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Submerged archaeological landscape investigation, Eleven Ballyboes, Republic of Ireland

Kieran Westley
Centre for Maritime Archaeology, Ulster University, Coleraine, BT52 1SA, Northern Ireland.
Email: kl.westley@ulster.ac.uk

Abstract
This paper reports on the first systematic attempt to conduct archaeological survey and excavation for submerged prehistory on the island of Ireland. Fieldwork was conducted in two small bays where early Mesolithic flint artefacts washed ashore hinted at the presence of a submerged assemblage. Methods employed include non-intrusive survey, hand coring and excavation. Together, these allowed identification of the artefact source (albeit reworked) in one bay and an early Holocene peat in the other. Though the subtidal assemblage is reworked and relatively small, it is significant in an Irish context and more widely illustrates the potential preservation of prehistoric sites and palaeo-landscapes in high-energy settings.

Key words:
Mesolithic, Holocene, peat, lithics, sea-level change, underwater archaeology

Introduction

Despite its island nature, the identification of submerged prehistoric sites and landscapes around the island of Ireland has lagged behind many of its Northwest European neighbours. England, for instance, has seen extensive work on the Mesolithic site of Bouldnor Cliff (submerged 11-12 m deep beneath the Solent) since its discovery in 1999 (Momber et al., 2011). Recent subtidal investigations in the Bristol Channel (Sturt et al., 2014) have also added to the numerous prehistoric intertidal finds from this area (Bell, 2007). Spectacular Middle Palaeolithic finds dredged from Area 240 (11 km offshore East Anglia) highlight the potential time depth of preserved archaeological landscapes submerged in the North Sea and have been recently subject to in-depth geophysical and geotechnical investigation (Tizzard et al., 2014). This has supplemented the considerable body of work already done by Gaffney et al. (2007; 2009) on North Sea palaeo-landscapes. In the Netherlands, a potentially in situ Mesolithic site submerged 20m deep at Maasvlakte (Rotterdam Harbour) has recently been discovered (Weerts et al., 2012; Vos et al., 2012) and adds to the vast quantity of Pleistocene/Holocene faunal and archaeological material trawled from the Dutch continental shelf (Peeters et al., 2009; Peeters & Cohen, 2014). Further afield, there is much well-documented submerged Mesolithic and Neolithic evidence from the Baltic, principally Denmark (Pedersen et al., 1997; Fischer, 2011), but more recently also including sites from Sweden (Hammarlund et al., 2013), Norway (Nymoen & Skar, 2011) and Germany (Lübke et al., 2011). These, and other, sites around the world have made a valuable contribution to knowledge, either through exceptional preservation or provision of unique evidence (Benjamin et al., 2011). By contrast, the Irish record of submerged prehistoric sites and landscapes does not extend beyond the intertidal zone (e.g. O'Sullivan, 2001; McErlean et al., 2002) and a handful of stray lithic finds from offshore (e.g. Common, 1933; Campbell, 2003; Westley & Woodman, forthcoming). Consequently, the nature of the Irish submerged prehistoric record, and its potential contribution to knowledge, remains conjectural at present.

Ireland's position on the edge of Atlantic may have contributed to this. The winter storms can be ferocious and their impacts on coastal archaeological sites correspondingly destructive (Edwards & O'Sullivan, 2007). This high-energy regime is reflected in the often rugged and rocky nature of the Irish coastline. Therefore, it may have often been assumed that, in contrast to the more sheltered North and Baltic Seas, archaeological sites and palaeo-landscapes were simply less likely to survive underwater. This mindset was arguably once applied to the island's shipwreck record (Breen 1996: 55). However, thanks to over twenty years of concerted work by maritime archaeologists in the Republic of Ireland and Northern Ireland, this has been proved false with numerous wrecks surviving despite the harsh conditions (e.g. Breen, 2001; Wheeler, 2002; Callaghan et al., 2007; Kelleher, 2011; Brady et al., 2012). The same may yet be true of the prehistoric submerged record, and its survival is partially supported by numerous instances of peats and forests preserved in the intertidal zone. These are found all around Ireland in contexts ranging from exposed beaches to sheltered sea loughs and are often only revealed when storms strip away the covering sand (e.g. Mitchell, 1976; O'Sullivan, 2001; McErlean et al., 2002; Wilson et al., 2011). The vast majority are Holocene in date, with a few Late Pleistocene examples (Carter, 1982).

It is only within the last decade that serious consideration has been given to the lack of research on submerged archaeological landscapes in Ireland (Bell et al., 2006). Even so, the most concerted efforts have been made only in the last five years. These have focused mainly on palaeo-landscape mapping and reconstruction (e.g. Westley et al., 2011a; 2011b; 2014), an approach heavily driven by availability of data generated by extensive seabed mapping of the Irish continental shelf (e.g. Dorschel et al., 2011). Although potentially useful for archaeological prospection and interpretation (e.g. Westley et al., 2014), these studies have yet to bridge the gap between palaeo-landscape reconstruction and archaeological site discovery. Therefore, this brief paper will report on the first attempt in Ireland to go beyond the landscape-scale research and conduct systematic survey/excavation for prehistoric material below the Low Water Mark.

Study area

The study area encompasses two small bays located in Eleven Ballyboes townland on the western shore of Lough Foyle (Co. Donegal, Republic of Ireland) (Fig. 1). The bays are unnamed and located on either side of the Skate Rock. Hereafter, the bay to the west of Skate Rock is referred to as SKW and that to the east as SKE. The former is c. 50 m wide across by 100-120 m long; the latter is slightly smaller (c. 40 x 100 m). Both comprise small sandy headland-embayment beaches backing onto former dunes (now a golf course) and separated by rocky headlands composed of steeply dipping Dalradian (Precambrian) metasediments (Cooper & Gault, 2002: 123).

Given local relative sea-level (RSL) history, the modern configuration of these bays only formed within the last few thousand years. Extant data and Glacio-Isostatic-Adjustment (GIA) modelling indicate a complex pattern of RSL change stemming from crustal rebound driven by the removal of large ice sheets at the end of the Last Glacial (Brooks et al., 2008; Bradley et al., 2011). The study area saw an initial highstand to c. 20-25 m at c. 20,000 cal BP followed by a lowstand of c. -10-15 m between 11-15,000 cal BP. This was then terminated by a second rise to a small highstand of c. 3-4 m at 6-7,000 cal BP and finally a fall to modern sea-level during the Late Holocene during which the present configuration of the study area was attained (Fig. 2). These changes are reflected by a series of raised shorelines (albeit many undated) around Lough Foyle (Cooper & Gault, 2002) and submerged and intertidal Holocene peats within the study area and wider region (see below and Westley et al., 2014). This pattern of RSL change also means that there was only a short (and relatively shallow) lowstand 'window' along the north coast of Ireland during which presently submerged landscapes were available for occupation.

Investigation focused on the Eleven Ballyboes bays for two reasons. Firstly, a large (c. 1700 items) collection of lithic material has been recovered from the intertidal zone over the last 15 years by local collectors (McNaught, 1998). Analysis of this collection identified a number of typically Earlier Irish Mesolithic (9800-8400 cal BP: Woodman, 2012: 1) forms such as single-platform cores, narrow blades and flake axes (Fig. 3; Costa et al., 2001). The lithics are in secondary context and the vast majority are water-rolled. They were therefore been interpreted as eroding out of a submerged deposit and washing ashore (McNaught, 1998: 65; Costa et al., 2001: 1).

Secondly, palaeo-geographic reconstructions suggest that the environment was transformed by lowered RSL during the early Mesolithic (Westley et al., 2011a: 106). The area presently covered by Lough Foyle was subaerially exposed and probably formed a broad plain/valley channelling the Foyle and Roe rivers out across the exposed continental shelf. Under these conditions, the study area was probably situated on a bluff overlooking the tidal stretches of the river Foyle (Fig. 4), a topographic situation previously suggested to be favoured for Mesolithic settlement (Woodman, 1978: 167).

Methods

Fieldwork at Eleven Ballyboes took place over three short field seasons during 2011-2013. Fieldwork was conducted in a stepwise fashion, aiming first to ascertain if the lithics were eroding out of the beach or backshore rather than washing in from offshore. This was done via intertidal test pitting, with three 1 x 1 m pits placed along each beach in both SKW and SKE. Subsequent offshore work then first utilized non-intrusive swimover surveys (along systematic transects) by divers to assess seabed character and locate any archaeological material lying on the seabed. In all cases, position fixing was done using a handheld GPS operated by a surface swimmer for shallower areas or attached to a surface marker buoy for deeper areas. The swimover survey was followed up by sediment coring along transects. This used simple 75 cm-long by 3 cm-wide PVC tubes hammered into the seabed by hand and split for recording on land after recovery. This was done to characterize sub-seabed stratigraphy and identify deposits of archaeological potential. Once identified, these deposits were then targeted for excavation, initially by small hand-dug test pits (2012), then in the final (2013) season by 0.5 x 0.5 m pits either dug using an induction dredge or block-lifted for excavation on land. The strategy of predetermining pit locations based on interpretation of core stratigraphy was chosen after a largely unsuccessful attempt using random sampling in 2011. Therefore, the following discussion will only use information from the 2012-13 pits.

Test pits and cores were laid out off a fixed baseline using 30 m hand tapes. Both SKE and SKW baselines were surveyed in using a Trimble RTK-GPS system (survey accuracy of ±3-4 cm). For the shallowest areas, this was deployed by wading at low spring tide and for deeper areas, was deployed from a small boat and guided by a diver. However, the RTK-GPS survey did not cover the entirety of each bay and was only used in the 2013 field season. Consequently, all depth measurements in the following text will be made with reference to a bathymetric LiDAR dataset which covers the entire study area, unless otherwise stated. This will ensure consistency in the reporting of depths which will be referenced to Ordnance Datum (Belfast) (OD(B)).

Results: Skate Rock West

Intertidal Excavation

Test pits in SKW reveal that the beach/intertidal zone is composed of sand or gravel at least 35-40 cm thick and lying above a layer of red-coloured silty gravel. This thickness of this layer could not be established due to the water table. Eight undiagnostic struck flints were found in the three test pits. These finds were water-rolled and spread throughout the excavated layers, along with modern litter such as bottle glass. This suggests that the upper sand and gravel layers of both beaches are constantly reworked and artefacts are not in situ. Moreover, there was no evidence of an eroding backshore. Together, this supported the original idea (McNaught, 1998: 65) that the intertidal lithics wash onto the beach from offshore rather than eroding out from onshore.

Non-intrusive seabed survey

The seabed in SKW is predominantly fine sand with patches of seagrass, gravel and cobbles. The edges of the bay are characterized by kelp-covered boulders and rocky outcrops which constitute the subtidal bases of the outcrops visible above water. Concentrations of modern litter and debris were also noted, for example; branches, planks, plastic bottles and piping. In terms of archaeological finds, 39 struck flints were found in SKW, concentrated in shallow water (<2 m at low tide) within 30-40 m of the intertidal zone. The finds include blades, cores, flakes and various fragments that are similar to the intertidal finds (i.e. narrow blades, single platform cores but also flakes of varying shapes and sizes). The underwater finds were located lying loose on the seabed surface and are therefore not in situ. However, their degree of water-rolling is variable and some were fresh or minimally rolled compared to the majority of the intertidal finds. No lithics were found in the outer and deeper parts of SKW. Dives here did not even identify chunks of natural flint such as are visible in the intertidal and inshore subtidal areas.

Stratigraphy

Stratigraphy within the bay was established first by sediment cores and later supplemented by test pits and additional cores. The following results are therefore derived from both cores and pits.

A total of 17 short (<50 cm) hand cores were taken in SKW over the three field seasons. Initially, cores were set out along a shore-normal transect down the centre of the bay at 5-10 m intervals. Test pits were subsequently dug along this transect and then extended out to either side, along with additional cores (Fig. 5a). These provided the following sediment profile across the intertidal and inshore subtidal zone (Fig. 6). Intertidal surface sediment consists of sandy gravel, which gives way to fine sand in the inshore subtidal zone (c. 10 m out from the low water mark). Under this surface layer, in the intertidal zone, is a layer of red silty gravel. This distinctly-coloured layer was also observed to underlie the test pits slightly higher up the intertidal zone (see above) and has been traced approximately 20 m out from the low water mark. In the subtidal cores, the red layer does not directly underlie the seabed, but is separated from it by a thin black organic silt. This appears to be a recently deposited (based on the presence of modern litter and organics) anoxic layer. It forms a distinct layer traceable in all the subtidal cores and test pits. At c. 20-25 m out from the low water mark, a change in stratigraphy occurs. Here, the red silty gravel either disappears, or dips to a depth beyond the test pits and cores. Instead, the surface sand and organic layer are underlain by a grey silty gravel layer lacking the distinctive reddish matrix. Texturally, it is very similar to the overlying black organic silt, and is differentiated by its colour and lack of a strong organic smell. This suggests that the two deposits may actually be a single layer, the uppermost part of which has experienced later organic deposition. The pits and cores indicate that the grey silty gravel forms a rough lens interposed between the seabed and the red silty gravel. It can only be traced c. 15m in a shore-normal direction (Fig. 6) whereupon it is replaced by a layer of bedded cobbles in c. 2 m water depth. Beyond 2 m water depth, the seabed down to 40 cm depth comprises sand only. The grey silty gravel also does not appear to run more than c. 15 m in a shore-parallel direction. West of the baseline, it pinches out, and the red silty gravel underlies the seabed. Its easternmost extent is uncertain, as the matrix of the underlying gravel in the easternmost core was sandy rather than silty. At times it is underlain by clean sand, or increasingly matrix-free gravel. However, neither could be excavated or traced sufficiently to determine their full extent.

Archaeological Excavation

In total, 14 pits were excavated (during 2012-13) and were placed to sample and define the extent of the grey silty gravel lying between the seabed sand and the red silty gravel. The rationale was that the red layer underlay the entire beach, but was not likely the source of the lithics (because it seemed too deeply buried to be constantly eroding). The outer parts of the bay beyond 2 m depth were covered by at least 40 cm of clean marine sand and therefore, also contained no evidence for an in situ palaeo-landsurface. The grey silty gravel however, was clearly distinct from either deposit and also located close enough to the seabed to suffer periodic exposure and erosion and could therefore be a source for the lithics.

Excavation proved this to be the case with the majority of finds coming from the grey silty gravel. Fig. 5b shows the finds clustering overwhelmingly in TP2, 3, 4, 9 and 10; all of which show good expression of the aforementioned deposit. A few finds were also made in the overlying black organic layer and the matrix-free gravel which sometimes underlies the grey silty gravel. By contrast, the red silty gravel proved archaeologically sterile. In total, the test pits produced 84 struck lithics and another 38 small (<5 mm) possible debitage flakes. The range of finds included cores, flakes, blades, shatter/debitage and various broken fragments. Again, distinctive forms included single platform cores and small narrow blades (Table 2; Fig. 7). The underwater finds, particularly those from the test pits, were almost universally fresh to lightly water-rolled, generally retaining sharp edges. By contrast, the intertidal finds are almost without exception water-rolled to varying degrees. Moreover, the freshest material tends to be dark grey or blue-grey in colour when excavated in contrast to the white, orange or yellow patina of the intertidal finds. Note however, that some of the excavated finds rapidly (within weeks) patinated following excavation. Therefore, the current colouration of the excavated finds (e.g. Fig. 7) is not reflective of their condition when first excavated.

In general, the sharpness, minimal patination and small size of many of the fresh finds (e.g. the debitage flakes) are suggestive of a minimally reworked context. However, modern glass was found within the test pits to depths of at least 15 cm. Moreover, the finds were not arranged in clear horizons, but distributed randomly. This implies that grey silty gravel and its lithics are reworked, albeit to a limited extent on the basis of their freshness. The grey silty gravel is underlain at times by clean sand, or by increasingly matrix-free gravel. Whether these represent the original undisturbed surface is uncertain as neither could be traced or excavated to any significant extent.

Results: Skate Rock East

Intertidal Excavation

As in SKW, the SKE test pits revealed that the beach/intertidal zone is composed of sand or gravel at least 35-40 cm thick. However, a clear underlying layer was not reached because the excavation did not penetrate sufficiently before reaching the water table. Three undiagnostic struck flints were found in one out of three test pits. Again, the water-rolled nature of the finds combined with the presence of modern litter was suggestive of reworking. Like SKW, the lack of evidence for backshore erosion suggested an offshore source for the lithics.

Non-intrusive seabed survey

SKE has produced only two loose seabed lithics to date (though reworked intertidal lithics have been found). However, the dive survey discovered a compact, dark brown peat layer within the inshore part of the bay (<2 m depth). Small (< c. 1-2 m across) patches of the peat are visible in places on the seabed protruding through the sand, or located under loose vegetated cobbles. Embedded pieces of wood and plant remains (including complete hazelnuts) are sometimes visible and in places the peat is covered by an organic-rich brown clay. One exposed piece of wood situated close to the seaward edge of the peat was identified as *Salix* (willow) (Fig. 8). Coring (see below) and hand-fanning away the overburden has allowed an estimate of the peat's extent; it forms a band across the width of the bay (c. 20 m) and extends at least 9-10 m along the bay's axis (Fig. 9). At the bay's edges, the peat runs up to the protruding outcrops. Along its inshore edge, it disappears beneath a layer of sand and cobbly gravel. At its seaward edge, the peat terminates in a vertical to sub-vertical face exposing the underlying layer – a compact stony blue-grey clay. This termination suggests that the peat is eroding back. At the time of survey the eroding face was protected by covering sand. This suggests that it experiences periodic erosion when the sand is stripped (e.g. during storms). Moving seaward away from this edge, the stony blue-grey clay continues beneath seabed sand.

Stratigraphy and excavation

Stratigraphy was established first by sediment cores and later supplemented by test pits and additional cores. The following results are therefore derived from both cores and pits.

Six hand cores were placed down the central axis of the bay to provide a stratigraphic profile (Figs. 9 & 10). These were supplemented by seven test pits along and to either side of the baseline. These show that the exposed peat edge is thinnest (c. 10 cm)**,** presumably because of erosion. As it runs landward beneath the seabed sediment, it thickens to c. 20-25 cm. In addition, the thicker buried parts of the peat (often containing large pieces of embedded wood) are capped by a mat of *Sphagnum* which itself is overlain by brown organic-rich clay (Fig. 10 & 11). Attempts to determine the inshore extent of the peat were hindered by the increasingly thick beach/seabed sediments. The full extent of the peat is therefore uncertain, but extends across at least c. 12 m in a shore-normal direction. Test pitting on either side of the baseline also revealed slight differences in peat stratigraphy. TP4 and TP5, located north of the baseline, have peat underlain by peaty clay which in turn overlies the stony blue-grey clay. However, TP6 and TP7, south of the baseline, have sandy peat/peaty sand underlying the peat, which, in TP7, transitions down to peaty clay and then blue-grey clay. Moreover, the peaty sand in TP7 appears to exhibit charcoal flecking. This raises the possibility that the thicker peat south of the baseline could contain evidence of a former landsurface developing over the blue-grey clay prior to the peat formation. This does not seem to have been preserved (or perhaps never developed) north of the baseline. Radiocarbon dates were obtained from the base of the peat immediately above the contact with the blue-grey clay, and from the top, including both the eroded surface and the *Sphagnum* layer. These are shown in Table 1 and bracket the peat to between c. 9.4-8.7 cal ka BP. Although the test pits proved useful in characterizing stratigraphy, they did not produce any archaeological finds beyond the charcoal flecking (possibly indicative of nearby occupation) and one possible flint fragment from the reworked seabed sand.

Discussion

The possibility that archaeological and palaeo-landscape evidence was preserved underwater at Eleven Ballyboes was initially suggested by the intertidal lithic collection (McNaught, 1998). The research carried out between 2011 to 2013 has verified this through the SKE peat layer and excavation of artefacts from SKW.

Skate Rock West

Archaeological material has been constrained to a zone of c. 5 x 5 m located c. 30 m off the modern beach in a water depth of -1 to -2 m. A wider scatter of surface finds is also evident within this bay. The artefact-bearing layer in question has also been identified, consisting of poorly-sorted silty gravel. The lithics it contains are generally fresher than their intertidal counterparts; characterized by sharp edges, distinct flake scars, and frequently minimal or no patination. These are all features suggestive of minimal reworking. However, the lithics display no apparent stratification within the silty gravel, which also contains modern glass down to depths of at least 15 cm. These are clear indications that the artefact-bearing deposit is reworked and that the artefacts are no longer in situ.

The precise nature of the artefact-bearing deposit is presently unknown. One possibility is that it represents a former coastal/beach deposit, which was subsequently inundated and later reworked either during inundation or by modern coastal processes. This possibility is suggested by the bedded cobbles observed in TP1 (water depth of c.2 m; buried under seabed sand) which closely resemble those at high water mark on nearby modern beaches. If these cobbles are indeed a former (now-submerged) beach, then the adjacent artefact-bearing silty gravel could represent a former backshore deposit which was inundated by RSL rise and which is periodically reworked, as shown by the incorporation of modern glass and continual washing ashore of artefacts. This would reconcile the minimally reworked nature of the excavated finds with the disturbed nature of their enclosing deposit given that similar observations were made at the classic Irish Mesolithic ‘raised beach’ site at the Curran Point, Larne. It is often assumed that the lithic material from this site was entirely reworked and water-rolled owing to its context within a raised beach deposit. However, the original excavation account (Movius et al., 1953/4: 38) clearly indicates that both unrolled and water-rolled lithics were found within deposits which are interpreted as a partially submerged spit/bar, sandy beach accumulation and foreshore/intertidal sediments. The varying degree of water-rolling was attributed to the distance travelled by each individual lithic and the local prevailing conditions (e.g. tides, waves and storms) it experienced from deposition until burial. In short, it is possible for fresh or minimally-rolled material to be present within a beach (semi-)continuously impacted by wave and tidal action.

It is possible that deeper buried levels of the silty gravel are less disturbed, or perhaps bury in situ remnants. Note for instance, the fine sand horizon located in TP3 at the base of the silty gravel. However, no artefacts were found within it and therefore, it cannot be conclusively confirmed as an in situ remnant. In any case, the results discussed here show that if any in situ layers are present, they are buried beneath at least 30-40cm of sand and gravel and would require more extensive excavation to locate.

Skate Rock East

The SKE peat provides clear evidence of in situ palaeo-landscape preservation along with well-preserved palaeo-environmental remains. The recorded stratigraphy is indicative of local palaeo-environmental changes though their precise nature and significance remain to be determined. A rough interpretation based on the stratigraphy alone (i.e. without pollen or other palaeo-environmental data) suggests an initial period of open low energy water (represented by the blue-grey clay) gradually infilling as vegetation (including trees) and soils developed. Development of this palaeo-landsurface was terminated by flooding associated with RSL rise and is represented by the brown clay which overlies the peat. No marine shells were observed within this layer, and therefore it could indicate rising groundwater levels rather than the incursion of marine water.

This interpretation matches that from similar sequences (i.e. peat sandwiched between fine-grained deposits) found elsewhere in the north-east of Ireland in, or adjacent to, the intertidal zone (e.g. Morrison & Stephens, 1960; Morrison et al., 1965; Whitehouse et al., 2008; Roe & Swindles, 2008). In these sequences, the lower fine-grained clays/silts have been interpreted either as open water or solifluxion deposits laid down during the GS-1 stadial (c. 11.5-10.9 ka cal BP), followed by peat formation during the early Holocene warming. The upper fine-grained deposit is then interpreted as representing the early-mid Holocene transgression (c. 7-6 ka cal BP). At SKE, the radiocarbon dates clearly place the peat within the early Holocene, hence supporting this interpretation. The basal date (UBA-21208: 9039 – 9406 cal BP; from a depth of -2.6 m) also fits well with extant sea-level models which indicate regional relative sea-level rising from -6 to -1 m (Brooks et al., 2008) or -3 to -1 m (Bradley et al., 2011) between 9-8 cal ka BP. Effectively, whichever model is adopted, they both indicate inundation of the study area within the period suggested by the radiocarbon dates.

With regard to archaeological testing, no finds were made stratified within or beneath the peat. However, the radiocarbon dates (Table 1) fit with the independent typological assignation of the SKW lithics to the Early Mesolithic. Moreover, the depth of the peat (c. -2 m) is similar to the artefact–bearing gravel in SKW suggesting that they may be stratigraphically equivalent. It is also clear from the continued collection of material from the intertidal zone that finds are still washing ashore from somewhere. There are two possibilities regarding the lack of archaeological finds. Firstly, the protection afforded by burial within the compact peat results in reduced erosion compared to the more mobile SKW sands and gravels and hence fewer finds get washed up. Secondly, there was less human activity in SKE and thus less archaeological material to find. The difference in lithic collections between SKE and SKW is stark; the former has 72 catalogued intertidal finds while the latter has 1620. It may simply be that evidence is that much rarer in SKE.

In any case, it should be noted that the excavated area is small in relation to the total peat extent: less than 2 m^2 versus at least 180 m^2; effectively, a <1% sample. Therefore, its potential for containing archaeological material should not be entirely ruled out. One possibility is the buried charcoal-flecked peaty sand recorded in TP7. While charcoal is not a guaranteed indicator of human presence, it does at least suggest the possibility of nearby occupation.

Wider context

Overall, the three seasons of fieldwork and research at Eleven Ballyboes have allowed, for the first time in an Irish context, the locating of an assemblage of submerged prehistoric material to a single deposit. By contrast, the other known subtidal findspots in Ireland are poorly located stray finds (Westley & Woodman, forthcoming). There is still potential for more work at this site given the discrepancy in terms of numbers of finds from intertidal versus submerged contexts (c. 100 subtidal finds from 2011-2013 versus c. 1700 intertidal items collected over the past decade). Either this is an indication that the assemblage has been largely reworked onto the beach, or that more material remains buried under the seabed. More extensive sampling would be necessary to confirm this, particularly within the SKE peat which affords conditions conducive to *in situ* preservation.

It is also an indication that submerged archaeological sites and landscapes can survive even along the relatively high energy Irish coastline and within the surf zone. In this case the two bays are wave-dominated and experience periodic change with storms, as evidenced by observed variations in beach level during the three field seasons. Offshore tidal currents are also strong due to the narrow strait which forms the entrance to Lough Foyle. That said, the two bays are oriented such that they do not face the open ocean and hence are fetch-limited. SKW faces south to Magilligan Foreland (a spit anchored to the facing shore), a distance of c. 1.3 km (see Figs. 1 and 4). SKE is also semi-enclosed and receives additional protection from a bedrock outcrop on its southern flank which limits the direction and force of the waves entering it (Fig. 1). This could help explain the difference in preservation between the two bays with the greater protection of SKE allowing the peat to firstly survive marine transgression, and secondly c. 8000 years of coastal processes.

More generally, the two bays could be seen as examples of 'pockets' of preservation along an otherwise high-energy shore. There are other similar bays within the general area while other stretches of the Irish coast are characterized by numerous inlets, sea loughs and islands, each of which could have different taphonomic conditions. Consequently, it is likely that similar instances of fortuitous preservation exist elsewhere around Ireland. This hypothesis would however require additional survey work to test. For instance, consideration could be given to other localities with recorded assemblages of intertidal flints to first ascertain if they are washing in or eroding out from inland followed by systematic test pitting and coring (as described here) if the former is found to be true. The inclusion of direct sampling is important given that the bulk of the evidence mostly likely comprises small lithics which are often difficult to detect visually underwater. Certainly, for Eleven Ballyboes, the ability to pick lithics out of larger samples was a more effective way of verifying and pinning down the archaeological deposit than the swimover surveys and is reflected in the greater number of excavated finds compared to those detected visually (c. 84 versus 39). Similar shallow-water work could also be conducted where there are known intertidal forests or peats, firstly tracing them offshore via coring or where available, sub-bottom profiling (e.g. Westley et al. 2014). While this is no guarantee of actually finding archaeological material, these approaches would at least provide a first assessment of the distribution of localities around Ireland where preservation is conducive for submerged prehistoric sites.

Finally, it is also the first time in an Irish context that there has been a systematic attempt to take prehistoric archaeological survey and excavation below the low water mark. Even in the wider British Isles, this is still a rarity with diver-led work is largely limited to Bouldnor Cliff (Momber et al., 2011) while other regions, such as Area 240, have employed ship-based sampling due to adverse conditions (i.e. strong currents, low visibility, large search areas) (Tizzard et al., 2014). The work described in this paper highlights the potential of local-scale diver-led investigations, particularly in inshore areas/shallow water to complement the landscape-scale, geophysical/geotechnical data driven research which is currently ongoing on the Irish shelf (e.g. Plets et al., 2014; Westley et al., 2011a; 2014). This may be especially important if, as discussed above, preservation in many parts of the Irish shelf is limited to small pockets which are amenable to diver-led work, rather than, for instance, vast expanses of preserved and deeply buried palaeo-landscape, such as characterize the North Sea (e.g. Gaffney et al., 2009).

Conclusion

Research undertaken at Eleven Ballyboes represents the first attempt in Ireland to conduct systematic survey and excavation for submerged prehistoric landscapes. The work conducted to date has provided a stratigraphic record of the two bays investigated, and has identified the artefact-bearing deposit in one of them (SKW). It was hoped that this deposit held in situ material, but this has now been shown to not be the case. Any remaining in situ deposits have either been eroded or reworked, or are more deeply buried than was possible to excavate. The presence of in situ material within the other bay (SKE) is still unclear. Whether this relates to an initial lack of human occupation or lack of exposure caused by burial within the discovered peat layer is presently uncertain. This deposit clearly provides the right context for preservation, but would require more extensive sampling to confirm. More broadly, this research has illustrated the potential that exists in Irish waters for the preservation and study of submerged prehistoric landscapes. It is only through this type of work that we can move the discipline beyond the speculative (e.g. Bell et al., 2006) and progress to finding, investigating and managing the prehistoric component of Ireland's underwater cultural heritage.

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Table Captions

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Table 2. Summary table of finds from Eleven Ballyboes broken down by bay, general find type and intertidal versus subtidal. Numbers in brackets show those excavated from test pits, those without brackets are loose surface finds. Note that these numbers do not include very small (c. <5mm) flakes found in several of the test pits which could represent fine debitage or knapping debris.

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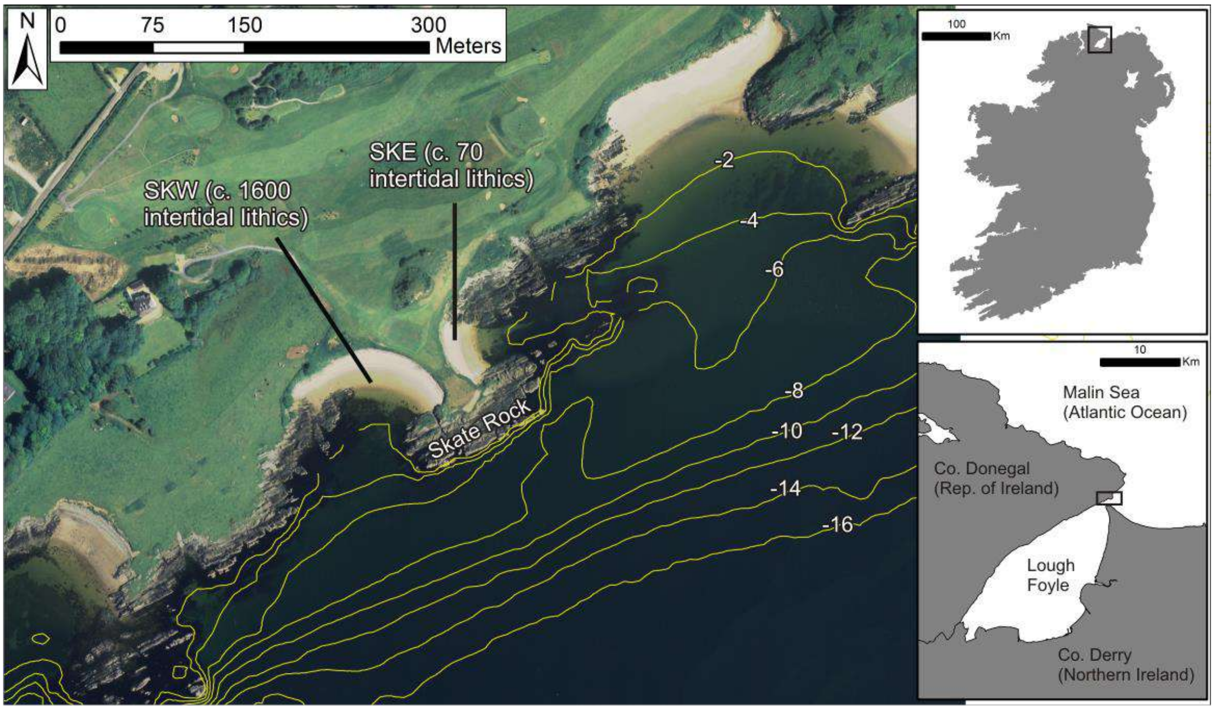
Figures



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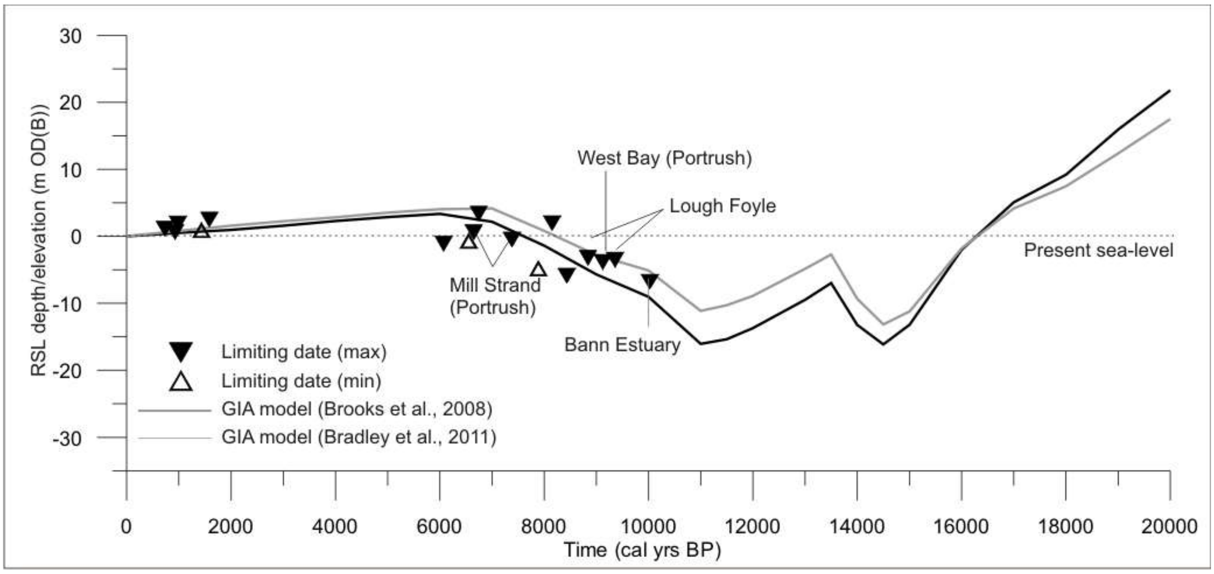

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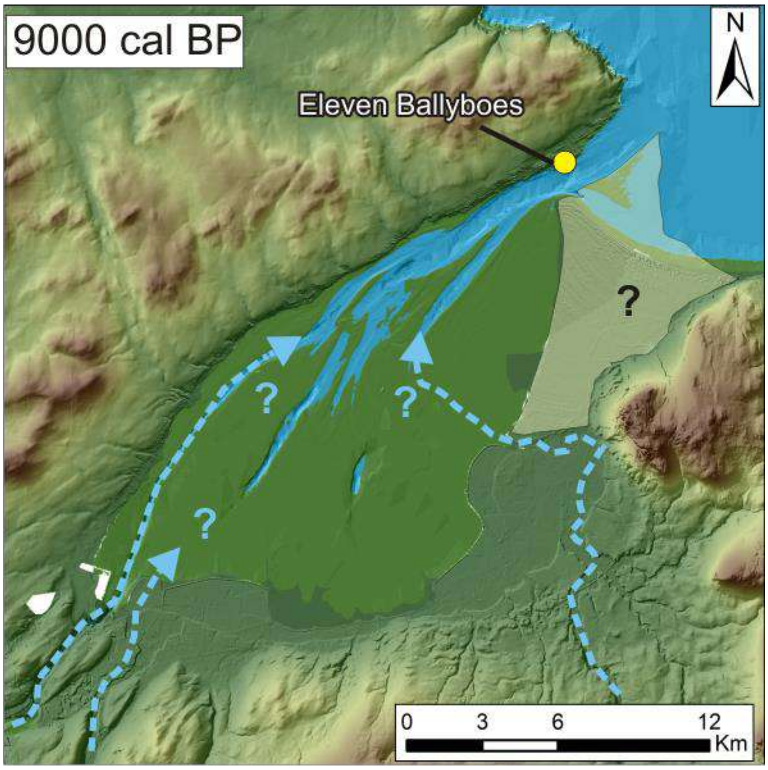

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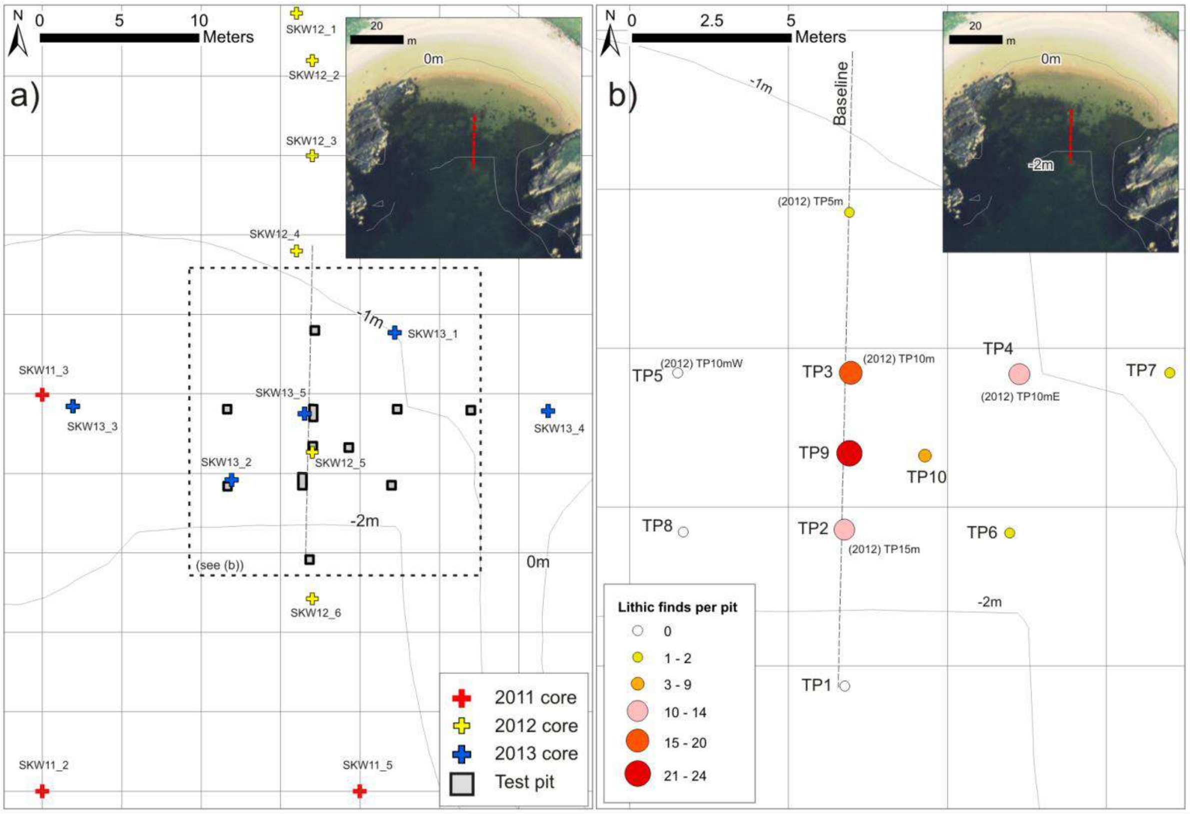

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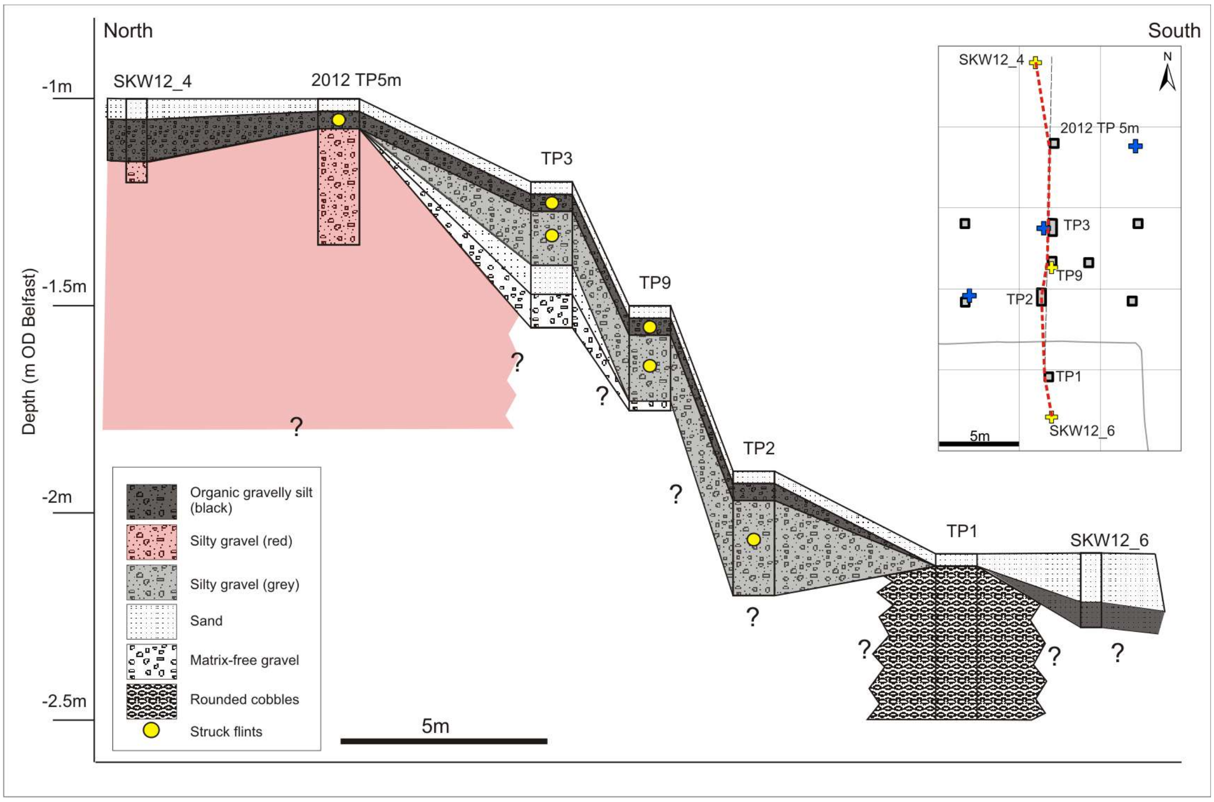

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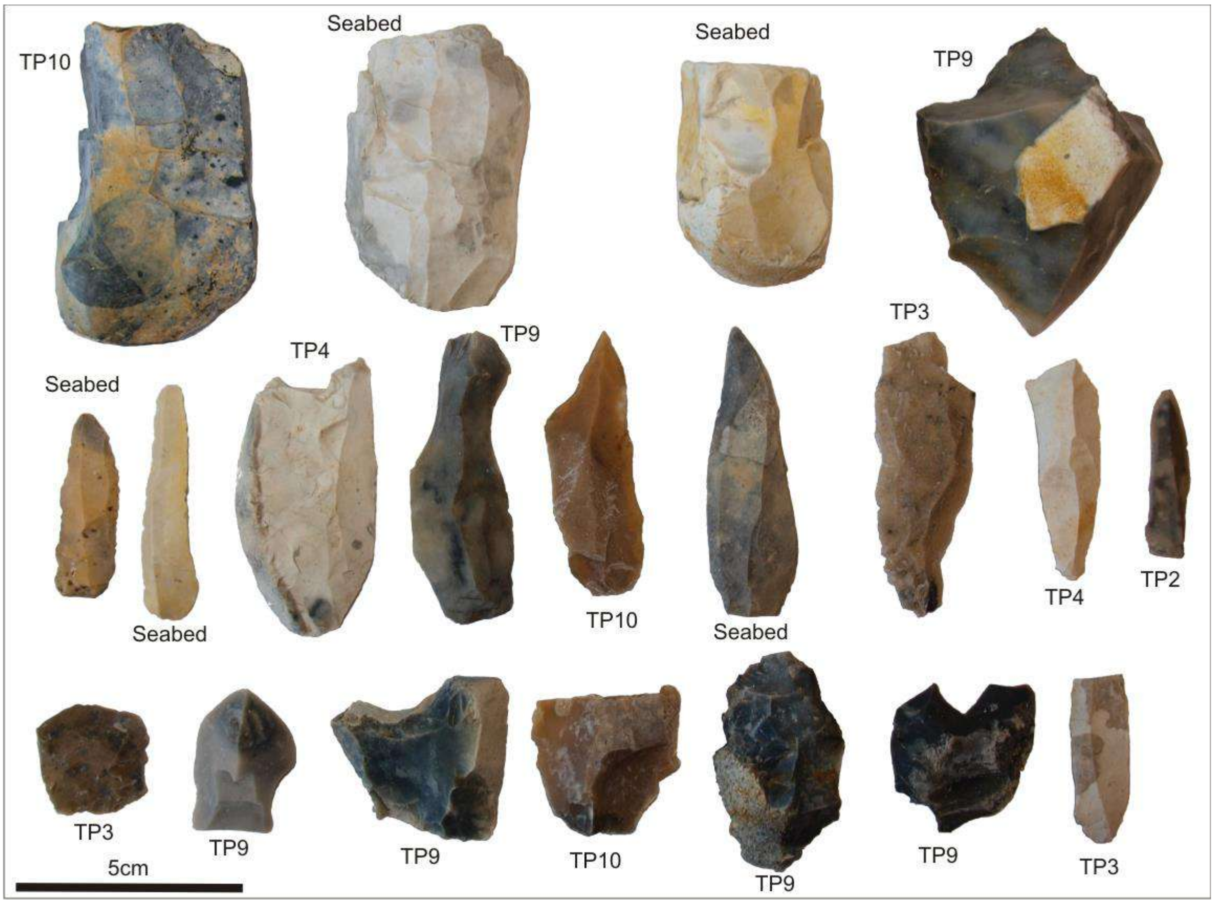

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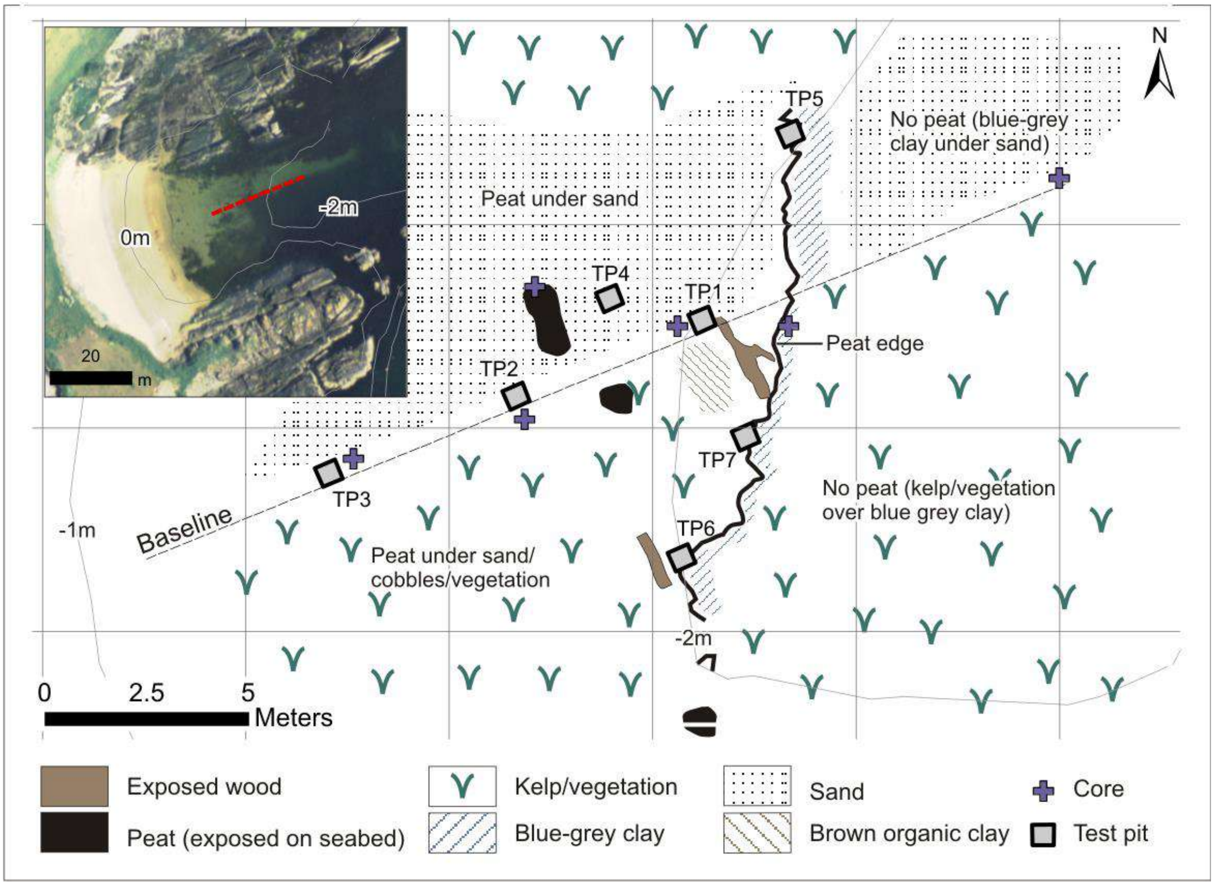

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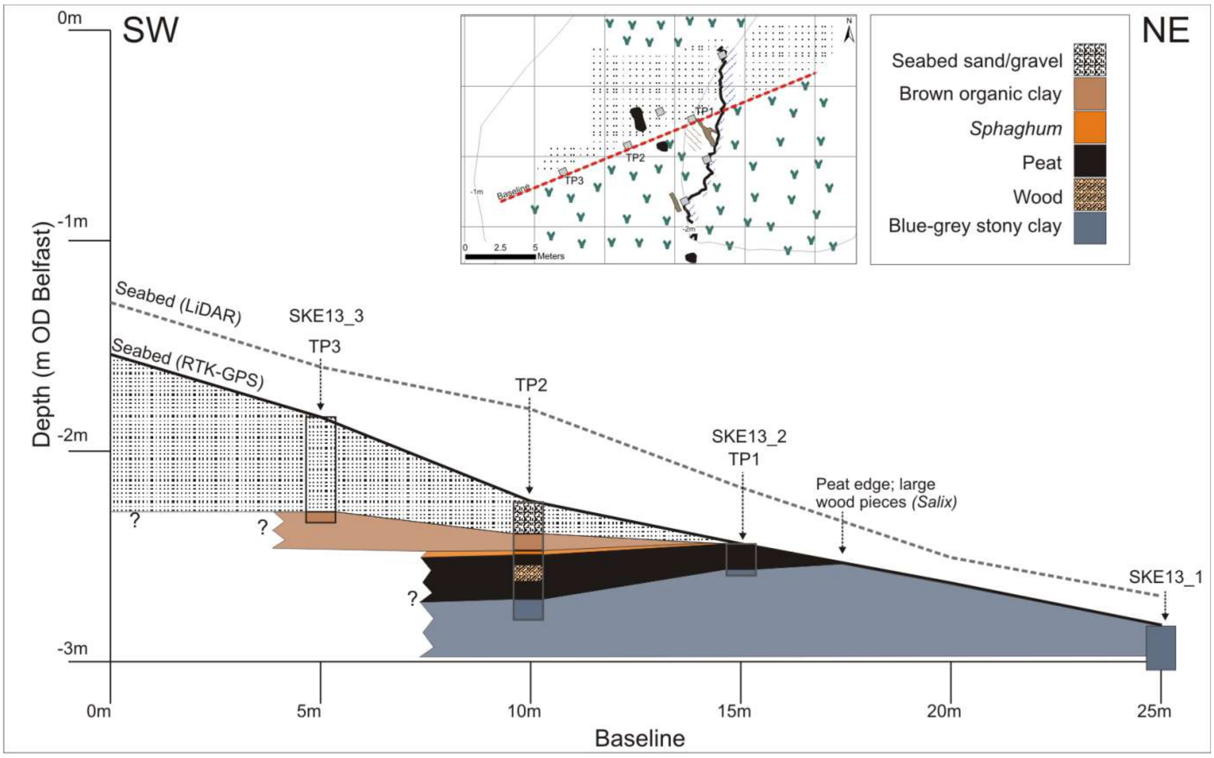

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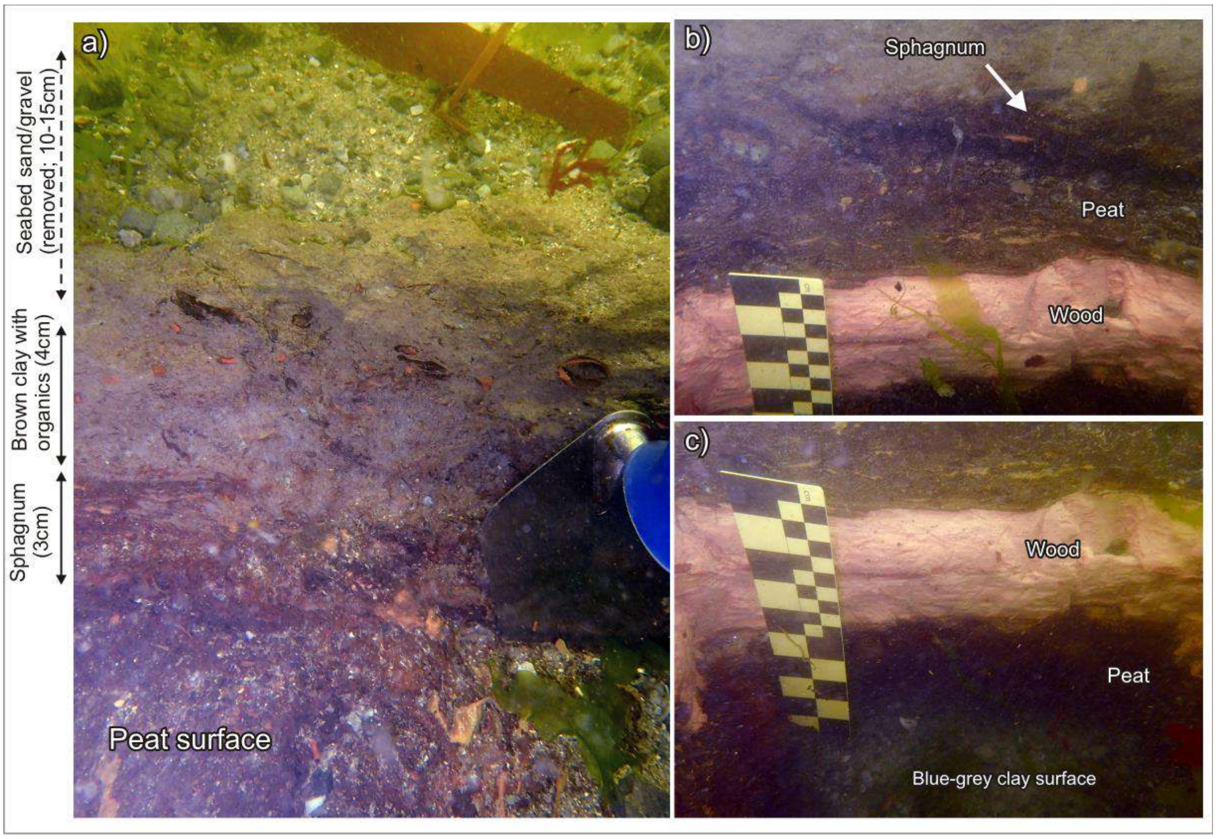

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Sample ID	Lab Code	Material	^{14}C age (yr BP)	Cal age: yr BP (2σ range)
SKE13_TP3_1	UBA-24555	Twig (overlying *sphagnum*)	7972±39	8652 – 8996
SKE13_TP3_2	UBA-24556	*Sphagnum* fibres (base of *sphagnum* mat)	7995±38	8717 – 9007
SKE12_1	UBA-21046	Twig (top of eroded peat)	7954±32	8649 – 8984
SKE12_2	UBA-21208	Bulk peat (just above blue-grey clay transition)	8255±44	9039 – 9406

Table 1. Radiocarbon dates from the SKE peat. All dates were calibrated using Calib 7.1 and the INTCAL13 curve (Reimer et al., 2013).

Bay	Area	Blades/ bladelets	Cores	Flakes	Fragments/ broken pieces	Axes (inc. preforms)	Retouched (e.g. scraper)	Uncertain/ other	Total
SKW	Beach/intertidal	464	106 (1)	636 (6)	341	11	5	57 (1)	1620 (8)
	Subtidal	7 (11)	10 (4)	11 (23)	8 (27)	0	0	3 (19)	39 (84)
SKE	Beach/intertidal	6	7	41 (2)	15 (1)	0	1	5	72 (3)
	Subtidal	0	1	0	0	0	0	1 (1)	2 (1)
	Total	477 (11)	124 (5)	686 (31)	363 (28)	11	6	66 (21)	1733 (96)

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