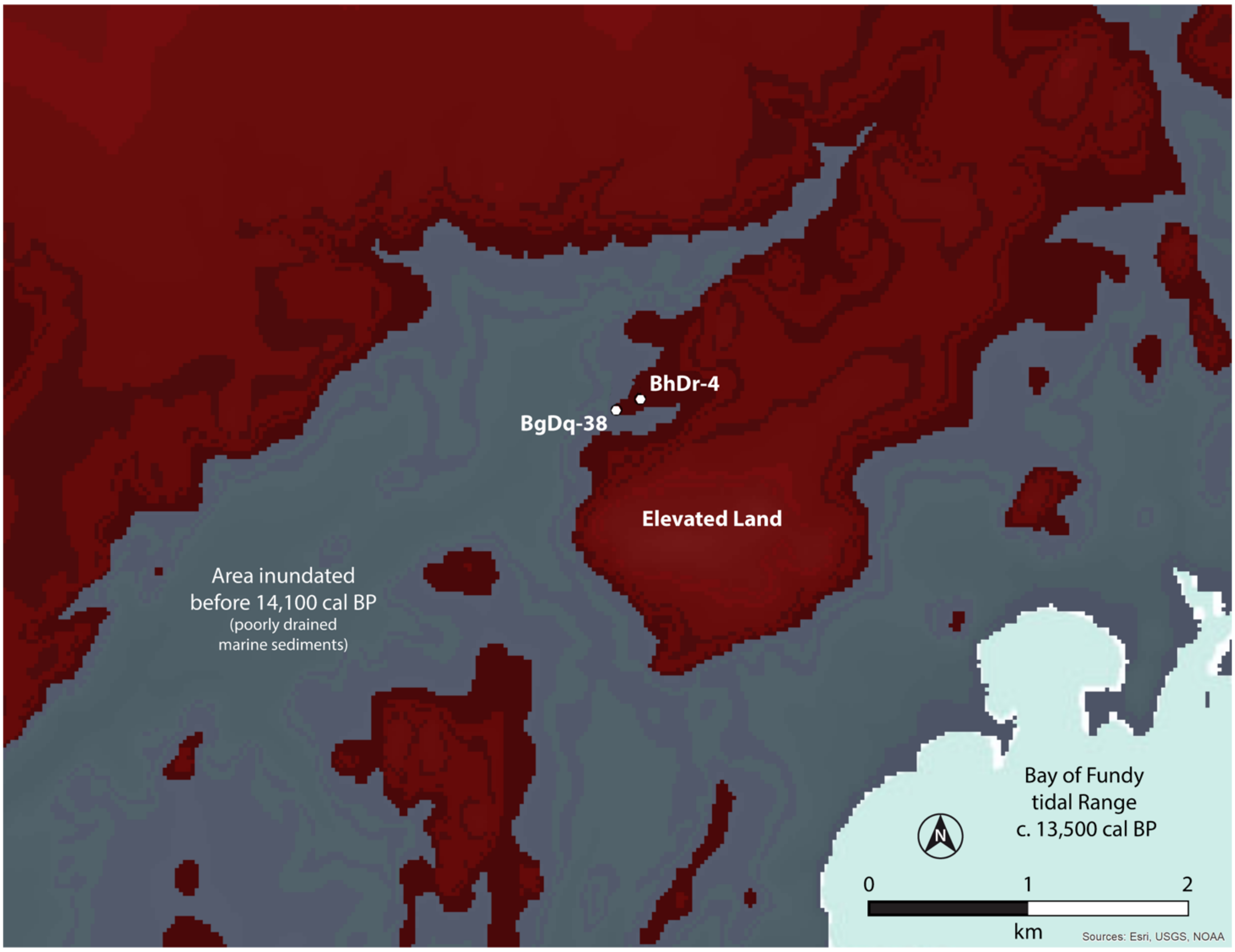

Figure 2. Map showing the location of two archaeological sites positioned along or near former shorelines in the Pennfield area. The red area indicates the area exposed as land both today and in the Late Pleistocene. The dark grey area depicts the extent of the Bay of Fundy c. 14,100 cal BP but is now dry land. The pale blue area depicts the tidal range of the Bay of Fundy c. 13,500 cal BP, after the land had risen and the shoreline retreated.

Modelling marine palaeo-shorelines has also resulted in the identification of other potential Pleistocene and Holocene shorelines and other significant palaeo-landforms across the region (Nicholas et al. 2022). These features include marine and lacustrine shorelines, wetlands representing infilled former lake basins and river valleys, and drowned or elevated former islands, all of which were likely the focus of human activity in the past. Efforts are currently underway to create an inventory of these transformed landscape features, along with associated temporal data, in order to begin to integrate them into the Archaeological Predictive Model for New Brunswick, to ensure that they are recognised and investigated in future research.

The identification of former landscape features without known toponyms, such as now-drowned islands, wetlands and lakes, led a noted and respected Indigenous archaeologist, the late Michael Nicholas, to draft a proposal to engage directly with contemporary Indigenous Nations in whose Traditional Territories these features are located. This partnership was intended to determine whether Indigenous Knowledge of the places existed, or indeed if former names were known by Indigenous knowledge-holders for these locations (Nicholas 2016). If no toponyms were known, Nicholas suggested a process by which a Nation might engage with Elders and Knowledge Holders within the communities to determine appropriate names for the features. This approach enhances the recognition of features of the palaeo-landscape, and aims to reconnect Indigenous names with places that may have held significance to ancestors and may retain that significance today. It was further proposed that, until this process was established, archaeologists and researchers should use a form of alpha-numeric designation to refer to the features. This suggestion has now been adopted and an inventory of features of past landscapes is nearing completion. The next phase will continue to work with Indigenous Nations and researchers to help understand and promote the palaeo-features' contemporary relevance.

The work begun by Michael Nicholas and carried on by his colleagues in New Brunswick demonstrates several points of relevance for palaeo-landscape modelling in archaeology and heritage management. Understanding the changing form of the landscape over time allows archaeologists and geomorphologists to identify palaeo-landforms. Integrating LiDAR data, landscape modelling, archaeological survey and excavation, palaeontological analyses and geomorphological research, enables features of former landscapes to be distinguished. Identifying such features can help archaeologists recognise areas where archaeological sites and other records of the human past are likely to be located, and thereby aid in both structuring field surveys and, once those results are in, conceptualising past land-use strategies. This has applications in archaeological predictive modelling, including for the continual revision and updating of the Archaeological Predictive Model for New Brunswick. The identification of palaeo-landforms can also emphasise the contemporary relevance of the archaeological landscape and be part of a conversation about heritage and its expressions. Engagement with Indigenous Nations, Elders and Knowledge Holders is an important dimension of palaeo-landscape modelling in New Brunswick as in many other parts of the world. This research is supporting significant discussions about palaeo-landscape features, including lakes, wetlands and islands that were used by the ancestors and that may be significant in Traditional Knowledge. Knowing and naming such features contributes to decolonising the landscape and making space for Indigenous topographies in multi-temporal landscapes.

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