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A Model of Coastal Wetland Palaeogeography and Archaeological Narratives: Loch Spynie, Northern Scotland

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ABSTRACT

This paper presents a new model for the palaeogeography of an important archaeological region in northern Scotland – the former Loch Spynie, Moray. The method employed refines existing glacio-isostatic adjustment and relative sea-level models for the Holocene with open data sources of geomorphological, geotechnical and archaeological data to constrain the proposed former extent of marine, estuarine and other wetland environment through time. The study area is shown to be an important isolation basin that is highly likely to preserve dateable relative sea-level index points. The resulting palaeogeographic model for the former Loch Spynie estuary is then used to develop an archaeological narrative of coastal and maritime activity in later prehistory critiquing and supporting an emergent paradigm in understanding later prehistory in northern Scotland. This study demonstrates how it is possible to develop palaeogeographic models at scales useful for site-based archaeological interpretation bridging a problematic gap in archaeological narratives.

KEYWORDS

Palaeogeography; sea-level change; maritime havens; Scotland; North Sea; Late Neolithic; Early Bronze Age; coastal archaeology

Introduction

The importance of understanding coastal wetland landscape change through time for archaeological interpretation has been highlighted consistently in north-west Europe for over a century (Reid 1913; Clark 1936; Coles 1998; Sturt, Garrow, and Bradley 2013; Bicket and Tizzard 2015; Sturt et al. 2018). Work has often focused on areas of significant relative sea-level rise resulting in submerged landscapes. Around the North Sea basin, exceptional evidence for submerged former coastal wetland landscapes has been explored, largely through remote sensing and palaeoenvironmental studies (Gaffney, Thomson, and Fitch 2007; Westley, Plets, and Quinn 2014; Bicket et al. 2017; Missiaen et al. 2021), although *in situ* archaeology is also known (e.g. Momber et al. 2011). In contrast, mainland Scotland is dominated by glacio-isostatic rebound with relative sea-level

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fall in the Holocene. Evidence for prehistoric coastal wetland activity is therefore located inland. Research on prehistoric maritime communities along the Moray Firth in northern Scotland has recently turned to examining relative sea-level changes and their impact on coastal wetland geomorphology as a primary focus for research (e.g. Bradley et al. 2016). This turn draws on Quaternary geological research in this region (see Smith et al. 2019), however, these studies are normally at scales too broad for detailed archaeological interpretation to be drawn out of them (Sturt, Garrow, and Bradley 2013, 3964; Griffiths et al. 2015; Bicket et al. 2017, 179–80; Shennan, Bradley, and Edwards 2018). Unpicking the human narrative of these former littoral zones relies upon developing finer-grained analyses that enable understanding of how the archaeology is shaped by dynamic changes in sea-level, other climate driven factors and anthropogenic processes. Efforts are needed to bridge the gap to bring broader-scale Quaternary sea-level analyses down more useful scales for archaeological narratives.

Using primarily freely available data, this paper presents a testable palaeogeographic model of a former lagoon system in northern Scotland – Loch Spynie, Moray. Loch Spynie is in an area known as the Laich of Moray, a low-lying coastal plain on the south side of the Moray Firth. The region is home to an exceptionally important and relatively well-studied archaeological record from at least the Mesolithic to the present. A time-slice palaeogeographic model presented here projects supra-regional relative sea-level (RSL) glacio-isostatic adjustment (GIA) models across the study area constrained by geomorphological, sedimentary and archaeological sea-level index points. The last 1000 years of the palaeogeographic model is also informed by documentary sources especially historic maps of the region. This blended approach brings into focus dynamic coastal wetland environments at scales useful for archaeological analysis (e.g. Dhoop 2016). As an example of the way this type of work can be a tool in the creation of testable archaeological narratives, this paper explores an emergent paradigm of 'maritime havens' of the Neolithic and Bronze Age of this region (Bradley et al. 2016) and what it might mean for major developments in understanding the movement of people (and their things and animals) indicated by ancient DNA (aDNA) studies (e.g. Olalde et al. 2018). This paper demonstrates what is possible as we enter a new era in the availability of large open datasets and asserts the importance of wetland palaeogeography in calibrating broader scale research to levels useful in addressing key archaeological questions.

The Study Area – The Laich of Moray

The coast between Burghead and Lossiemouth is characterised by sandstone cliffs the tops of which stand between 10 and 20 m above storm beaches below. These cliffs slope gently to the south (away from the coast) where they meet the 'Laich of Moray', an area of low-lying, now arable, land bounded by higher ground incised by the River Lossie to the south (Figure 1). Through the Holocene until the mid-second millenium AD, the Laich consisted of a large lagoon estuary (Loch Spynie) into which the River Lossie flowed. The lagoon lost its connection to the sea in the mid-second millennium AD creating a large freshwater loch which was partially documented by medieval records (Lewis and Pringle 2002, 12–3). Following the transition of the basin from estuary to lake, these wetland environments in the Laich were subsequently drained, culminating in the final drainage of Loch Spynie through a series of canals and ditches in the

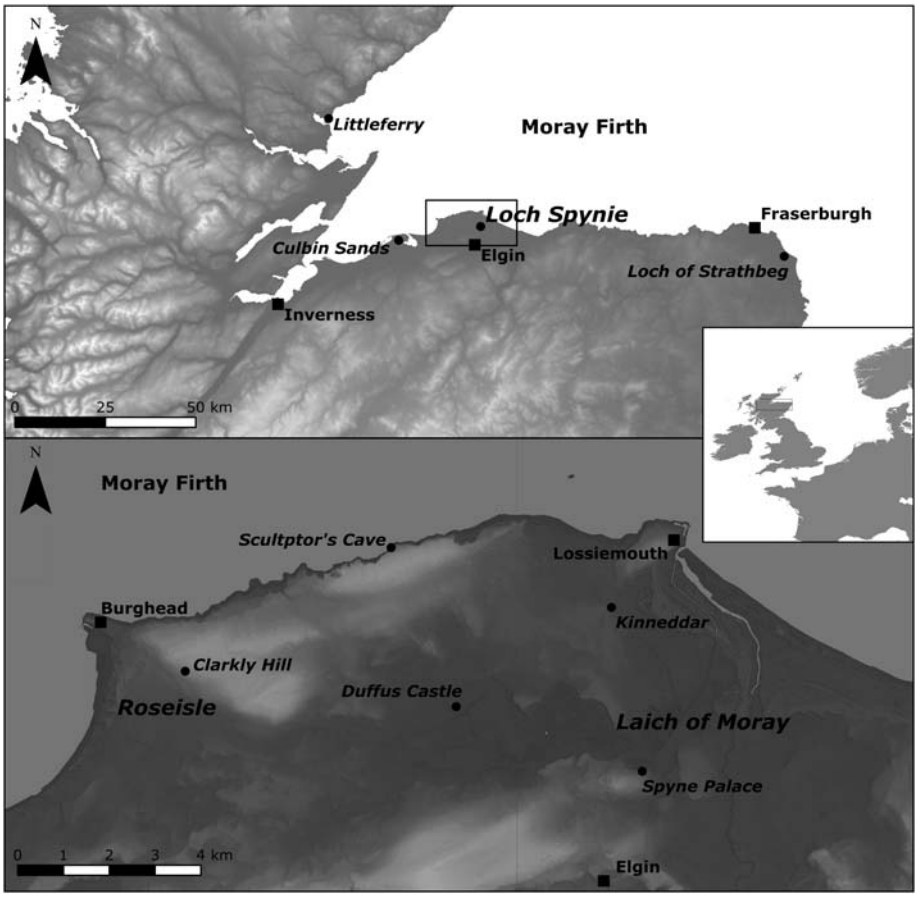

Figure 1. Map of the Laich of Moray, northern Scotland and other locations mentioned in the text.

early nineteenth century (Stratigos 2018). The extent of the former estuarine Loch Spynie has been subject to speculation since the nineteenth century (Martin 1837; Gordon 1859). Since then, characterisations of the former landscape have broadly outlined it based on available documentary, toponymic and archaeological data (Shepherd 1993; Jones and Mattingly 2002; Jones and Keillar 2002; Main 2009), but detailed testable palaeogeographic models have not been made.

Archaeological research programmes and development-led projects have taken place (or are in progress) in this area that cover most periods of human activity. Important evidence for Neolithic and Bronze Age burial was uncovered through the second half of the nineteenth century (e.g. Innes 1862). More recently, sealed Bronze Age and Iron Age deposits in a series of sea caves along the north-facing sea-cliffs in this area have revealed evidence for specific mortuary practices that probably included ritualised decapitation (Armit and Büster 2020). Successive programmes of aerial reconnaissance makes this part of Scotland among the best for aerially identified archaeology (Jones and Keillar 2002). One crop-mark site of note is the Iron Age settlement at Clarkly Hill which contained evidence for metal working and contact with the Roman Empire in the first centuries of the first millennium AD (Hunter 2012). Ongoing research at Burghead, a very large

coastal promontory fort, has confirmed it as a major centre of power in the Pictish period (AD 400–800), with continued activity into the ninth–tenth centuries AD (Noble pers comms.). Burghead, the Sculptor's Cave (also the site of Bronze and Iron Age funerary activity mentioned above), and the Kinnedar monastery and cathedral site, contain an internationally significant group of early medieval stone sculpture and carvings (Noble et al. 2019; Armit and Büster 2020). Spynie Palace, located on the southern shore of the former Loch Spynie estuary and first occupied in the twelfth century AD, was the residence of the Bishops of Elgin, among the most significant sees in pre-Reformation Scotland (Lewis and Pringle 2002).

Further development of archaeological narratives in this important landscape is hampered by the lack of detailed understanding of its palaeogeography. This stems in part from the inability to readily bridge the gap between the supra-regional GIA and RSL models and from the relative lack of palaeogeographic research in the region (Figure 2). In 2014, archaeological fieldwork was undertaken 25 km west of the Laich of Moray at Culbin Sands which has improved the situation in this part of Scotland. The work at Culbin suggested that the locality was a prehistoric maritime landing place (Bradley et al. 2016). The former coastline at Culbin Sands has recently been modelled suggesting

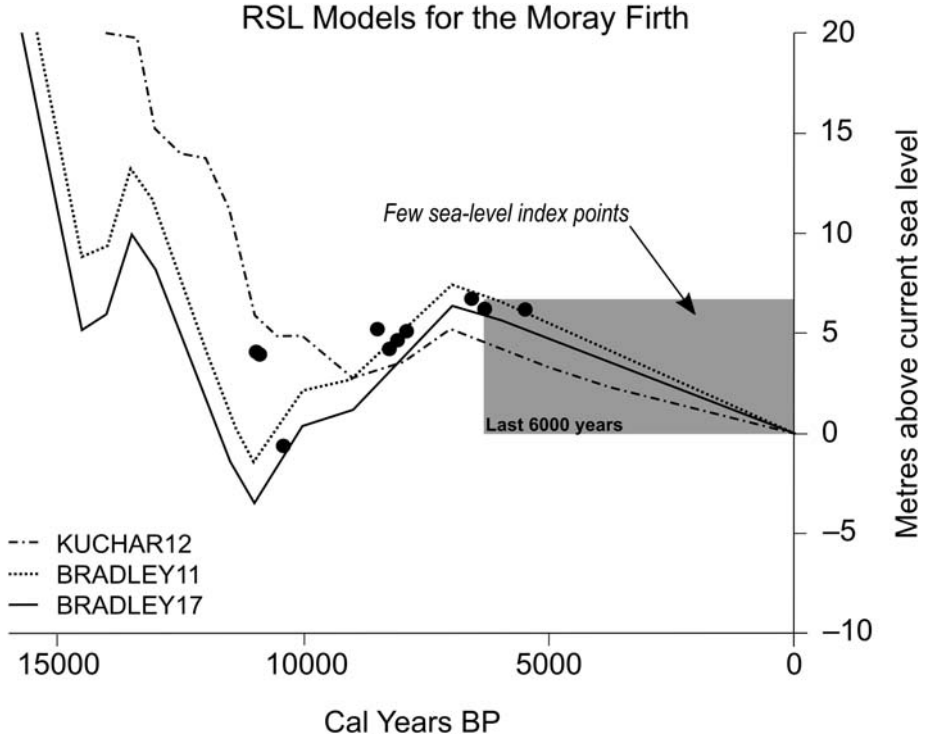

Figure 2. RSL models that incorporate GIA for the Moray Firth, note that there are few RSL index points for the last 5000 years and none from the Loch Spynie basin. Adapted from Shennan, Bradley, and Edwards 2018, 151. Reprinted from *Quaternary Science Reviews*, volume 188, Ian Shennan, Sarah L. Bradley, Robin Edwards, 'Relative sea-level changes and crustal movements in Britain and Ireland since the Last Glacial Maximum', pg 151, Copyright 2021, with permission from Elsevier. License # 502184079209.

isostatic rebound and sedimentation that saw the coastline move seaward from 4000–2000 cal BC (Bradley et al. 2016: Figures 2 and 3). GIA models put this part of the Moray Coast in a region of non-linear RSL change over the past 15,000 years, with RSL fall prior to 8000 cal BC, then rises in RSL to a mid-Holocene high-stand before falling again to present sea-level (Shennan, Bradley, and Edwards 2018, 148; Figure 2). However, there are no directly observed RSL index points from the Laich of Moray informing these models, meaning the trend surfaces calculated for GIA and RSL models are at their most interpolated in this region (Shennan and Horton 2002; Shennan, Bradley, and Edwards 2018; Smith et al. 2019). Furthermore, this does not account either for the very local nature of RSL change that can occur throwing off the predictive ability of GIA and RSL models at archaeological scales (Griffiths et al. 2015). To overcome this and develop palaeogeographies at archaeological scales, calibration of the larger-scale models with local data is necessary.

Materials and Method

Reconstruction of the coastal wetland palaeogeography of the Laich of Moray was undertaken through collation of modern elevation data, mapped geomorphological features, geotechnical data, archaeological records, toponymic data, other documentary records (especially historic maps) and regional GIA and RSL models (Table 1). In QGIS (ver. 3.10), estuarine and lacustrine environments were identified and mapped across the study area with reference to their height above Ordnance Datum (see following

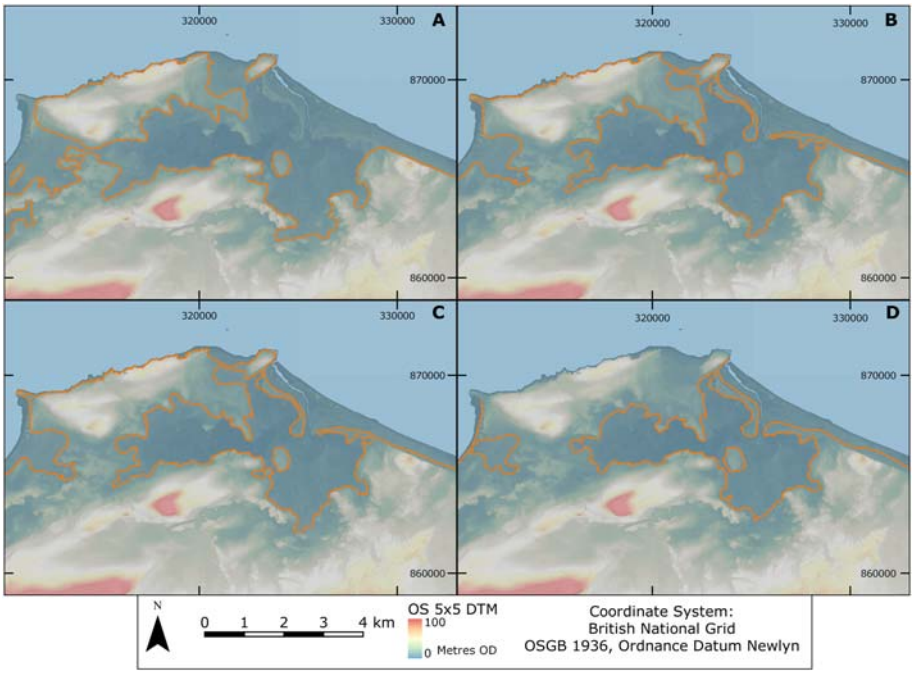

Figure 3. (A) Late glacial palaeoshoreline, before 12,000 cal BC. (B) Early Holocene low-stand shoreline c. 9000 cal BC. (C) Mid Holocene high-stand shoreline c. 6000 cal BC. (D) Neolithic shoreline c. 4000 cal BC.

Table 1. Data sources used in analysis see supplementary material.

Data	Source
British Geological Survey Borehole Scans	http://www.bgs.ac.uk/data/boreholescans/home.html
British Geological Survey 1:50,000 Superficial Geology	http://mapapps.bgs.ac.uk/geologyofbritain/home.html
BRITICE II, GIS database of glacial landforms of the last British–Irish Ice Sheet	https://doi.org/10.1111/bor.12273 (Clark et al. 2018).
Ordnance Survey 5 × 5 m Digital Terrain Model	https://digimap.edina.ac.uk/ (Note: not fully Open Data)
Scottish Government Phase I LiDAR	https://remotesensingdata.gov.scot/data#/list
Pont Maps of Scotland (1583–1614)	http://maps.nls.uk/pont/
Blaeu Atlas Maior (1662–5), Volume 6	http://maps.nls.uk/atlas/blaeu-maior/vol/6
Roy Military Survey of Scotland (1747–55)	http://maps.nls.uk/roy/index.html
Plan of the Loch of Spynie and Adjacent Grounds, Moray (1783)	http://www.scotlandsplaces.gov.uk/record/nrs/RHP427/plan-loch-spynie-and-adjacent-grounds-moray/nrs
First Edition 6″ Ordnance Survey (Elgin Sheets, I, II, III, VI, VII, VIII)	http://maps.nls.uk/os/6inch/index.html
CANMORE Database, Sites and Monuments of Scotland	https://canmore.org.uk/site/search
GIA and RSL models	Shennan, Bradley, and Edwards (2018); Smith et al. (2019).

paragraphs for description of these different features and how they relate to the palaeogeography). These heights were then used to establish contours on 5 × 5 m Ordnance Survey Digital Terrain Model (OS DTM) within QGIS as a first-pass model for former shorelines. These contours were then cleaned by hand within QGIS for each feature and with reference to the collated geotechnical, archaeological and documentary data to produce the final models for shorelines and other wetland environments (Supplementary Data).

Geomorphological and geological sea-level, lacustrine and bog/fen index points were identified from a range of open datasets (Table 2 – BRITICE II, BGS 1:50,000 superficial geology and the National Geoscience Data Centre collection of borehole scans). RSL index points included raised beach ridges, marine/estuarine sediment and lacustrine and bog/fen sediment (see Shennan, Bradley, and Edwards 2018: Table 1). The National Geoscience Data Centre collection of borehole scans was especially useful for providing height data on sediment RSL index points (Supplementary Material).

Archaeological index points were identified from a download of all records available in the Scottish national archaeological sites and monuments database Canmore comprising a total of 430 records (Supplementary Material). Effort was made to clean the archaeological data through assessment of each record, removing duplicates and highly uncertain/dubious records. Records for post-AD 1700 were filtered out due to how numerous they

Table 2. Period classifications adapted from Mann (2013).

Palaeolithic	40,000 BC–9000 BC	
Mesolithic	9000 BC–4000 BC	Transition Period 1
Early Neolithic	4000 BC–3300 BC	
Late Neolithic	3300 BC–2500 BC	Transition Period 2
Early Bronze Age	2500 BC–1800 BC	
Middle Bronze Age	1800 BC–1300 BC	
Late Bronze Age	1300 BC–800 BC	Transition Period 3
Earlier Iron Age	800 BC–400 BC	
Later Iron Age	400 BC–AD 1	
Roman Iron Age	AD 1–AD 250	
Late Roman Iron Age	AD 250–AD 400	Transition Period 4
Early Medieval	AD 400–AD 1000	
Medieval	AD 1000–AD 1600	

are and that from after AD 1700 documentary evidence, particularly from maps, provide greater spatial and chronological precision in modelling former environments. Period classifications for before AD 1700 were applied to the records where there they were not already indicated following Mann (2013) (Table 2). The heights above Ordnance Datum (OD) for all the archaeological index points were extracted from the 5 × 5 m OS DTM.

Chronological intervals were selected based upon archaeological transitions (which allow archaeological records datable to those broad periods to be used to constrain former marine extents) and Smith et al. (2019) review of Scottish Quaternary sea-levels that identify a series of dated shorelines across Scotland. More recent intervals are examined relevant to the archaeological narrative and local conditions of the study area (c. AD 1400, AD 1750 and Present). No geomorphological features in the study area are directly dated, so dates from cognate features directly dated elsewhere along the Moray Firth have been used. Terrestrial archaeological records of likely or known date were used to constrain the maximum height of Mean High Water Spring Tides (MHWS). For the periods covering the last c. 400–600 years, documentary and cartographic sources were primarily used which provide finer detail in the presence and extent of marine, estuarine and other wetland environments.

Results and Discussion

Late Glacial–4000 cal BC

Before c. 12,000 cal BC, the Laich of Moray was either covered by the Moray Firth lobe of the British and Irish Ice Sheet or submerged with former sea-level at least as high as +10 m OD creating an island between Burghead and Lossiemouth (Figure 3(a)) (Shennan, Bradley, and Edwards 2018; Smith et al. 2012, 2019). Sub- and peri-glacial features are found within the Laich of Moray mostly related to the retreat of the last glaciation (BRITICE II data). Between 10,500 cal BC and 9000 cal BC, during the Loch Lomond Stadial (or Younger Dryas), sea level in this area rapidly drops to a level between −1 m OD and −3 m OD (Figure 3(b)) (Smith et al. 2012). This period of lower RSL is probably represented by the submerged forest and land-surface at Burghead beach (SCAPE: site #12864). The Loch Spynie basin would have been fully above sea-level at this time although probably remained dominated by lacustrine and/or bog/fen environments. Unfortunately, there is no secure recorded archaeology in this area from this relatively early period, although Palaeolithic material in Scotland has only been consistently identified in the last 15–20 years and it is possible that future finds or re-examination of older lithic material might uncover Palaeolithic evidence in this area (ScARF 2012, 12).

The period of lower RSL during the Loch Lomond Stadial was followed by marine transgression through the period c. 8000–4000 cal BC. The highest shoreline here is indicated by the largest and highest (most westerly) beach ridge in the study area which stands at +8 m OD (Figure 3(c)). This, and other ridges to the east, are visible in available LiDAR data and relevant borehole scans. The Loch Spynie lagoon would have been established behind the first raised beach ridge at +8 m OD. At Culbin Sands and in the Dornoch Firth are similar features with dated sequences of clastic layers (dating to the earlier Holocene pre-4500 cal BC) overlain by finer sands and gravel (post 4500 cal BC) (Comber 1995;

Firth et al. 1995; Hansom 2001). It is likely that they represent cognate features dating to the same period. This is consistent with GIA and RSL models that see a shoreline in this area at +6–8 m OD at c. 6000 cal BC suggesting the earliest beach ridge to the east of Loch Spynie was contemporary to this shoreline (Smith et al. 2012, 69). The former shoreline at c. 6000 cal BC has been proposed here at +7 m OD (Figure 3(c)).

From establishment of first beach ridge sometime before c. 6000 cal BC, the outlet of the Loch Spynie basin passed through a relatively narrow gap, which is now approximately 300 m wide, through the beach ridge formations. At this point, the environment of the Loch Spynie basin was an expansive, shallow estuarine lagoon. Projecting the modern spring tidal range of 3.5 m (Ramsay and Brampton 2000) onto these former shorelines, the horizontal distance between high and low tide in certain places could have reached greater than 1000 m. Surrounding the estuary, expansive bog/fen and open freshwater environments were also present indicated by BGS boreholes with recorded peats and clays consistent with these environments, especially to the west and south of the Loch Spynie basin. There is little archaeological evidence to help constrain the RSL model for this period. However, a series of shell middens are known from within the study area that may be of Mesolithic date. Although none are directly dated, two of the highest shell middens respect a +7 m OD shoreline. The first, Nether Meft shell midden, excavated in the nineteenth century contained marine species shells up to 500 mm deep alongside charcoal and flint flakes which point to a prehistoric use of the site (Morrison 1873, 251–2). The second, Easterton of Roseisle, is located closer to a what was probably a bay or small estuary at Roseisle to the west of the main Loch Spynie, and has been assumed to be Neolithic based on association to nearby Neolithic activity (Walker 1968).

4000 Cal BC–cal AD 1000

In this 5000-year period, there is substantial, but seemingly steady, RSL fall indicated by regional GIA models, from around +6 m OD to its present state (Smith et al. 2012; Shennan, Bradley, and Edwards 2018). The recorded Neolithic sites within the basin respect a shoreline at +6 m OD (Figure 3(d)). After the Neolithic, between c. 2500 cal BC and 1 cal BC, the situation is more difficult to discern. While Bronze Age (2500 cal BC–800 cal BC) archaeology is present across the study area, there is only a single identified record below the +6 m OD shoreline within the basin. It is a stray find, probably the tip of a Late Bronze Age sword, in the eastern side of the Loch Spynie basin (Hunter 1999). As such, the c. 2500 cal BC shoreline is the least well constrained for a period where one might expect significant settlement remains. As a result, the model for this period is based solely on projecting GIA and RSL models at +4 m OD (Figure 4(a)). The model suggests the find spot of the Late Bronze Age sword tip was within the former extent of the estuary, but this type of artefact is commonly known across Britain to be found in wetland locations as votive or ceremonial deposition (Yates and Bradley 2010, 406).

Sites within the area dated to the Iron Age (800 cal BC–cal AD 400) also respect a former shoreline as high as +4 m OD, but on balance a shoreline closer to +2.5 m OD can be proposed given GIA and RSL models. The potential for further marine transgressions through the first millennium BC cannot be ruled out here, and this might explain the lack of surviving archaeology dated to the Bronze Age and Iron Age in the areas

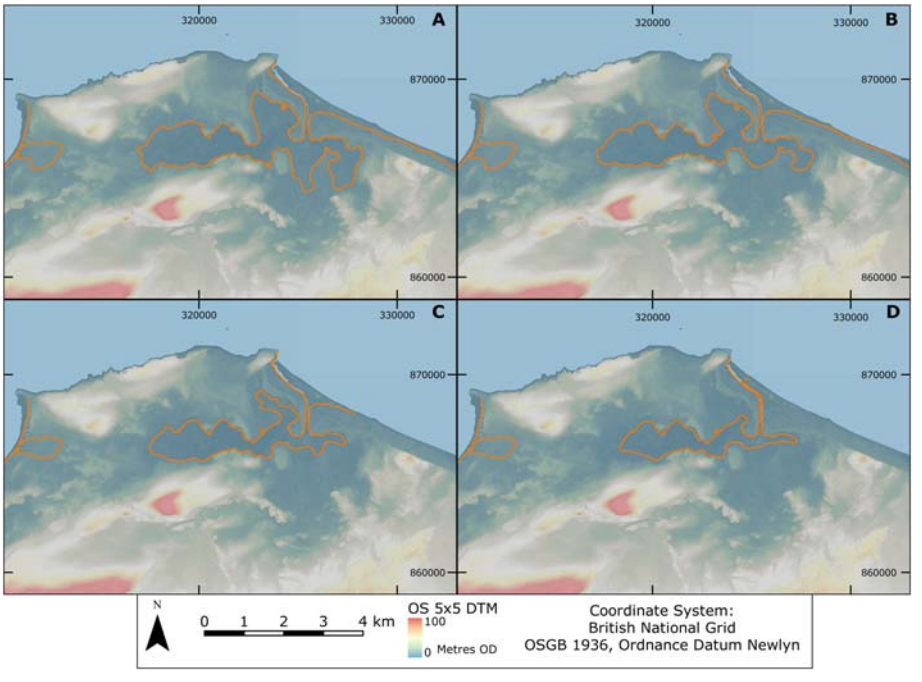

Figure 4. (A) Bronze Age shoreline c. 2500 cal BC. (B) Iron Age shoreline c. 800 cal BC. (C) early medieval shoreline c. cal AD 1000. (D) Medieval shoreline c. AD 1400.

between +2–6 m OD. Sturt, Garrow, and Bradley (2013, 3974) suggest increased rates of inundation in the North Sea zone in the periods 1500–1000 cal BC and 500–1 cal BC which could have overtaken rates of glacio-isostatic rebound at times. Thus, marine transgression may have removed some archaeological evidence from the later prehistoric period. There are a large number of 'ring-ditch' features that could constrain palaeoshorelines here, but the wide chronological horizon of the site-type and portmanteau application of the classification preclude their use here without direct dating evidence for them on a case-by-case basis. A further explanation for the lack of Bronze and Iron Age archaeology in these lower lying areas is that agricultural improvements since the mid-eighteenth century removed greater depths of archaeological strata in areas more recently below MHWS compared to those in more elevated locations, but this would require further detailed assessment. The rates and direction of RSL change after c. 1 cal BC are also difficult to pinpoint. However, by c. cal AD 1000 a palaeoshoreline at +2 m OD would remain consistent with the archaeological record and the RSL/GIA models for this area. and with wider patterns of RSL which sees relatively little RSL change over the past 2000 years in the UK and Ireland (Smith et al. 2019, 19) (Figure 4(b)).

Cal AD 1000–Present

In the second millennium AD, models indicate continued stable RSL around Loch Spynie, but the period of the Little Ice Age results in great change to this landscape. A former shoreline remaining at c. +2 m OD in line with RSL models (Smith et al. 2019, 19) can

be proposed for c. AD 1400, but with a significantly reduced area under intertidal conditions due to documented reclamation efforts, traces of which remain in several places in the basin, and likely sedimentation (Figure 4(c)). Historic records in this region from the middle of the fourteenth century AD describe the Loch Spynie basin as connected to the sea until that time (Innes 1837, 192). A medieval/post medieval salt production site at Salter Hill which sits at c. 1.5 m OD could have been located within the upper tidal range to capture sea water for evaporation driven salt production (Mackintosh 1924, 72). However, Loch Spynie is not depicted on any known maps as a sea loch, the earliest of which dates to the late sixteenth century. It can therefore be assumed that the basin's connection to the Moray Firth closes off by that time. From at least the fourteenth century, difficulties with sediment accumulation in the lagoon was occurring. John of Pilmuir (Bishop of Elgin from 1326–1362) attempted to keep the basin navigable through sinking ships (Simpson 1927, 17). More widely, wind-blown sand deposition caused problems for medieval communities across north-east Scotland with documentary records of other settlement abandonment (e.g. Forvie, Aberdeenshire, Griffiths 2015, 108). Similar events seem likely to have been responsible for cutting off Loch Spynie from the Moray Firth as wind-blown sand sits across the point where the basin connected to the sea through the beach ridges.

By the late sixteenth century, the formerly estuarine Loch Spynie was freshwater and in its western half, expanded (Figure 5(a)) with areas of medieval rig and furrow submerged at Wester Greens and Oakenhead (Plan of the Loch of Spynie and Adjacent Grounds, Moray). It is possible the inundated localities were within areas reclaimed in the medieval period from the estuarine Loch Spynie (Ross 2003, 209–10) (Figure 5 (a)). The other freshwater lochs, and the boggy ground around the Loch Spynie basin, which probably existed in some form since the area became ice free, were systematically drained as the Improvement period begins in earnest after c. 1750 (Stratigos 2018). The smaller lochs seem to have been nearly all drained by 1800, while Loch Spynie was drained in the first decades of the nineteenth century. By time of the production of the First Edition Ordnance Survey map in 1870–1, the only survival of the Laich of Moray wetland environments are small fragmented bodies of wetland environment (Figure 5(b)).

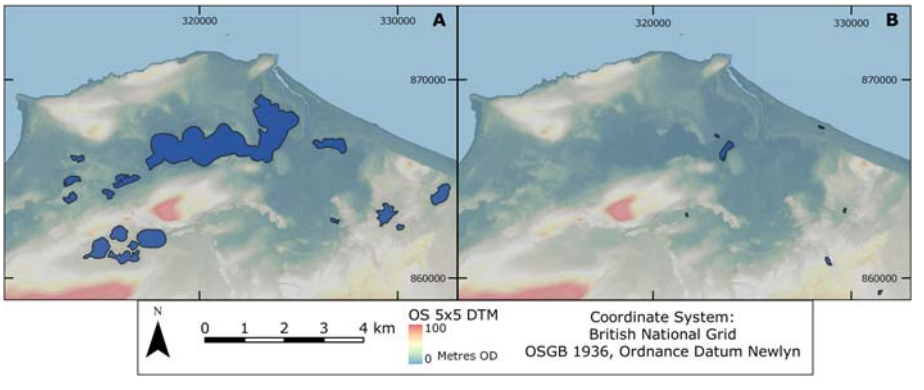

Figure 5. (A) Improvement period c. AD 1750. (B) Present.

Late Neolithic and Early Bronze Age Maritime Havens

The model palaeogeography laid out above could be used to test and propose archaeological narratives from any period from the Late Pleistocene to the present. But I wish to illustrate this briefly through exploring an emergent paradigm recently developed by Richard Bradley et al. (2016) in what they describe as 'maritime havens' dating to the Late Neolithic and Early Bronze Age. They suggest certain localities, at Culbin Sands (Bradley et al. 2016) and across the Moray Firth at Littleferry, Sutherland (Bradley et al. 2018), along with other examples from across Britain (Bradley et al. 2016, 16), can be identified from a particular palaeogeography and a range of material culture. A specific set of criteria for maritime havens in the Late Neolithic and Early Bronze Age was proposed with palaeogeographic features and material culture at its core (Bradley et al. 2016, 141, Table 2). They identify maritime oriented littoral areas composed of islands and promontories providing safe and convenient landing places for watercraft with further archaeological features highlighted as support indicators for maritime havens (Table 3).

It is thus striking that such assemblages and features are known from around the Laich of Moray just 10 km east of Culbin Sands. Like Culbin and Littleferry, Loch Spynie would have been a large, sheltered harbour associated with a major river in the Late Neolithic and Early Bronze Age, all three of these shared similar changing geographies as RSL dropped at this time. Loch Spynie has further similarities to Culbin and Littleferry which include a very rich archaeological landscape with material culture evidence for both local and long-distance trade networks. Although the areas around Loch Spynie do not have the quantity of lithic and ceramic material that Culbin Sands produced, there is clearly a Late Neolithic and Early Bronze Age presence known from the area. The most indicative find for local networks at the Laich comes from Culbin Sands. A lithic assemblage of silcrete found at Culbin most likely came from a source at Lossiemouth (Bradley et al. 2016, 134). Late Neolithic and Early Bronze Age non-local artefacts are known from Clarkly Hill where lithic finds of raw material from the Den of Boddam on the east coast of Aberdeenshire and flint from Yorkshire were found (Ballin 2014, 4) which is also paralleled at Culbin (Bradley et al. 2016, 134–5). Further evidence for long distance maritime connections around Spynie include jet necklaces from cist burials (Figure 6) – Tappoch Hill (Innes 1862) and Brandston (Morrison 1873, 256). Jet artefacts were being produced and exported to Scotland from around Whitby, Yorkshire from the Late Neolithic through the Early Bronze Age (Sheridan et al. 2002). It seems that along with Culbin Sands and Littleferry, the former Loch Spynie estuary would have been a Late Neolithic/Early Bronze Age maritime haven facilitating both local and long-distance journeys by boat. The proximity of the Laich of Moray and Culbin suggest these localities might be

Table 3. Criteria for maritime havens after Bradley et al. (2016).

	Culbin	Loch Spynie	Loch of Strathbeg
Location with sheltered harbour?	Yes	Yes	Yes
Location with major river mouth?	Yes	Yes	No
Artefacts present on promontory, bar, or island?	Yes	Yes	No?
Artefacts also present in the surrounding area?	Few	Yes	Yes
Evidence of hearths or other structures?	Yes	Few	No
Evidence of shell middens?	Yes	Yes	No
Evidence of burials?	Yes	Yes	Yes

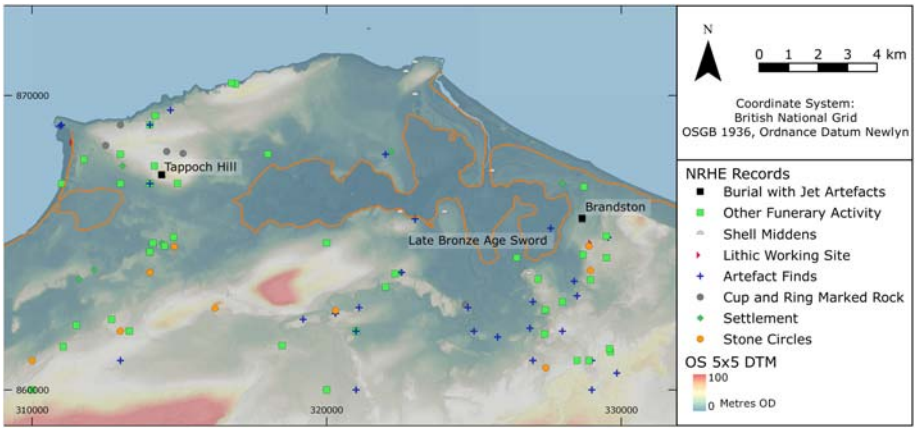

Figure 6. Recorded Late Neolithic and Bronze Age sites around the former maritime haven of Loch Spynie. Jet artefacts were recovered from funerary contexts at Tappoch Hill and Brandston.

far more common along the north-east Scottish coast. For example, another likely further example can be found at the Loch of Strathbeg, Aberdeenshire 80 km east of Loch Spynie (Figure 7).

This archaeological landscape and narrative for the Moray Firth region is elevated to central importance for north-west European prehistory in light of recent advances in aDNA indicating that large-scale movement of people that began in the Late Neolithic and Early Bronze Age resulted in 'a minimum of 90% +/− 2 population turnover' in Britain (Olalde et al. 2018). With seemingly every sheltered harbour around the north-east Scottish coast showing evidence for direct and implied local and long-distance maritime trade networks, we should assume that the genetic exchange indentified in this period occurred primarily through maritime vectors. This study and that of Bradley

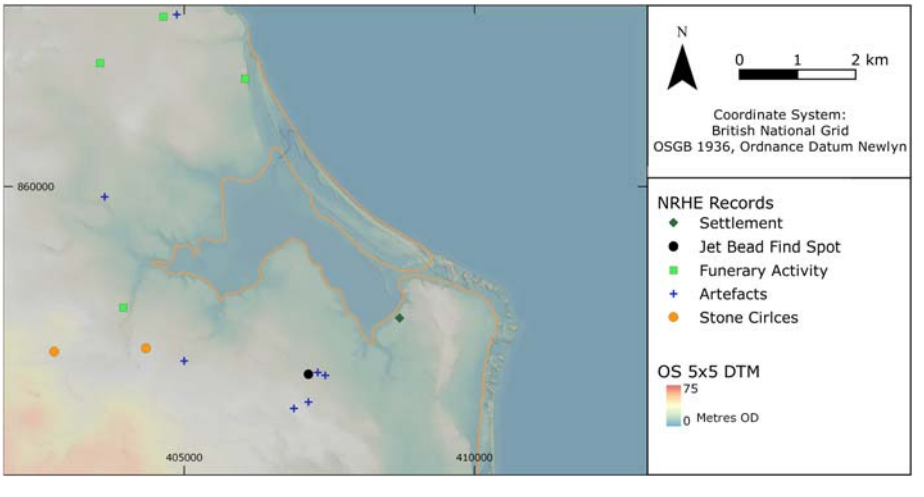

Figure 7. Loch of Strathbeg c. 2500 cal. BC shorelines. Note that far less survey has been carried out in this landscape compared to the Laich of Moray, thus the density of recorded archaeology consequently reduced.

et al. (2016, 2018) also highlight that this maritime movement of people, material and ideas was set within a landscape of dynamic coastal change in this region. There is a need to archaeologically address narratives developed out of aDNA research (including both intended and unintended narratives; see Downes 2019; Frieman and Hofmann 2019). The approach presented here, and the focused future work it can facilitate within the maritime havens paradigm, is a way in which we can study how that movement of people and things took place. In lieu of contemporary watercraft finds north of the Humber, England, it may be the only way to understand the nature of changing maritime networks in the transition from the Neolithic to the Bronze Age in north-west Europe and complex interaction of people from different communities it facilitated.

Conclusion

The palaeogeography set out above describes a series of major changes in the form and character of the coastal wetland landscape in the Laich of Moray through time. This has been achieved through collation and analysis of primarily freely available data and makes possible new interpretation of archaeological sites and approach in this important region. This was highlighted through consideration of Loch Spynie as a Late Neolithic and Early Bronze Age maritime haven, a concept which has emerged as an important lens for understanding this region, especially with recent developments in aDNA research indicating specific large scale movement of people beginning in this period. That so few direct archaeological remains of maritime journeys are known (i.e. boats and boat parts) from this period, it has been argued that palaeogeographic analysis of this kind may be one of the better ways in which we can archaeologically interrogate the process of maritime connectivity that appears to have been such an important part Late Neolithic and Early Bronze Age social and cultural trajectories. The former shorelines and wetland environments identified by this study can also be considered as a route map and series of hypotheses to test in order to tap into the significant potential this basin contains, both archaeological and palaeoenvironmental. Loch Spynie is an important isolation basin, and despite major drainage of this landscape in the eighteenth and nineteenth centuries, is still likely to preserve important records for Holocene RSL and how people have interacted with this dynamic coastal wetland environment through time.

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References

Armit, I., and L. Büster. 2020. *Darkness Visible: Later Prehistoric Ritual and Identity at the Sculptor's Cave, North-East Scotland*. Edinburgh: Society of Antiquaries of Scotland.

Ballin, T. B. 2014. "Moray's Lithics – Impressions from Local Museums and Excavations." Elgin Museum.

Bicket, A. R., C. L. Mellett, L. Tizzard, and C. Waddington. 2017. "Exploring Holocene Palaeogeography in the 'White Ribbon': a Mesolithic Case Study from the Northumberland Coast." *Journal of Quaternary Science* 32 (2): 311–328.

Bicket, A., and L. Tizzard. 2015. "A Review of the Submerged Prehistory and Palaeolandscapes of the British Isles." *Proceedings of the Geologists' Association* 126 (6): 643–663.

Bradley, R., A. Rogers, F. Sturt, A. Watson, D. Coles, J. Gardiner, and R. Scott. 2016. "Maritime Havens in Earlier Prehistoric Britain." *Proceedings of the Prehistoric Society* 82: 125–159.

Bradley, R., A. Watson, R. Scott, and A. Jack. 2018. "Littleferry, Sutherland: an Earlier Prehistoric Coastal Site in Context." *Proceedings of the Society of Antiquaries of Scotland* 147: 17–28.

Clark, J. G. D. 1936. *The Mesolithic Settlement of Northern Europe*. Cambridge: Cambridge University Press.

Clark, C. D., J. C. Ely, S. L. Greenwood, A. L. Hughes, R. Meehan, I. D. Barr, M. D. Bateman, et al. 2018. "BRITICE Glacial Map, Version 2: a Map and GIS Database of Glacial Landforms of the Last British–Irish Ice Sheet." *Boreas* 47 (1): 11–e8.

Coles, B. J. 1998. "Doggerland: a Speculative Survey." *Proceedings of the Prehistoric Society* 64: 45–81.

Comber, D. P. 1995. "Culbin Sands and the Bar." *The Scottish Geographical Magazine* 111 (1): 54–57.

Dhoop, T. 2016. "Shaped by Ships and Storms: A Maritime Archaeology of Medieval Winchelsea." PhD thesis, University of Southampton.

Downes, S. M. 2019. "The Role of Ancient DNA Research in Archaeology." *Topoi* pp. 1–9.

Firth, C. R., D. E. Smith, J. D. Hansom, and S. G. Pearson. 1995. "Holocene Spit Development on a Regressive Shoreline, Dornoch Firth, Scotland." *Marine Geology* 124 (1): 203–214.

Frieman, C. J., and D. Hofmann. 2019. "Present Pasts in the Archaeology of Genetics, Identity, and Migration in Europe: a Critical Essay." *World Archaeology* 51 (4): 528–545.

Gaffney, V., K. Thomson, and S. Fitch. 2007. *Mapping Doggerland: The Mesolithic Landscapes of the Southern North Sea*. Oxford: Archaeopress.

Gordon, G. 1859. *The Geology of the Lower or Northern Part of the Province of Moray: Its History, Present State of Inquiry and Future Examination*. Edinburgh: Neill and Co.

Griffiths, D. 2015. "Medieval Coastal Sand Inundation in Britain and Ireland." *Medieval Archaeology* 59 (1): 103–121.

Griffiths, S., F. Sturt, J. K. Dix, B. Gearey, and M. J. Grant. 2015. "Chronology and Palaeoenvironmental Reconstruction in the Sub-tidal Zone: a Case Study from Hinkley Point." *Journal of Archaeological Science* 54: 237–253.

Hansom, J. D. 2001. "Coastal Sensitivity to Environmental Change: a View from the Beach." *Catena* 42 (2): 291–305.
Hunter, F. 1999. "Stonewells (Urquhart Parish), Fragment of Bronze Blade; Iron Age Decorated Stud; Romano-British Brooch." *Discovery and Excavation in Scotland*, p. 64.
Hunter, F. 2012. Excavations at Clarkly Hill, Roseisle, Moray 2011 Interim Report. National Museums of Scotland. Accessed December 3, 2020. https://canmore.org.uk/collection/1331408.
Innes, C. 1837. *Registrum Episcopatus Moraviensis, e pluribus codicibus consarcinatum circa AD 1400*. Aberdeen: Bannatyne Club.
Innes, C. 1862. "Notice of a Tomb on the Hill of Roseisle, Morayshire, Recently Opened; Also of the Chambered Cairns and Stone Circles at Clava, on Nairnside." *Proceedings of the Society of Antiquaries of Scotland* 3: 46–50.
Jones, G. D. B., and I. Keillar. 2002. "'In Fines Borestorum': Reconstructing the Archaeological Landscapes of Prehistoric and Proto-Historic Moray." *Northern Scotland* 22 (1): 1–25.
Jones, G. D. B., and D. Mattingly. 2002. *An Atlas of Roman Britain*. Oxford: Oxbow Books.
Lewis, J. H., and D. Pringle. 2002. *Spynie Palace and the Bishops of Moray: History, Architecture and Archaeology*. Edinburgh: Society Antiquaries Scotland.
Mackintosh, H. B. 1924. *Pilgrimages in Moray: a Guide to the County*. Elgin: W.R. Walker and Co.
Main, J. 2009. *The Moray Coast: From Cullen to Culbin Through Time*. Stroud: Amberley Publishing.
Mann, B. 2013. *North-East Scotland Research Framework*. Aberdeen: Aberdeenshire Council.
Martin, J. 1837. "On the Geology of Morayshire." *Prize-Essays and Transactions of the Highland and Agricultural Society of Scotland* 5: 417–440.
Missiaen, T., S. Fitch, M. Muru, R. Harding, A. Fraser, M. De Clercq, D. G. Moreno, W. Versteeg, and V. Gaffney. 2021. "Targeting the Mesolithic: Interdisciplinary Approaches to Archaeological Prospection in the Brown Bank Area, Southern North Sea." *Quaternary International* 584: 141–151.
Momber, G., D. Tomalin, R. G. Scaife, and J. Satchell. 2011. *Mesolithic Occupation at Bouldnor Cliff and the Submerged Prehistoric Landscapes of the Solent*. York: Council for British Archaeology.
Morrison, J. 1873. "Remains of Early Antiquities, in and on the Borders of the Parish of Urquhart, Elgin, Including Hut Circles, Kitchen Middens, Stone Cists with Urns, Stone Weapons, etc., etc." *Proceedings of the Society of Antiquaries of Scotland* 9: 250–263.
Noble, G., G. Cruikshanks, L. Dunbar, N. Evans, D. Hall, D. Hamilton, C. MacIver, et al. 2019. "Kinneddar: a Major Ecclesiastic Centre of the Picts." *Proceedings of the Society of Antiquaries of Scotland* 148: 113–145.
Olalde, I., S. Brace, M. E. Allentoft, I. Armit, K. Kristiansen, T. Booth, N. Rohland, et al. 2018. "The Beaker Phenomenon and the Genomic Transformation of Northwest Europe." *Nature* 555: 190–196.
Ramsay, D. L., and A. H. Brampton. 2000. Coastal Cells in Scotland: Cell 3 – Cairnbulg Point to Duncansby Head. Scottish Natural Heritage Research, Survey and Monitoring Report No. 145.
Reid, C. 1913. *Submerged Forests*. Cambridge: Cambridge University Press.
Ross, A. 2003. "The Province of Moray, c. 1000–1230." Unpublished PhD thesis, University of Aberdeen.
ScARF. 2012. *Palaeolithic & Mesolithic Panel Report*. Edited by A. Saville, and C Wickham-Jones, Scottish Archaeological Research Framework: Society of Antiquaries of Scotland. Accessed 2 December 2020. http://tinyurl.com/d86dgfq.
Shennan, I., S. L. Bradley, and R. Edwards. 2018. "Relative Sea-Level Changes and Crustal Movements in Britain and Ireland Since the Last Glacial Maximum." *Quaternary Science Reviews* 188: 143–159.
Shennan, I., and B. Horton. 2002. "Holocene Land- and sea-Level Changes in Great Britain." *Journal of Quaternary Science* 17 (5-6): 511–526.
Shepherd, I. 1993. "The Picts in Moray." In *Moray: Province and People*, edited by W. H. D. Sellar, 75–90. Edinburgh: The Scottish Society for Northern Studies.
Sheridan, A., M. Davis, I. Clark, and H. Redvers-Jones. 2002. "Investigating Jet and Jet-like Artefacts from Prehistoric Scotland: the National Museums of Scotland Project." *Antiquity* 76 (293): 812–825.
Simpson, W. D. 1927. *The Palace of the Bishops of Moray at Spynie*. Elgin: James D. Yeadon.
Smith, D. E., N. L. Barlow, S. L. Bradley, C. R. Firth, A. M. Hall, J. T. Jordon, and D. Long. 2019. "Quaternary Sea Level Change in Scotland." *Earth and Environmental Science Transactions of the Royal Society of Edinburgh* 110 (1–2): 219–256.

Smith, D. E., N. Hunt, C. R. Firth, J. T. Jordan, P. T. Fretwell, M. Harman, J. Murdy, J. D. Orford, and N. G. Burnside. 2012. "Patterns of Holocene Relative Sea Level Change in the North of Britain and Ireland." *Quaternary Science Reviews* 54: 58–76.

Stratigos, M. J. 2018. "Loch Drainage and Improvement in Scotland." *Landscape History* 39 (2): 71–89.

Sturt, F., N. C. Flemming, D. Carabias, H. Jöns, and J. Adams. 2018. "The Next Frontiers in Research on Submerged Prehistoric Sites and Landscapes on the Continental Shelf." *Proceedings of the Geologists' Association* 129 (5): 654–683.

Sturt, F., D. Garrow, and S. Bradley. 2013. "New Models of North West European Holocene Palaeogeography and Inundation." *Journal of Archaeological Science* 40 (11): 3963–3976.

Walker, I. C. 1968. "Easterton of Roseisle: a Forgotten Site in Moray." In *Studies in Ancient Europe: Essays Presented to Stuart Piggott*, edited by J. M. Coles and D. D. A. Simpson, 95–115. Leicester: Leicester University Press.

Westley, K., R. Plets, and R. Quinn. 2014. "Holocene Paleo-Geographic Reconstructions of the Ramore Head Area, Northern Ireland, Using Geophysical and Geotechnical Data: Paleo-Landscape Mapping and Archaeological Implications." *Geoarchaeology* 29 (6): 411–430.

Yates, D., and R. Bradley. 2010. "Still Water, Hidden Depths: the Deposition of Bronze Age Metalwork in the English Fenland." *Antiquity* 84: 405–415.