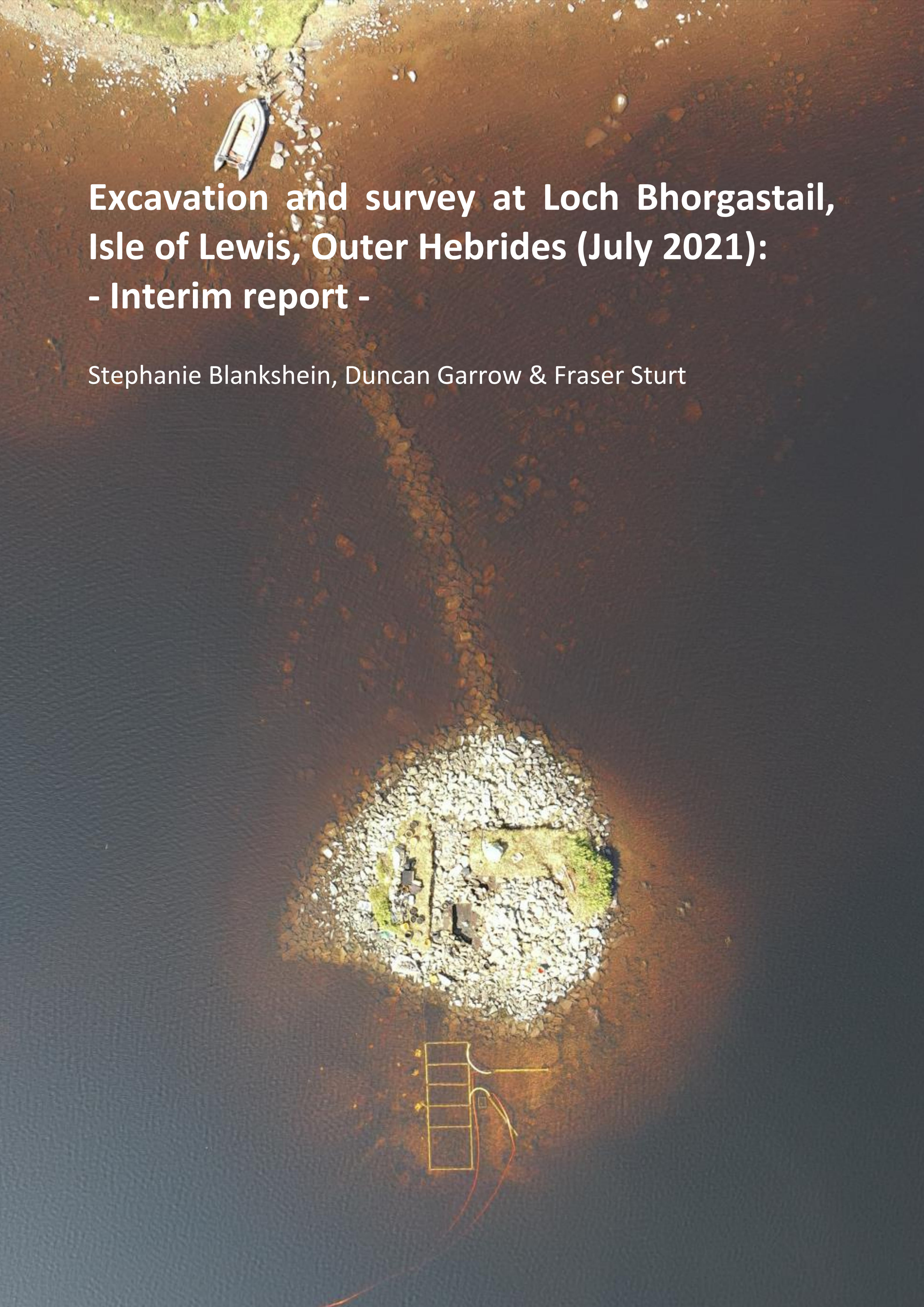

Excavation and survey at Loch Bhorgastail, Isle of Lewis, Outer Hebrides (July 2021): - Interim report -

Stephanie Blankshein, Duncan Garrow & Fraser Sturt

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Excavation and survey at Loch Bhorgastail, Isle of Lewis, Outer Hebrides (July 2021): interim report

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1. Executive summary

Following on from previous survey work carried out in 2016 and 2017, a more substantial excavation was undertaken on and around the crannog in Loch Bhorgastail (Figure 1), during July 2021. This involved both terrestrial and underwater excavation. On the surface of the islet, vegetation and peaty soils were removed across approximately 60% of its extent, revealing the full structure and character of its stone architecture. Additionally, a small sondage was excavated through the stone 'base' of the islet. This revealed a sequence of brushwood/heather and other layers, indicating that the stone phase of the crannog was pre-dated by a timber construction. Adjacent to the stone islet, an underwater trench was excavated extending out from the SE quadrant. This revealed an extensive spread of laid timbers, brushwood and silts. To a considerable extent, this stratigraphy matched closely the lower levels observed in the on-land sondage. Underwater, the pre-stone, timber phase architecture was traced six metres beyond the outer edge of the stone islet, with the furthest extent yet to be determined. Alongside this excavation work, four additional surveys within the local landscape were undertaken: palaeoenvironmental coring across an area of 1.4 x 0.7 km; coring of the loch bed in the vicinity of the islet to obtain sedaDNA evidence; a walkover GPS survey involving recording of features across the local landscape and multiple drone flights to build a topographic model.

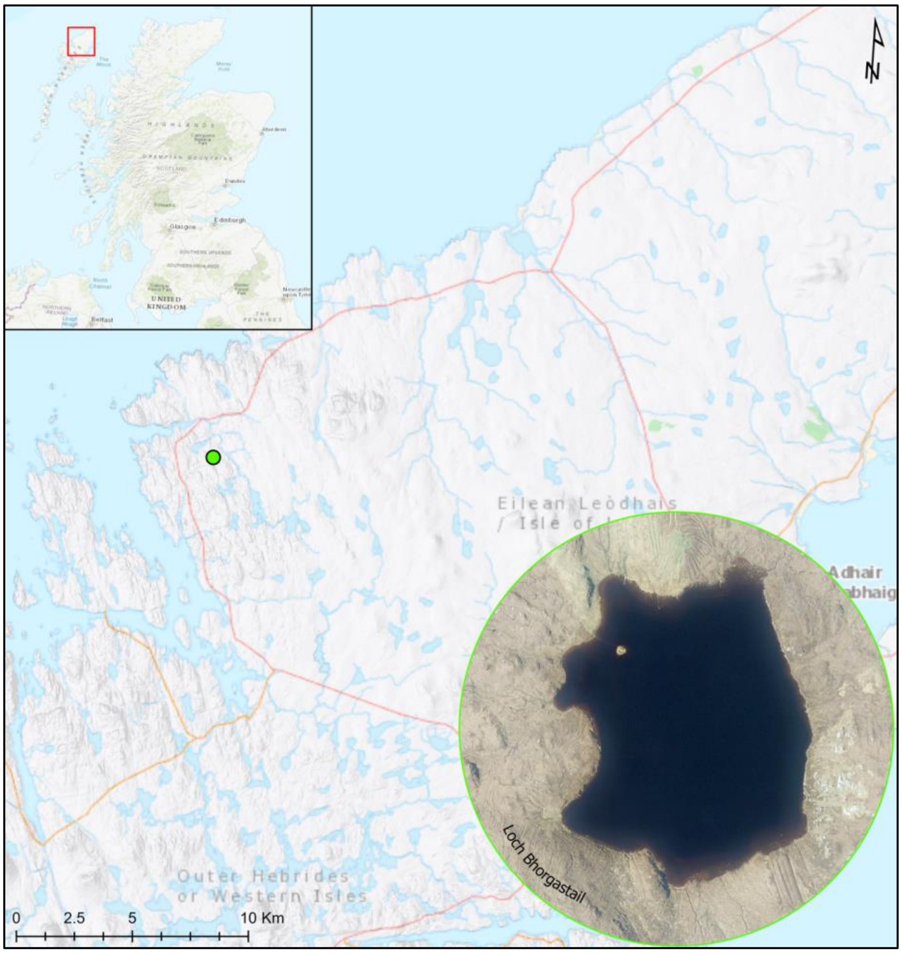

Figure 1. Map showing the location of Loch Bhorgastail

2. Research background

Underwater reconnaissance work carried out in 2012-2015 by Chris Murray (an amateur underwater archaeologist) and Mark Elliot (then Conservation Officer, Museum nan Eilean, Stornoway) revealed the presence of identifiably Neolithic pottery in association with islet sites in five different lochs across the Isle of Lewis, including Loch Bhorgastail (Garrow & Sturt 2019a). Other diagnostic material culture (including worked quartz, quernstones, etc.) as well as architectural features (including worked timbers and artificial stone causeways) were also identified. This work was carried out on an ad hoc, voluntary basis, with notes made on finds locations, photos taken of artefacts in situ, and all finds reported to and subsequently examined by Alison Sheridan (National Museum of Scotland). Further work undertaken by Murray on some of these sites since then has also been declared to Treasure Trove, with the pottery reported on by Mike Copper (Garrow & Sturt 2019b, Appendix 1).

Unsurprisingly, these new discoveries attracted considerable attention within the archaeological community, representing as they did possible evidence for the widespread presence of Neolithic crannogs. We subsequently contacted Chris Murray about the possibility of carrying out further underwater survey work on some of the sites, and obtained funding from the British Academy/Honor Frost Foundation to undertake three short seasons of work from 2015-17.

In May 2015, we carried out a reconnaissance visit to Lewis, visiting all of the sites over the course of two days. Subsequently, in July 2016, we focused our survey work on three sites: Loch Arnish, Loch Bhorgastail and Loch Langabhat (Garrow, Sturt & Copper 2017). Our priorities were: to resolve in more detail the topography/bathymetry of the sites in order to understand in detail the local context within which the islets may have been constructed, and thus potentially whether or not they were artificial; to carry out underwater geophysical survey work in order to understand the extent/depth of loch-bed sediments; and to undertake diver-based survey work in order to recover further diagnostic material and to identify architectural features such as worked timbers, stone causeways, etc. The survey employed non-intrusive techniques (dual frequency echo sounder, side-scan sonar, diver survey and aerial remote sensing) to characterise the archaeology at all three locations. The time spent at each site was short (c. 3 days) and, as such, the results presented were necessarily of a fairly preliminary nature.

Given the additional challenges created by the multi-period nature of Loch Arnish, our next season of work in 2017 focused on two sites only: Loch Bhorgastail and Loch Langabhat (Garrow & Sturt 2019b). Our priorities for each site were: to undertake photogrammetric recording of the islet, both above and below the water, in order to construct a holistic 3D model of the site with the aim of enabling a better understanding of its character and the construction methods used in its manufacture; to excavate a trench on top of the islet, again in order to understand more fully the construction methods used in building the artificial islet and to establish the presence/absence of any buildings or other architectural features, occupation deposits, etc.; to recover any archaeological material associated with the islet itself (in addition to the substantial quantities recovered previously from the loch bed around it) in order to establish a firmer date for the islet's construction and use; to obtain short cores for palaeoenvironmental assessment; and to help understand the broader potential of these sites.

The amount of work it was possible to undertake at Loch Bhorgastail in 2017 was limited due to the discovery of an otter resting place on the islet. Nonetheless, even the limited vegetation clearance work undertaken prior to that revealed significant information about the character of the site and its construction. Our diver survey further demonstrated the complexity of architectural construction underwater – most notably what appeared to be a revetment (including upright stakes and horizontal timbers) built several metres out from the main stone-built structure. Evidence of a substantial layer of organics (including wood fragments and hazelnut shells) identified within our cores between the stone mound and putative outer revetment structure suggested that the latter may have been created in order to help contain this additional layer of wood. Substantial quantities of pottery were also recovered from the loch bed around the islet.

The limitations imposed by the otters on our 2017 investigations at Loch Bhorgastail meant that we were able to carry out more work than anticipated on and around the islet at Loch Langabhat. There it was possible to ascertain that the artificial construction of the islet had focused on an existing rocky crag that would presumably have extended above the water in prehistoric times as well. Construction methods above water consisted of a ring of stones with, in this case because of the natural crag, a not very flat base. Occupation deposits (including pottery, quartz and flint) relating to the Neolithic use of the site were identified on top of the islet. In addition to these, a small stone-built structure was also recorded, from which Middle Bronze Age radiocarbon dates were later obtained; while this feature may have been built in the Neolithic and subsequently re-used, our preferred explanation is that this structure is most likely to have been *built* in the Middle Bronze Age as well (see Garrow & Sturt 2019b for details). At Loch Langabhat, unlike Loch Bhorgastail, no underwater timbers or organic layers were observed, although with only limited excavation undertaken it is impossible to be certain that none exist. Just as at Bhorgastail, deposition of ceramics into the water had occurred all the way round the islet.

Following our work in 2016 and 2017, in 2018 we submitted a new grant application to the Arts and Humanities Research Council. This was successful, with the associated funding enabling three further seasons of fieldwork focused on Neolithic crannogs in 2021-23. During the 2021 and 2023 seasons, our focus is on excavating the project's 'showcase' site at Loch Bhogastail (see below); in July 2022, we successfully attempted to identify further Neolithic material in association with known islet sites in North Uist, Benbecula, South Uist and Barra (see Blankshein et al. in prep.).

3. Dry-land excavation (2021)

3.1. Methodology

The vegetation cover on the islet at Loch Bhorgastail was very dense, comprised predominantly of woodrush with occasional patches of bracken. Initially, this vegetation was removed (through a combination of sawing and spading) in a 2m wide trench extending across the islet from NW to SE. Since this work progressed relatively quickly, the decision was taken to remove more, with vegetation ultimately removed completely across approximately 60% of the site (two main blocks were left in on the SW and NE sides) (Figure 2). Immediately underneath the woodrush was a thick layer of peat [33] (c. 0.30 m in depth) that had formed across much of the islet immediately above the stones (Figure 3). This layer was removed across the same area as the vegetation, using a combination of mattocking, spading and trowelling. It is worth noting that, in order to make room for further work on the islet, all of the vegetation and peat had to be transported manually in buckets by boat across the loch to an area of shore suitable for the storage of spoil, ultimately filling twenty-one one tonne rubble bags – a considerable amount of work.

Once the peat had been removed from the main excavated area, the extent and full character of the stones forming the above-water portion of the islet could be discerned (see Section 3.2). At this point, with available time limited, a small 1.40 x 1.00 m sondage was dug through/below the stone 'base'. Before we started this sondage, we expected the stones to continue down to the loch bed. However, the stone 'base' was only one 'coarse' deep, giving way almost immediately to soil deposits, along with brushwood layers. The sondage was excavated to a depth of 0.80 m before the loch water level was reached, at which point excavation became impractical.

The majority of spatial recording on site was carried out digitally, with context sheets and some drawings completed on paper. Context extents were recorded with the RTK GPS (Leica Viva GS12) and through photogrammetry. Photogrammetric surveys were completed most days; this was conducted for the whole islet via UAV (Matrice 300) and for the underwater trench using two Go Pros (Hero9) fixed on a stereoscopic mount. Photogrammetric surveys were processed every evening using DJI Terra for the UAV surveys and Agisoft Metashape for the underwater surveys. The results could then be analysed and used to inform the next day's work. Low resolution photogrammetry models were created for the sake of time and efficiency, but during post-excavation processing high resolution (between 0.5 and 0.1 cm) digital elevation models (in plan and section), orthomosaics and 3D models were generated. The locational accuracy of these models was maintained through the use of ground control points which were fixed on the islet, on the grid of the underwater trench and around the loch shore. These ground control points were recorded with the RTK GPS and their coordinates used to retain spatial accuracy when processing the photogrammetric surveys. The use of these control points ensured that the photogrammetric outputs could be 'stacked' in ArcGIS in order to visualise the contexts and phases of work as well as generate digital plans from them. This process was assisted by the recording of context extents with the RTK GPS, also imported into ArcGIS. Profiles were generated across the digital elevation models to create digital sections which were subsequently combined with digitised hand-drawn sections in CorelDRAW.

3.2. Observed features

Stone phase

The only feature clearly visible on the islet prior to removal of vegetation was a small, square stone cairn (c. 1.0 x 1.0 x 1.2 m high) located approximately in the centre. Cairns like this are visible on many crannogs in Lewis and it was, we presume, created relatively recently.

Upon removal of the vegetation and peat layers, other features and architectural elements of the stone islet were gradually revealed. First among these was a circular stone 'cairn' feature (F3) located towards the eastern edge of site. The cairn measured c. 5 m in diameter and c. 2 m in height overall. During our 2021 excavations, a substantial number of stones were removed from this feature, in order to explore it in further detail. At first, we wondered whether it could potentially be a collapsed house-like structure with tumble on top, but on further investigation this proved not to be the case. Despite its cairn-like form, neither internal stone structures nor any clear structure to the arrangement of stones at its core were visible. Notably, the cairn included in its make-up a very nice Neolithic saddle quern.

Overall, the stone islet's basic architecture consisted of a slightly raised 'ring-like' element around the outside (F1) and a flattish base (F2) towards the centre (Figure 2). F1 was clear to see in the north-western quadrant where there was a noticeable internal 'edge' that dropped down to the flat base of F2 (see also Figure 3) but it was not identified in other parts of the site; it was absent in the eastern quadrant, and – if present at all – potentially obscured by unexcavated areas to the south and north, as well as cairn F3 to the east.

Very few artefacts were recovered in association with the stone phase of the crannog. In total, three pieces of worked quartz and no pottery were recorded.

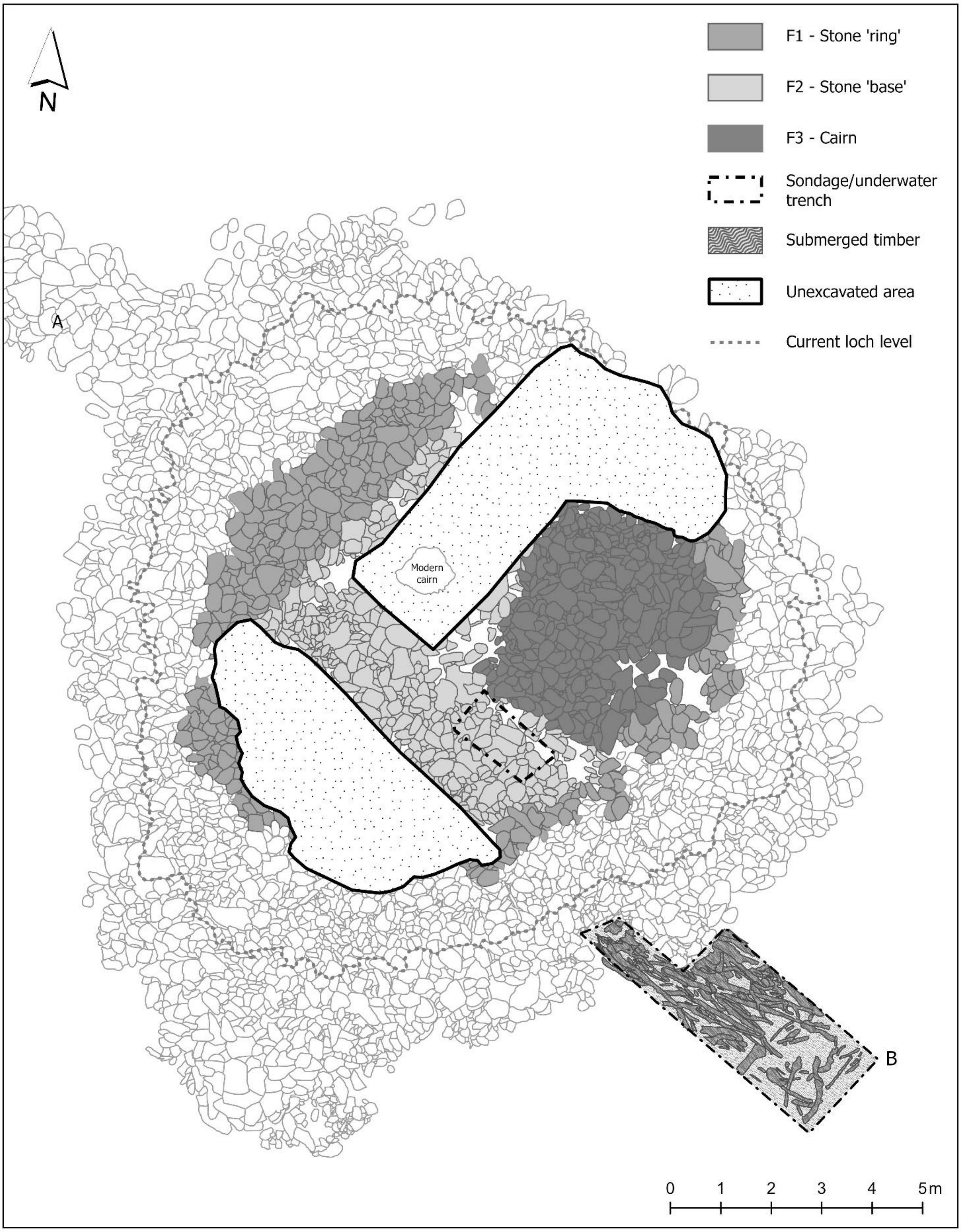

Figure 2. Plan of crannog, as revealed in 2021

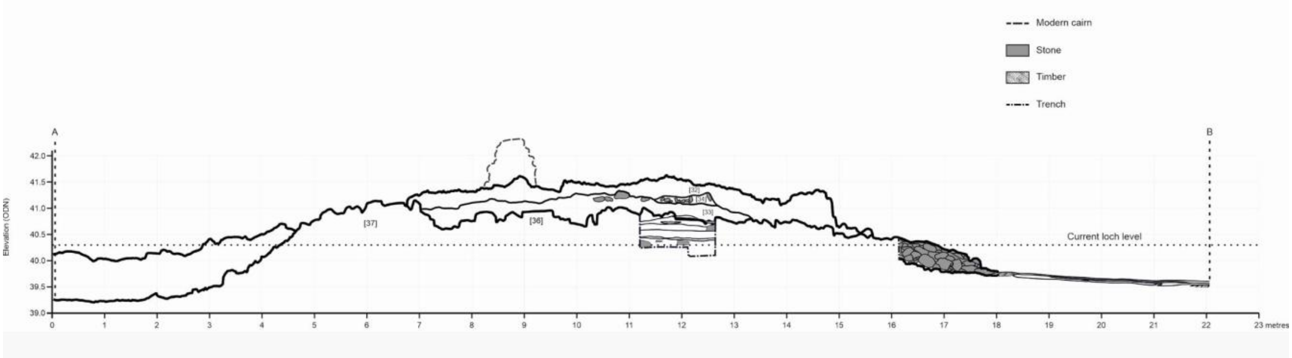

Figure 3. SW-facing section of crannog, as revealed in July 2022. Note that the drawn sondage section was actually NE facing; it has been projected at the correct location in this image.

Timber phase

As mentioned above, once a substantial area across the islet had been dug down to the stones, excavation continued within a small 1.40 x 1.00m sondage, located within the south-east quadrant of the site. Following removal of a single layer of stones from the islet base (F2), a mixed series of deposits was encountered (Figures 4 and 5; Table 1). Immediately below was a slightly gritty, mid grey-brown peaty clay layer [38] that essentially appeared to have formed a base layer for the stones. Below this was a series of layers associated with burning, including a black, charcoal-rich scoop-like feature (F4) which had seemingly acted as a hearth or focused area of burning (0.90 x 0.50 x 0.05 m deep). Surrounding and also below this was a patchy series of bright, orange-red layers c. 1.30 m wide x 0.05-0.10 m deep extending across the full 1m width of the sondage. These deposits are interpreted as peat ash slag associated with F4.

Below these burnt layers was a mid-dark grey silty clay layer [43], c. 0.10 m thick, which extended across the entire sondage. Immediately below this layer, again extending across the full extent of the sondage, was a c. 0.20 m thick layer of preserved wood and organic material comprised mainly of heather twigs, moss and small roundwood [44]. Below this was a blue-grey gritty sand layer, c. 0.05 m thick, containing occasional degraded rock [45/47]. Below this was a second brushwood layer, again extending across the full extent of the sondage and at least 0.30m thick [48]; whilst broadly similar, it appeared to contain larger sized branches than [44]. Before we could define the base of [48], the terrestrial excavation had to stop as it had begun to merge with the underwater one, the sondage having got down to loch water levels.

Context	Description
33	Peat layer across islet
36	Stones forming flat base of islet (F2)
38	Grey-brown layer immediately under stone base
39-42	Hearth (F4) and associated peat ash deposits
43	Dark grey clayey layer
44	Organic brushwood/heather layer
45	Grey silt
47	Blue grey gritty sand/degraded stone
48	Larger brushwood layer

Table 1. Summary of key contexts within the dry-land trench/sondage

Figure 4. Photo of sondage section (looking SW; scale 50 cm).

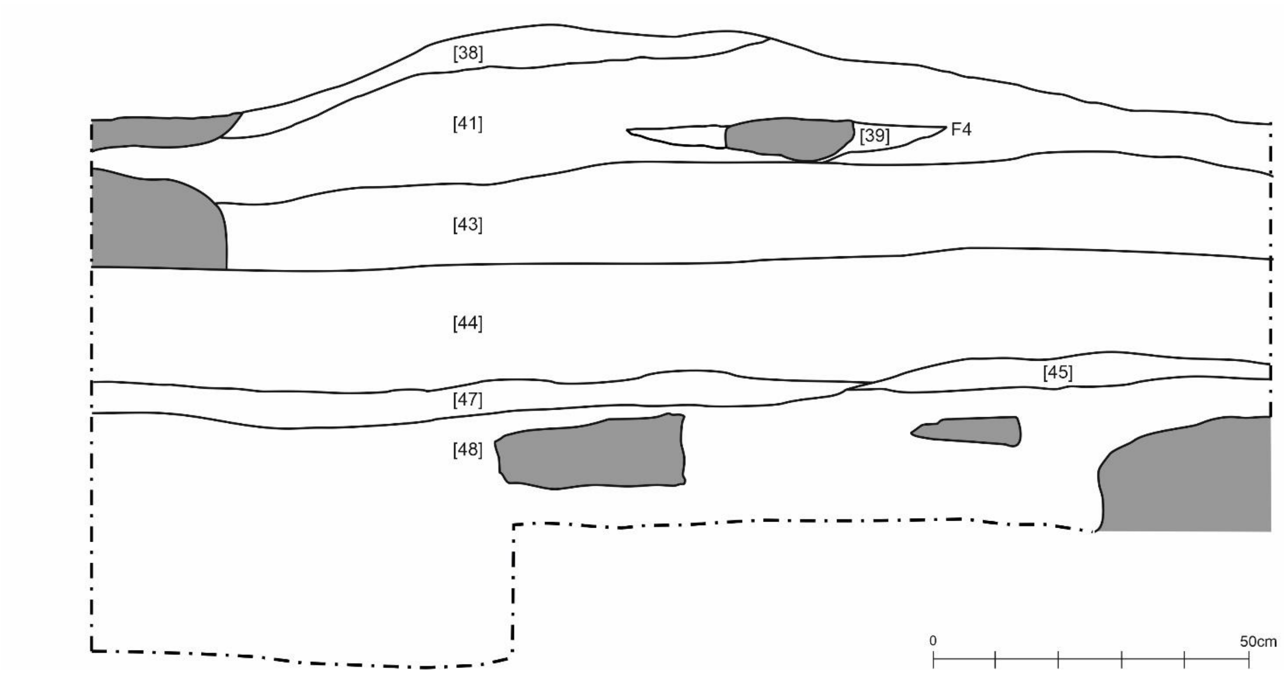

Figure 5. Drawing of sondage section (looking SW)

Substantial quantities of worked quartz and Neolithic pottery were recovered from the lower brushwood layer (and associated grey sandy silts) in particular (see Figure 8 below). The brushwood layers encountered within the sondage appear to indicate that the crannog at Loch Bhorgastail began with a substantial timber phase (or phases). As detailed in the next section, these layers also matched closely those observed within the underwater trench.

4. Underwater excavation (2021)

4.1. Methodology

Our excavation strategy from the outset was to link directly our dry-land and underwater work on site. To this end, at the start, the underwater trench was set out as a continuation of the initial dry-land 2 m wide trench (the latter subsequently expanded significantly) running from NW to SE across the islet. Initially a 2 x 4 m underwater trench was defined, with a metal grid frame providing a reference for the trench edges and ground control points as well as a firm anchor point which could be used as a support whilst excavating. The trench was extended for c. 2 m at its NW end in order to investigate the stratigraphic relationship between timber and stone phases underwater as well. Single context excavation was carried out across the full extent of the underwater trench, with deposits removed using hand fanning and trowelling combined with an induction dredge to remove the spoil created.

4.2. Observed features

A series of layers was encountered across the underwater trench (Table 2). In sequence from top to bottom these were: a thin gravelly sand layer [201], c. 1-3 cm thick, essentially the present-day loch bed; a bright yellow sandy silty clay layer [202] which varied slightly in thickness (c. 1-2 cm), getting thicker towards the deep-water end of the trench, interpreted as a low energy in-washing sediment; a grey-white gravelly silty sand [203], again of variable thickness (c. 3-6 cm), interpreted as weathered rock and loch silts; patches of dark grey/black organic rich silt containing small wood fragments, most evident at the north-west end of the trench [204]; and finally a substantial wood layer [205/206], comprised of branches up to c. 20 cm in diameter (Figures 6 and 7). As mentioned above, the underwater trench was extended at its NW end to assess the extent of this wood layer; it was clearly observed to continue underneath the stone 'skirt' of the crannog, demonstrating the same relationship between stone and wood phases as seen in the dry-land trench. Excavation did not continue below [205/206] simply because we ran out of time at the end of the 2021 season; timber samples taken across the width of the trench revealed more timbers underneath this uppermost phase. Observations made on site indicated that the timber construction layer(s) clearly also continued horizontally beyond the edges of the underwater trench on all sides.

Context	Description	Interpretation
201	Thin gravelly sand	Present-day loch bed deposits
202	Yellow sandy silty clay	Low energy in-wash
203	Grey-white gravelly silty sand	Weathered rock and loch silts washed in
204	Dark grey/black organic rich silt	Organic rich construction material
205/206	Wood construction material	Timber construction layer

Table 2. Summary of excavated contexts, in stratigraphic order, within the underwater trench

Figure 6. Orthomosaic showing full extent (as revealed in 2021) of wooden layer [205/206]. Scale: 1 m.

Figure 7. Wooden layer [205/206], detail. Approx. width of photo: 1 m.

As with the dry-land deposits, substantial quantities of pottery and flint were found in association with the lower layers underwater, in particular [202] and [203] which together produced 218 sherds of pottery and substantial quantities of worked quartz (Figure 8). Context [204] yielded little in the way of artefacts due to its thin and ephemeral nature.

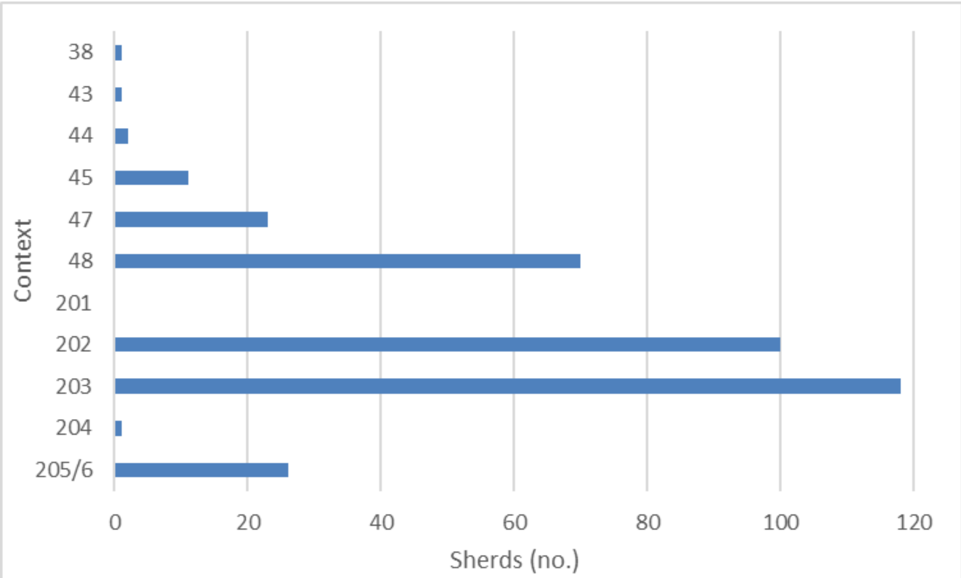

Figure 8. Quantities of pottery found in each context

5. Pottery

Mike Copper

During the summer of 2021, 372 sherds of pottery weighing a total of 6184g were excavated at Loch Bhorgastail from contexts on the islet itself and from the surrounding loch bed, adding to the ninety nine sherds recovered from this site in previous years (Copper in Garrow and Sturt 2019b, 45–7). The pottery was analysed in the autumn of 2021 by Mike Copper at the University of Bradford.

Estimating vessel numbers during analysis was problematic due to the restricted range of diagnostic features and limited variation in fabrics. As such, not all of the sherds could be assigned to specific vessels. With this in mind, the minimum number of vessels can be given as 61; it is possible that the total could be as high as 91, though the latter figure is less likely as it is based on the number of sherd groups rather than positively identified vessels (see below). Sixty-four per cent of the vessels were identified from a single sherd, with the maximum number of sherds unambiguously associated with a single vessel being fifty. The average number of sherds per vessel was 3.44 and the average sherd weight 16.6g.

During analysis, the sherds were placed into sherd groups on the basis of form, decoration and fabric. A sherd group may comprise a single sherd or as many as several dozen sherds. Many sherd groups represent—or are highly likely to represent—a single vessel, though certain vessels are made up of sherds from two or more sherd groups. The name of each sherd group comprises a context number followed by the number of the group (e.g. 202/6 indicates the sixth sherd group identified from context 202). When a sherd group can be associated with an individual pot, the pot is given its own vessel number in addition to a sherd group number or numbers.

5.1. Fabrics

The opening agents added to the clay used to make the Loch Bhorgastail vessels vary little from one vessel to the next. Minerals present, primarily quartz, feldspar and biotite, are in keeping with with the local geology (igneous gneiss). Small, sandy beaches around the shores of Loch Bhorgastail provide easy access to this material in a form that can be added directly to the clay with little or no processing. Three fabric types were defined at Loch Bhorgastail, though these represent points on a continuum rather than discrete groups.

- Fabric 1: Fine, well-fired clay varying from dark grey to pale earthy yellow and orange and containing common to very common (20%-40%) sub-rounded to sub-angular, well-sorted fine sand with rare larger fragments (>2mm across).
- Fabric 2: As Fabric 1, but with the addition of moderate (10%-20%) inclusions of up to 3mm (small granules). Inclusions in Fabric 2 are moderately sorted.
- Fabric 3: Well-fired clay varying from dark grey to pale earthy yellow and orange, with common (20%-30%), moderate to poorly sorted, sub-rounded to sub-angular inclusions ranging in size from fine sand to sparse (<10%) granules of 3-4mm.

Fabric 3 made up just four of the vessels (3%) from the 2021 excavation. Eighty-two per cent of the pots were of Fabric 1 with the remaining 15% being of Fabric 2. Despite Fabric 1 being the finest of the fabrics, this was used for both large and small vessels.

The pale colour of much of the pottery is indicative of it having been fired in an oxygen-rich environment, most likely an open or partially enclosed fire. As is the case with most Hebridean Neolithic pottery the Loch Bhorgastail pots were well made and fired. Where it was possible to ascertain construction methods, they were invariably coil-built.

5.2. Abrasion

Fifty-four per cent of the sherds from Loch Bhorgastail exhibited very little abrasion, with just 22% classified as ‘abraded’ or ‘highly abraded’. The remaining 24% exhibited only minor or differential abrasion. This not only reflects the excellent preservation conditions at the site but also suggests that the pottery was deposited shortly after being broken before abrasion had had time to occur.

5.3. Organic Residues

Organic residue was visible on 24 sherds. This, along with sooting on a small number of sherds and the very pale colour of others that probably resulted from direct exposure to heat after firing (primarily sherds from vessel bottoms), indicates that many pots had been used for cooking. Unfortunately, it was not possible to quantify how many sherds were sooted due to the difficulty of separating such sherds from those excavated on the loch bed that had been affected by algal growth.

5.4. Vessel forms

The vessel categories used during analysis of the Loch Bhorgastail assemblage correspond to those previously defined by Copper (2015: 88–91). Where vessel forms could be identified with certainty, the Loch Bhorgastail 2021 assemblage can be broken down as follows:

Vessel Type	Number of Positively Identified Vessels	Percentage of Positively Identified Vessels
Baggy Jars	8	22.3
Ridged Baggy Jars	18	50
Other Jars	1	2.8
Unstan Bowls	4	11.1
Simple Bowls	3	8.3
Other Bowls	2	5.5

Table 3. Vessel forms from BHO21 (note that only unambiguously ridged jars have been included in the category 'Ridged Baggy Jars' and only unambiguously baggy jars have been included in the category 'Baggy Jars'; the category 'Other Jars' includes a single vessel that may or may not be of baggy/ridged form)

Baggy jars vary in shape from ovoid to sub-spherical and may be decorated—usually with diagonal lines forming herringbone motifs—or undecorated. Rim forms also vary, with three baggy jars having flat-topped 'flanged' rims and two bearing steeply bevelled external collars (Figure 9). Simple rims, flattened rims and internally bevelled rims were represented by one example each. Flanged rims also occurred on the ridged baggy jars (three examples) but collared rims (eleven), usually formed through the external addition of a strip of clay just below the rim, were by far the most common rim form. Ridged baggy jars differ from other jars on account of their multiple horizontal ridges separating decorative motifs into horizontal bands (Figures 9 and 11). Unstan bowls are shallow vessels with vertical collars. Like all the other vessel forms at Loch Bhorgastail these are round-based. All of the Unstan bowls, as well as the three simple bowls, had unelaborated rounded rims.

Figure 9. Collared rim, herringbone motif and horizontal ridge on ridged baggy jar (BHO21 Vessel 1; Scale = 5cm)

A small number of vessels had flanged rims decorated with an intricate motif of concentric bands of twisted cord impressions (Figure 10). These vessels include Vessels 5, 50 and 58 (probably of bowl form), and Vessels 6 and 20 (both of uncertain form). While uncommon, it is of interest that this motif was represented on a particularly well-made bowl from Loch Langabhat, which lies just 3km north of Loch Bhorgastail (Vessel 50a, Copper in Garrow and Sturt 2019b: 44). All of the other rim forms are well represented in Neolithic pottery assemblages from across the Western Isles.

Figure 10. Concentric twisted cord impressions (BHO 21 Vessel 5; Scale = 5cm)

Estimating vessel sizes is complicated by the fact that vessels with similar rim diameters may have had very different volumes due to variation in vessel shapes. Thus, a shallow Unstan bowl may have had a smaller capacity than a deep baggy jar despite having a wider rim diameter. In practice, however, Unstan and other bowls at Loch Bhorgastail tended to fall towards the lower end of the range of rim diameters (18cm and 14cm for the measurable Unstan bowls and 18cm, 19cm and 16cm for other bowls). Ridged baggy jars have an average rim diameter of 21.8cm and other baggy jars 21.7cm, with both forms exhibiting a unimodal distribution around 21cm (Table 4).

Rim diameter (cm)	Vessel Form	14–17	18–21	22–25	26–29
Jars	Jars (possibly baggy/ridged)	0	1	0	0
	Baggy Jars (possibly ridged)	2	1	4	0
	Unambiguous Ridged Baggy Jars	2	5	3	4
	Total Jars	**4**	**7**	**7**	**4**
Bowls	Unstan Bowls	1	1	0	0
	Other Bowls	2	2	0	0
	Total Bowls	**3**	**3**	**0**	**0**

Table 4. Measurable rim diameters by vessel type

Two large sherds from ridged baggy jars sherds were recovered from the deeper water where the loch bed falls away steeply to the east of the Loch Bhorgastail islet (Figure 11). These sherds are well preserved and illustrate the variation in size within a single vessel category. Interestingly, both of these pots tend towards spherical forms rather than the more ovoid shape usually associated with of this vessel type.

Figure 11. Ridged jars from deep water to the east of the Loch Bhorgastail islet (Scales = 5cm): BHO21 Vessel 121 (left) and BHO21 Vessel 120 (right).

The Loch Bhorgastail assemblage was dominated by motifs made up of diagonal lines, often seen on larger sherds to constitute elements of herringbone motifs. Four vessels bore 'hurdle motifs' in which horizontal bands running around the pots are made up of alternating groups of horizontal and vertical (and occasionally diagonal) lines. The four unambiguous Unstan bowls from the 2021 excavations were decorated with multiple horizontally incised lines below the rim above a band of diagonally incised lines extending to the base of the vertical collar. This motif, or minor variations thereof, is found on over 95% of all known Unstan bowls in the Western Isles. In one case (BHO21 Vessel 28) the diagonal lines extend up and over the horizontal lines as well as onto the base of the vessel (Figure 12). Decoration on the base of Unstan bowls is extremely unusual: only one other example is known to the author, from Loch Langabhat (LAN17 Vessel 51). A possible fifth Unstan bowl (BHO21 Vessel 30) appears to be undecorated.

With the exception of the small number of impressed rim sherds described above, decoration was invariably incised; this varied from broad and shallow grooving to narrow and more deeply incised lines. Most of the vessels were smoothed prior to decoration. A few possible examples of slipping were noted, though this is hard to quantify due to the difficulty of separating surfaces smoothed with the addition of water (wet-smoothing) from true slipped surfaces.

Figure 12. Unstan bowl sherd with incised decoration extending onto the base (BHO21 Vessel 28)

5.5. Discussion

The pottery excavated at Loch Bhorgastail in 2021 can be added to that recovered in previous years to give a total assemblage of 471 sherds weighing a total of 7780g and an average sherd weight of just over 16.5g. Vessel forms identified in 2021 largely correspond to those from earlier work at the site, with jars considerably outnumbering bowls (Table 5).

Vessel Type	Number of Positively Identified Vessels	Percentage of Positively Identified Vessels
Baggy Jars	18	29
Ridged Baggy Jars	27	43.6
Other Jars	6	9.7
Unstan Bowls	6	9.7
Simple Bowls	3	4.8
Other Bowls	2	3.2

Table 5. Loch Bhorgastail vessel forms, all years combined (see note for Table 3, above)

The nature of the sherds that could not be assigned with confidence to one or other of the positively identified vessels suggests that most of the remaining pots were baggy jars. As at Loch Langabhat but, interestingly, in contrast to Eilean Dòmhnuill and Northton, Unstan bowls were rare at Loch Bhorgastail. Also absent from the site were the distinctive shouldered bowls, often bearing Unstan-style 'grooves-above-vertical/diagonal-lines' motifs, found at Eilean Dòmhnuill and Northton and, on Lewis, at Loch Arnish (ARN15 Vessel 46, Copper in Garrow and Sturt 2019b: Figure A8). Only one example of this vessel form was found at Loch Langabhat.

There is no particular reason to believe that the Loch Bhorgastail pots could not have been made close to the site. While clay sources large enough to make multiple pots have not yet been identified close to the loch itself, clay was dug and used to make pottery in neighbouring parishes into the 19th and 20th centuries (Mitchell 1881: 43–50) and small patches of workable clay were identified around the loch edge during 2021, suggesting that further, larger deposits may be available nearby. In addition, the opening agents present in the Loch Bhorgastail pottery are readily available in the form of beach sand around the loch edge.

The vessel forms and decorative motifs found at Loch Bhorgastail fit well with those identified at other 4th millennium sites in the Western Isles. While well made and fired, Hebridean Neolithic pottery exhibits surprisingly little formal or decorative variation, with elaboration largely restricted to the multiplication of pre-existing motifs rather than true innovation. The social factors that might account for such a conservative tradition are elusive. However, the elaborate nature of the vessels suggests that their external appearance was of particular importance and it may be that adherence to a standardised set of motifs was therefore of significance in and of itself. Similarly, many of the baggy jars would have had a capacity of several litres, some suitable for preparing food for a dozen or more individuals. One possible interpretation of this is that the Loch Bhorgastail pottery was used during gatherings at or near the loch.

Particularly close similarities exist between the Loch Bhorgastail pottery and that recovered from the islet and surrounding loch bed in Loch Langabhat. Most notable in this respect are the decorated Unstan bowl bases and the finely decorated flanged rims found at the two sites. While such similarities might be expected between assemblages from sites located just 3km apart, the relationship between these two islet locales is hard to discern. Likewise, differences between the Loch Langabhat and Loch Bhorgastail assemblages and the pottery from sites such as Eilean Dòmhnuill and Northton, with their much higher proportions of Unstan bowls, or An Doirlinn and Screvan Quarry (Squair 1998; Copper in Garrow & Sturt 2017: 157–73), where most vessels were undecorated, are difficult to explain, though there is currently no strong evidence for regional variations in Hebridean Neolithic ceramics or of significant change through time.

5.6. Conclusion

All of the pottery from Loch Bhorgastail belongs to the distinctive Hebridean Neolithic style, characterised by round-based horizontally-ridged baggy jars and bowls, shallow vertical-collared Unstan bowls, shouldered bowls and a range of less 'prototypical' vessel forms (Copper 2015). The Loch Bhorgastail pottery excavated during 2021 adds significantly to that recovered in previous years. Both quantitatively and qualitatively reiterating many of the patterns observed during previous work, the assemblage also raises interesting questions about the nature of the site itself and its relationship with surrounding sites, most notably the islet in Loch Langabhat, that will hopefully be addressed as a result of future work planned over the coming years.

6. Stone tools

Hugo Anderson-Whymark

6.1. Struck lithics

In total, 18 pieces (70g) of struck flint and 900 pieces (24,284g) of struck quartz were recovered from the 2021 excavations. The majority of the assemblage was recovered from deposits 202 and 203, but smaller quantities were retrieved from deposits 33, 43, 44, 45 and 48. The flints have been fully recorded, but the quartz was rapidly scanned and quantified with key pieces identified and general notes made on raw material and technological attributes.

The flint assemblage was manufactured from small round beach pebbles with smooth or chattered cortical surfaces. The flint is typically light grey and of good flaking quality, although of limited size. The majority of the struck lithics were the product of bipolar reduction strategies, a technique well suited to maximising the size of flakes struck from small pebbles. Platform reduction was also practiced, with plain platforms noted on a few flakes and an exhausted later Neolithic Levallois-like core (context 203) indicating more specialised reduction strategies. Four retouched tools were recovered: two scrapers and two edge-retouched flakes.

The struck quartz assemblage was dominate by angular milky quartz, presumably sourced from a local vein, but there was some variability in the raw material with the texture of some pieces being more granular, possibly indicating use of a quartzite; a few small transparent pieces of rock crystal were also noted. The flaking properties of the raw material also varied, with some pieces prone to shattering along internal flaws while others exhibited sub-conchoidal fracture. A rapid scan of the assemblage revealed several single and multi-platform cores and many platform struck flakes among a large body of less diagnostic angular debitage classified as 'chunks'. The platform reduction techniques appear to be relatively basic, with little evidence of precise or systematic working of cores. Bipolar reduction does not appear to have been used on the quartz. The quartz flakes are typically much larger than the flint tools, with many achieving 50-70mm in length, and many hold a reasonable edge. Three retouched quartz tools were identified, comprising two end scrapers (context 202 and 203) and a simple flake knife (context 202); it is likely further retouch will be recorded with a more systematic study.

In conclusion, the struck lithic assemblage is dominated by quartz with small quantities of flint. The raw materials were obtained from different sources, with beach pebble/cobble quartz seemingly avoided when it could have been readily collected from beaches with the flint, but angular quartz is both easier to knap and readily available in the local landscape. Distinct reduction techniques were employed for each material, due to differences in flaking properties and the form in which the material was collected (e.g. angular block vs. rounded pebble), but similar tools were manufactured including sharp flakes, retouched knives and scrapers. The presence of cores and irregular chunks indicates that knapping was undertaken on site, but the assemblage is biased towards larger debitage from hand collection; sieved residues may reveal micro-debitage.

6.2. Cobble tools

Three possibly utilised cobbles were recovered from the excavations, but none exhibited well-developed use wear. Two possible quartzite hammerstone from contexts 37 and 202 exhibited slight battering on exposed ends, which may reflect limited use. A third cobble from context 35 exhibited very smooth faces that could potentially indicate that it was used as a burnisher.

6.3. Recommendations

It is recommended that a detailed catalogue of the quartz is produced as careful examination is required to identify retouch and classify quartz debitage. A publication report should be prepared with reference to lithic working practices on other sites in the Hebrides.

7. Plant remains and wood

Anne Crone & Jack Robertson

7.1. The wood assemblage

Samples of wood from four contexts were examined to determine species composition and suitability for dendrochronology (Table 6).

Sample	Context	Material	Comments	Diam (mm)	Species ID	Growth pattern
10	205	Wood	large log	160	*Salix* sp.	15r per cm - est 100 - 120 r
13	206	Wood	bark-covered branch	55	*Salix* sp.	
1	/	Wood	large eroded log - half surviving. Chopmarks on one face	240	*Salix* sp.	
12	206	Wood	large log	150 x 120	*Salix* sp.	9-10r per cm = est 60-70 r
14	206	Wood	small branch	70	*Salix* sp.	
15	206	Wood	bark-covered branch	70	*Betula* sp.	
16	206	Wood	bark-covered branch	80	*Betula* sp.	
18	44	Twigs	brash & twigs	4 - 10	*Corylus avellana* x 10	
9	48	Twigs	brash & twigs	6 - 10	*Corylus avellana* x 7	2 - 5 yrs age/cut spring-early summer
				6 - 12	*Betula* sp. x3	x1 with 10+ rings

Table 6. Wood samples from the 2021 excavation season

Three species were present, logs and branches of willow (*Salix* sp.) and birch (*Betula* sp.) in layer [205/206], and brash and twigs of hazel (*Corylus avellana*) in deposit [44]. Deposit [48] contained predominantly hazel twigs with a few birch twigs. The wood in [205/206] was mixed in size, varying from 55 mm to 240 mm in diameter. The morphology (see Figure 6) and mixed size of the wood suggests that small trees and scrubby bushes were probably cut down to construct the layer. The hazel twigs in deposit [44] were very small, 4-10 mm in diameter and in section; there is no evidence of larger branches. The same is true of the hazel and birch twigs in deposit [48] which are between 6-12 mm in diameter. This suggests that the brash may have been the residue from trimming larger branches, which were presumably kept aside for some other (structural?) purpose. Narrow outer rings were present on some of the hazel twigs from deposit [48] suggesting that the wood had been cut in the late spring/early summer, not long after new growth had begun.

The ages of the two larger willow logs were estimated and both came from fairly mature trees, with relatively long ring-patterns. However, the ring-patterns of both species are notoriously difficult to measure and consequently unreliable so dendrochronology is not recommended. Nonetheless, ageing an assemblage of the larger logs and branches from the site would provide vital evidence about the Neolithic woodland resource available to the builders and also complement more regional palynological studies on Lewis.

7.2. The ecofact assemblage

Five washovers and five bulk samples were submitted for environmental assessment, the main aim of which was to assess the archaeological potential of the ecofacts for further study. The results are presented in Table 7.

Methodology

The dried washover samples were processed at the University of Southampton and then re-floated at AOC to maximise recovery of any surviving ecofacts. Three bulk samples were processed in their entirety and a sub sample of 25% was extracted from the remaining two. These were gently disaggregated by hand using a method designed to retrieve both ecofacts and artefacts (cf. Kenward *et al*. 1980). Once the sediment was broken down, the washovers were fed through a stack system of 4.0 mm, 2.0 mm, 1.0 mm and 300 µm sieves and were analysed using a low powered microscope at x10-40 magnification. The heavy fraction was dried at room temperature and sieved using a stack system of 4.0 mm, 2.0 mm and 1.0 mm sieves and scanned by eye. The waterlogged ecofacts were subsequently stored in coldstore in distilled water.

Both the carbonised and waterlogged assemblages were examined at x10-450 magnifications where necessary to aid identification. Species identifications were confirmed using modern reference material and seed atlases stored at AOC Archaeology Group (Lousley & Kent 1981; Jermy & Tutin 1982; Freethy 1987; Cappers *et al* 2006; Jacomet 2006; Cappers & Neef 2012; Cappers & Bekker 2013; Schulz 2018). Nomenclature for plants follows Stace (2010).

The carbonised macroplant assemblage

The charred plant remains were composed of two barley caryopses (*Hordeum* sp.), one cereal and one hazelnut (*Corylus avellana* L.) shell fragment, all recovered from deposit [44], and represent redeposited food remains that were deliberately transported to the site. This was the only real evidence for anthropogenic activity among the ecofact assemblage. Preservation of these finds was adequate.

The waterlogged macroplant assemblage

The waterlogged plant assemblage consisted of species of peatland, woodland, weeds and moss. Preservation of these finds ranged from poor to good. The concentration of heather in only two contexts, [44] and [45], together with quantities of peat fragments raises the possibility that turves were brought onto the island to use as fuel, flooring or building. The *Sphagnum* moss was probably introduced accidentally alongside the heather and peat. The weed assemblage was small and these finds were scattered with no evidence of selective or deliberate disposal. These weeds would have grown on both the disturbed surface of the crannog and along the surrounding loch edge.

Of note was the absence of any aquatic creatures such as *Daphnia* sp and caddis flies suggests that flooding did not regularly occur on this part of the site. Nor was there any widespread evidence of insect activity. The insects recorded represent the natural habitat rather than having derived from human activity.

7.3. Discussion and statement of significance

The plant assemblage recovered from Loch Bhorgastail in 2021 was small and limited in its anthropic content. The size of the samples collected from each deposit varied from 12g to 5kg but there is no evidence to suggest that volume unduly influenced the assemblage as the results across some of the smaller and larger contexts were similar. However, the poor recovery of ecofacts may have been impacted by the drying out the some of the washovers prior to analysis as this may have damaged some of the more fragile waterlogged macroplants.

Evidence of human activity was limited to infrequent inclusions of charred food remains and an organic surface. The most information that can be gathered from the waterlogged plant assemblage concerns the formation and development of the surrounding landscape from the Neolithic to the Bronze Age period. The samples have been fully analysed and no further work is required on the sondage deposits. The processed samples and ecofacts are currently in cold storage at AOC Archaeology Group Edinburgh and are suitable for long term storage.

Sample			1	2	3	4	5	6	7	8	9	17
Context			38	39	41	42	43	204	44	45	48	33
Weight			83.2	12.9	53.3	32.5	67.2	58.7	2109.6	471	5165.7	371
% Analysed			100	100	100	100	100	100	25	100	25	100
Species	**Name**	**Part**										
Crops												
Hordeum sp.	Barley	© Caryopsis/es							2			
Cerealia sp.	Cereal	© Caryopsis/es							1			
Peatland												
Calluna vulgaris L.	Heather	Seed(s)							*			
Calluna vulgaris L.	Heather	Fruit(s)							***	****		
Calluna vulgaris L.	Heather	Leave(s)							****	****		
Calluna vulgaris L.	Heather	Stem(s)							****	***		
Peat		© Frag(s)	<4mm	<4mm							<4mm	
Peat		Frag(s)	<4mm	<4mm	<4mm	<4mm	<4mm	****	<4mm	<4mm	<4mm	<4mm
Peat/roots		Frags							****	****	****	
Woodland												
Betula pendula L.	Silver birch	Fruit(s)	*									
Betula pubescens L.	Downy birch	Fruit(s)					*					
Corylus avellana L.	Hazel	© Shell frag(s)							1			
Corylus avellana L.	Hazel	Shell frag(s)								*	**	
Corylus avellana L.	Hazel	Whole shell(s)									**	
Pinus sp.	Pine	Needle(s)	*								*	
Pteridium aquilinum L.	Bracken	Pinnule/Fronds frag(s)						*				
Bark		Frag(s)						****			***	
Buds		Bud/scale		*								
Leaf		Frag(s)	*			*						
Wood		Frag(s)					<4mm	****		****	****	
Weeds												
Carex sp.	Sedge	Nutlet(s)					**					
Juncus sp.	Rush	Seed(s)					*					
Persicaria maculosa L.	Redshank	Achene(s)					*					
Potentilla erecta L.	Tormentil	Achene(s)						*				
Potentilla sp.	Cinquefoils	Achene(s)						*		*		
Prunella vulgaris L.	Sealfheal	Nutlet(s)		*	*							
Rumex sp.	Dock	Achene(s)									**	
Stellaria sp.	Chickweed	Seed(s)							*		*	
Unknown	Indet	Achene/fruit/seed		*		*	*	*			*	
Roots		Frag(s)	****	****	****	****	****					
Plant stems		Frag(s)	****	****	****	****	***		***		****	
Other												
Orange clay		Frag(s)		<4mm								
Charcoal		Frag(s)	<4mm	<4mm	<4mm				*	*	*	<4mm
Moss												
Sphagnum sp.		Loose leaves						*			**	
Moss sp.		Stem/leaves			*		*	****	***	*	**	****
Spores												
Cenococcum sp.		Spore(s)	**		**			*	*		*	
Mega spores		Spore(s)					***	*		*		
Insects												
Beetle		Frag(s)				*	*			*	*	
Earth worm		Capsule(s)							**	*		
Fly		Puparia	*					*				
Insect		Eggs(s)	**				*					
Mod contamination												
Grass		Stem(s)	*	*	**	*	*	*	*	*		

Table 7. The macroplant assemblage.
Key: waterlogged macroplants semi quantified, *=<10, **=10-29, ***=30-99, ****=>100, ©= carbonised

8. Radiocarbon dating

Duncan Garrow

A total of 16 occupation-related samples from our 2021 field season were submitted to SUERC for radiocarbon dating (Table 8, Figure 13), along with eight samples relating to the sedaDNA loch cores (discussed further in Section 9.1). The 16 included: six samples taken on charred residues adhering to pottery (recovered from layers within the sondage and underwater) and 10 samples relating to charred or waterlogged plant remains/wood (five from layers encountered within the dry-land sondage and five from layers encountered underwater). Here we present a brief summary of these results. Further dating work and Bayesian modelling will be undertaken in due course.

Context	Context description	Material	Classification (e.g. species)	Sample material description	Lab No.	Age	error 1s	from (cal BC, 95%)	to (cal BC, 95%)
38	Soil layer immediately under stone base [36]	Charcoal roundwood	Hazel	Roundwood	GU59911	3037	27	-1400	-1220
39	Charcoal rich fill of hearth F4	Charcoal roundwood	Willow	Roundwood	GU59912	3098	27	-1430	-1280
44	Upper brushwood/heather layer in sondage	Charred nutshell	Hazel	Fragment	GU59913	4680	28	-3520	-3370
45	Grey silt under brushwood [44]	Waterlogged nutshell	Hazel	Two frags	GU59914	3020	24	-1390	-1130
48	Lower, larger brushwood layer in sondage	Waterlogged nutshell	Hazel	Two almost complete shells	GU59915	4721	26	-3630	-3380
205	Timber/brushwood layer underwater	Waterlogged wood	Willow	5-10 outer rings	GU59916	4658	23	-3520	-3370
206	Timber/brushwood layer underwater	Waterlogged wood	Willow	outer 5 rings	GU59917	4686	27	-3530	-3370
206	Timber/brushwood layer underwater	Waterlogged wood	Willow	outer 5 rings	GU59921	4618	27	-3510	-3350
206	Timber/brushwood layer underwater	Waterlogged wood	Birch	Bark	GU59918	4628	27	-3510	-3360
206	Timber/brushwood layer underwater	Waterlogged Wood	Birch	Bark	GU59922	4638	23	-3510	-3360
47	Blue grey gritty sand/degraded stone	Carbonised food residue	n/a	n/a	GU60117	4679	23	-3521	-3372
48	Lower, larger brushwood layer in sondage	Carbonised food residue	n/a	n/a	GU60118	4675	23	-3521	-3371
48	Lower, larger brushwood layer in sondage	Carbonised food residue	n/a	n/a	GU60119	4708	24	-3622	-3374
48	Lower, larger brushwood layer in sondage	Carbonised food residue	n/a	n/a	GU60120	4691	24	-3528	-3372
203	Grey-white gravelly silty sand	Carbonised food residue	n/a	n/a	GU60121	4733	23	-3631	-3378
203	Grey-white gravelly silty sand	Carbonised food residue	n/a	n/a	GU60108	5081	23	-3958	-3799

Table 8. Radiocarbon dates obtained for BHO21 occupation-related deposits

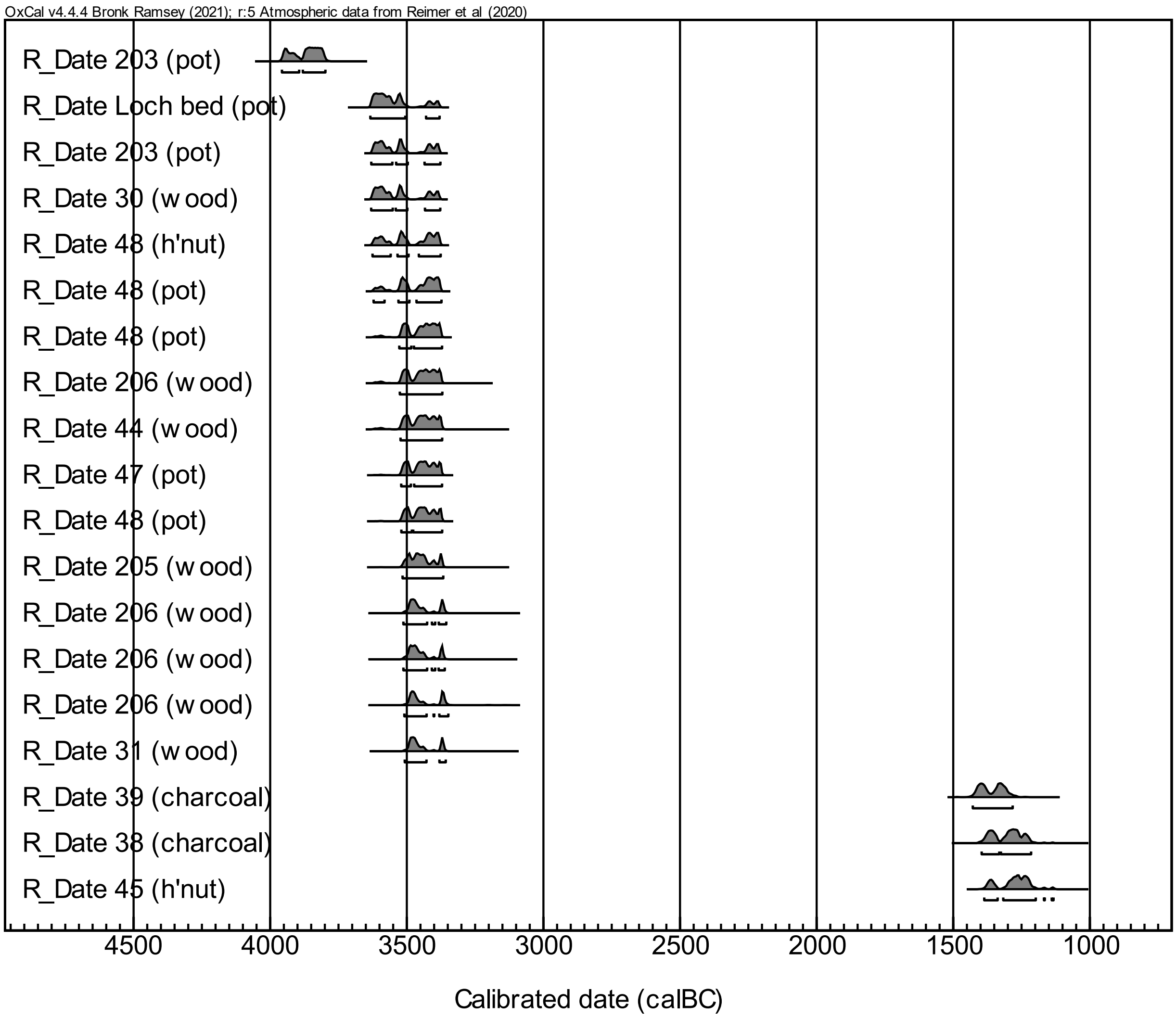

Figure 13. Calibrated radiocarbon determinations from Loch Bhorgastail.

The majority of samples gave calibrated dates that were in line with our expectations based on our understanding of the Neolithic phase from previous radiocarbon dating work undertaken, c. 3530-3350 cal BC. However, four samples produced unexpected results. One determination was surprisingly early, c. 3960-3800 cal BC; this sample would benefit from re-dating since, if it is an accurate date, this represents a very early phase of activity on site that is not (so far at least) reflected by any timber construction. Three further results indicated a phase of Middle Bronze Age activity c. 1430-1130 cal BC. Significantly, two of these determinations were obtained on material from the grey-brown layer [38] immediately *under* the stone base, and from hearth F4 [39] below that. The timbers excavated within the underwater trench were dated to the Neolithic, as was the lower brushwood layer observed within the sondage. Further work is required in order to understand the upper layers within the sondage fully, since dates obtained on hazelnut shells found in the upper brushwood layer [44] and the grey silt [45] beneath it gave Neolithic and MBA dates respectively; it is possible that the latter hazelnut shell fragments were intrusive but some uncertainty remains.

According to the radiocarbon dated evidence, therefore, the crannog was very likely constructed, using timber architecture, during the third quarter of the 4th millennium BC; the span of its Neolithic occupation and use is also short, dated closely to the same period. It is possible that there was some earlier activity on site during the very early 4th millennium but this remains unresolved at present. The site was then reoccupied c. 2000 years later, probably during the third quarter of the 2nd millennium BC. The exact character of this occupation is not fully understood but seems to have involved burning episodes of some kind. Interestingly, both the character of this evidence and its time span are closely comparable with MBA activity observed on the site at Loch Langabhat as well (Garrow & Sturt 2019b). Perhaps most significantly, however, the dates obtained at Loch Bhorgastail suggest that *all* of the stone architecture of the crannog must post-date this MBA phase. This unexpected finding is discussed in more detail below (Section 10).

9. Other analytical work

A number of other elements of our research programme were undertaken as part of the 2021 field season (and associated post-ex) but will not be reported on in detail here since analytical work is still ongoing. Brief summaries are, however, presented below as a record of the work that took place. A particular focus of this work was on improving our understanding of the landscape context within which the site is located. Substantial questions remain as to the nature of the environment during the period within which this site was active. These questions relate both to how it changed through the course of the Holocene, and with regard to how more widely observed patterns played out at local levels. As Fossit (1996), Bishop (2013, 180) and Bishop et al. (2018) have discussed, prior to the 4th millennium BC there is evidence for reasonably substantial woodland across the Hebrides, with the amount of woodland increasing in Uist and Barra.

Part of the difficulty in resolving the specific nature of the environment and how it changed through time is taphonomic. As Wilkins (1984) argued, high wind speeds are likely to have led to extended transport of arboreal pollen and thus low representation in sampling sites. This has led to the conclusion that during the Mesolithic woodland would have been relatively widespread (Bishop 2013, 181), except in exposed locations. Tree cover is then seen to decrease and coincide with moorland and blanket peat expansion from the 4th millennium BC onwards – with moorland becoming dominant by the 1st millennium BC. This narrative, while broadly observable in reported samples, may oversimplify the process and rate of change, and with it the potential causes; e.g. deforestation. As Bishop (2013, 181) notes, there was developing blanket peat in Western Lewis by c. 7000-6500 BC. A site such as the islet at Bhorgastail thus has considerable potential to both inform on our understanding of this changing environment, and to discuss how human-environmental interactions may have played a part in forming the signal we observe today. A strategy was thus devised to sample both the islet, core the loch and investigate the surrounding landscape.

9.1. Sedimentary DNA coring

Sam Hudson, Helen Mackay, Roseanna Mayfield, Ben Pears, Fraser Sturt

Recent work has demonstrated the high potential of sedimentary sequences within lochs, and in close proximity to crannog sites, for reconstructing past environments and human activity (Brown et al. in press). The 'Site Biogeochemical Halo' (SBH), the area around the site that captures deposits, has particularly been emphasised as of importance. To this work was undertaken to identify the lateral extent of any halo and to recover cores for analysis within the laboratory.

Methodology

A floating coring platform was created through joining two inflatable boats, with a gap created between the two craft to allow corer deployment and recovery. A smaller inflatable was used to act as a tender and to help with manoeuvring the raft (Figure 14).

Figure 14. Coring raft in operation

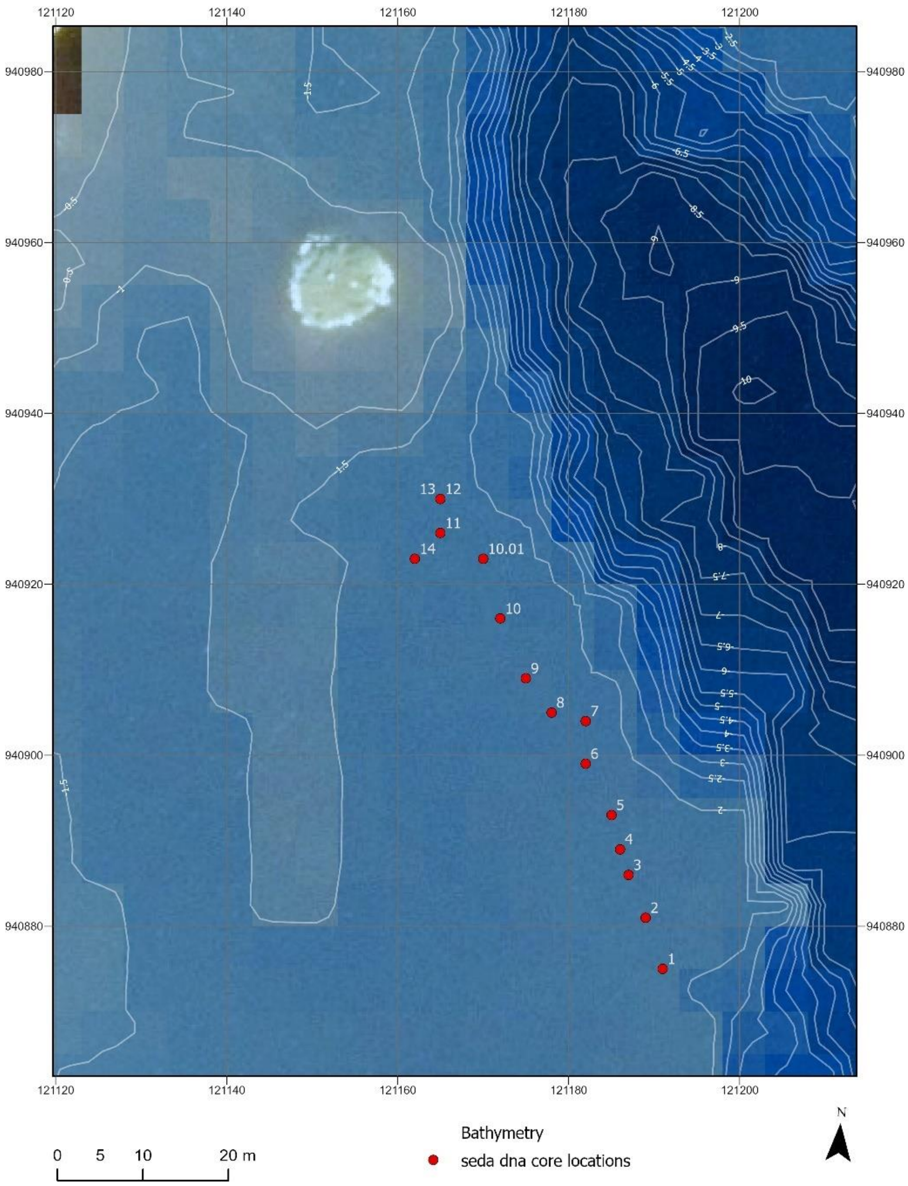

Figure 15. Locations of sedaDNA cores taken in 2021.

A bathymetric survey had previously been conducted of the loch, allowing for a transect to be plotted from the crannog out across a shallower shelf to deeper water. A 1m long 2cm wide gauge auger was used to extract cores at 12 locations moving from the crannog into deeper water. This allowed for determination of loch bed stratigraphy and selection of an optimal location for recovery of an undisturbed sample with either a Nesje/Baron 3m long pipe, or in event of a shorter sequence or difficulties in recovery, a Livingstone corer was to be used.

Results

Twelve locations were sampled with the gouge auger (figure 15), revealing the following units.

Unit	Description
1	Dark red brown (coffee coloured), homogenous, organic rich, degraded, silty clay with some sand
2	Dark brown with hints of grey, organic rich silty clay with more fine-medium sand than #1. No visible macros but higher organic matter content that #1
3	Brownish yellow, higher clay content than units 1 and 2, high Fe content (orange tinge), no obvious organics, odd grains of sand
4	Light blue grey clay, some sand
5	Light grey (less blue than #4) with Mn (black flecks), small fine sand (reached 200 cm, not bottomed out but not collecting in gouge)
(a)	Dark brown gyttja with some sand
(b)	White/light grey mixed clay
(c)	Grey clay with dense yellow lenses and black flecks (Mn)
(d)	Yellow Clay

Table 9. The seven sedimentary units recorded during gouge auger survey

The variation in thickness of these deposits was used as the basis to select the location for coring with the Baron system. This led to recovery of c. 118cm of undisturbed material at location 14, which is currently undergoing analysis at the University of Southampton. This has included:

LOI (Loss-on-Ignition) Analysis

Loss on Ignition (LOI) analysis has been conducted to standard methodology (Heiri *et al.* 2001) and consisted of 90 samples of 2mg sediment, subsampled at 1cm resolution from the BHO21 Core 14. Samples were heated in an oven for 12 hours at 50°C to estimate moisture content, burned at 550°C for two hours to estimate organic content and finally burned at 950°C for four hours to estimate carbonate content.

Radiocarbon Dating (loch core)

Eight samples were taken from the length of the core for radiocarbon dating, focusing on the base and top of the core, as well as key stratigraphic changes. Samples were sieved to extract short lived plant macrofossils where possible. This led to three plant macrofossil samples being submitted and five sediment samples.

Sample	**Lab number**	**Depth**	**Sample Type**	**Wet Weight**	**Species**	**d13C**	**F**	**F1sRME**	**Age**	**Age1s**	**Status**
BHO21 1	GU60109	23cm	Bulk Sediment	3.79g	NA	0.0	0.0000	0.0000	0	0	Fail Carbon
BHO21 2	GU60110	45cm	Bulk Sediment	3.15g	NA	-23.8	0.3165	0.0010	9240	25	Completed
BHO21 3	GU60111	65cm	Bulk Sediment	2.64g	NA	-25.0	0.2739	0.0009	10402	26	Completed
BHO21 4	GU60112	65cm	Plant Macrofossil		Unknown leaf fragment	0.0	0.0000	0.0000	0	0	Fail Carbon
BHO21 5	GU60113	70cm	Bulk Sediment	2.72g	NA	-19.0	0.2815	0.0009	10184	26	Completed

BHO21 6	GU60114	72cm	Plant Macrofossil		Possible Characeae stem	-11.6	0.28 11	0.000 9	10193	25	Completed
BHO21 7	GU60115	80cm	Bulk Sediment	2.93g	NA	-17.7	0.20 60	0.000 7	12693	25	Completed
BHO21 8	GU60116	82cm	Plant Macrofossil		Possible Characeae stem	0.0	0.00 00	0.000 0	0	0	Fail Carbon

Table 10. Radiocarbon dating results from Core 14

As Table 10 indicates, three samples failed to return a date due to lack of carbon. The result of this is that while we have dates for the lower section of the core, the upper sequence (associated with the islet) remains undated. To address this further samples have been taken to be submitted for dating. This will help inform the need for any further core retrieval in the field season of 2023.

ITRAX Analysis

Core 14 has been subject to geochemical examination using ITRAX, a high-resolution multi-function core scanner that enables both X-radiography and X-ray fluorescence (XRF) analysis on any sediment profile (Croudace *et al.* 2006). The geochemical and multi-elemental analysis provided by high-resolution XRF was used to determine the depositional processes at the site.

SedaDNA Analysis

*Sed*aDNA extraction followed protocols documented by Hudson *et al.* (2022) using the QIAGEN DNeasy Powersoil Kit and was performed in a dedicated ancient DNA laboratory at the University of Southampton. PCR amplification used primers of the P6 loop of *trn*L UAA intro of the plant chloroplast genome (Taberlet *et al*. 2007) and exact PCR procedure followed Alsos *et al.* (2021). Four negative extraction controls, two PCR negative controls and one positive control were carried out. Eight individually tagged PCR repeats were made for each sample to increase the chance of detecting taxa represented by low quantities of DNA, as well as to increase confidence in the taxa identified. Paired-end sequencing was performed on an Illumina HiSeq 2500 platform using TruSeq SBS Kit v3 (FASTERIS SA, Switzerland).

All next-generation sequence data were aligned, filtered and trimmed using the OBITools software package (Boyer *et al.* 2016) using similar criteria as Alsos *et al.* (2020). Resulting barcodes were assigned to taxa using the *ecotag* program and four independent reference datasets. One reference contained arctic (Sønstebøe *et al*. 2010) and boreal (Willerslev *et al*. 2014) vascular plants as well as bryophytes from the circumpolar region (Soininen *et al*. 2015) (ArcBorBryo, n=2280 sequences of which 1053 are unique), , one the NCBI nucleotide database (January 2021 release), and finally the NorBOL database (Alsos *et al.* in review). The resulting identifications were merged and filtered, retaining barcode sequences if they were identified to 100% in at least two reference sets and had at least 10 reads across the entire dataset. False positives relating to common PCR errors and food contaminants were removed based on 'blacklists' built up from previous research at The Arctic University Museum of Norway (Rijal *et al*. 2021), as well as taxa identified above family level. For the last step of filtering, the frequency of PCR repeats in samples compared to negative controls was examined. Sequences were retained if they had an overall frequency of PCR repeats in samples at least twice as high as that in negative controls.

The above analyses are all still underway, with full synthesis yet to be carried out.

9.2. Palaeoenvironmental coring and borehole survey

Rob Batchelor & Mike Simmonds

In order to understand the environmental and wider archaeological context of the crannog in Loch Bhorghastail, a detailed landscape survey in the geographical basin immediately surrounding the loch was required. The survey was undertaken by Rob Batchelor and Mike Simmonds (Quaternary Scientific, University of Reading).

Aims

1. To clarify the nature of the sub-surface stratigraphy across the site.
2. To clarify the nature, depth, and extent of any peat deposits.
3. To clarify the palaeoenvironmental and archaeological potential of the site.
4. To collect samples for further palaeoenvironmental assessment.

Objectives

1. To undertake a geotechnical survey of the loch basin, using cores/auger profiles
2. To produce a stratigraphic model, permitting reconstruction of a pre-peat land surface
3. To retrieve undisturbed continuous samples from a total of three borehole locations for laboratory-based lithostratigraphic description and further palaeoenvironmental work.

Methods

An initial 44 borehole survey was undertaken across an area of 1.4 x 0.7 km. These samples were then supplemented with an additional 154 borehole points in areas of greatest palaeoenvironmental significance.

Results

The results of the field investigations revealed an uneven bedrock surface, overlain by superficial deposits of peat. The thickness of the peat surface across the landscape is variable, ranging from being absent entirely, through to 3.45m sequences (Figure 16). Within the wider landscape, three small basins were identified (West Bog, Lower South Bowl, and Upper South Bowl), with two of these (West Bog and Lower South Bowl) both providing sequences greater than 3m deep. Three core sequences were sampled, chosen due to their locations representing the deepest identified points across the landscape. The condition of the peat on removal was excellent and these samples have the potential to provide a wealth of palaeoenvironmental information through the analysis of proxies within these cores.

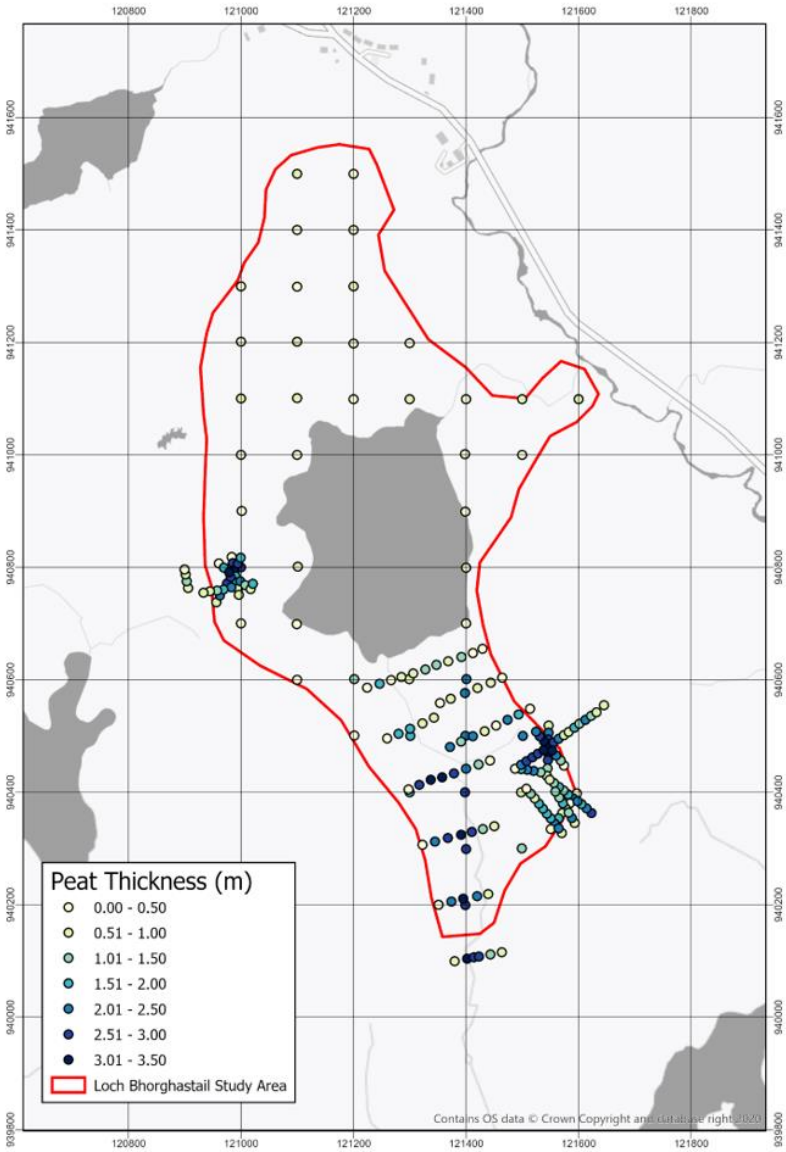

Figure 16. Peat thickness across the area of interest

9.3 Pollen

The cores described above are currently being assessed for pollen by Dr Michael Grant at the University of Southampton. Samples have been taken for radiocarbon dating from the base of each of the three basins identified in section 9.2 to shape the programme of ongoing work.

9.4. Topographic and walkover survey

Angela Gannon

Fieldwork survey in support of the project was undertaken by Historic Environment Scotland during the final week of excavation. The landscape around four of the six Neolithic crannogs on Lewis was investigated. This work involved a review of the positional accuracy and classification of all previously recorded sites in the national record, Canmore, as well as ground prospection for new sites. The majority of new discoveries all related to the post medieval period. QGIS was used in the field on a handheld computer with downloaded maps, site records and aerial photographs; unfortunately only a small area had lidar coverage. All archaeological features were plotted by dGPS at mapping scales and brief descriptive accounts were created supplemented by photography where appropriate. The results of this fieldwork have all been processed and are available online through Canmore.

10. Discussion

Excavation work at Loch Bhorgastail in July 2021 resulted in a transformed understanding of two key aspects of the site: its architectural form(s) and its chronology. It is now clear that the crannog here had both a timber and a stone phase, separated in time by c. 2000 years. Radiocarbon dating indicated that, contrary to our prior expectations about the site, *all* of the stone architecture is likely to be post-Middle Bronze Age in date. Burnt layers dating to the Middle Bronze Age were observed underneath the main stone 'floor' of the islet. The precise date of the stone phase at present remains unestablished, since no suitable samples for dating were recovered *above* the stones with which to bracket their date.

The Neolithic phase of the islet appears to have consisted of a 'packwerk' crannog constructed with piled-up brushwood and larger, laid timbers on the loch bed. The full extent of this timber architecture has not yet been established but potentially extends for up to 23m across in total, if its edges are indeed defined by the upright piles identified underwater. Two clear phases of wooden construction were observed within the dry land sondage. At present, it appears that the lower of the two matches up with the timber layer observed within the underwater trench; certainly both of these were associated with large quantities of Neolithic pottery and quartz. The upper brushwood layer, by contrast, produced very little material culture and could potentially represent a later, initial Middle Bronze Age foundation layer, although this is at present uncertain.

Our findings at Loch Bhorgastail in 2021 were very revealing, and also surprising in many ways. The fact that, during the Neolithic, this site appears to have been made only from timber raises questions about other known sites of this date, such as Loch Langabhat – is it possible that the stones on those two were also post-Neolithic, with the relevant timber layers hidden underneath the stone and/or as yet undetected? Equally, our findings also raise questions about the date of the stone crannog. The absence of any clear Bronze Age or Iron Age material culture on the site is puzzling, to say the least. When exactly was this stone architecture added and what was the site's function at that point? Given all of these remaining questions, it is certainly thankful that we have another season of work planned for summer 2023.

Key issues/questions to be addressed through further work at Loch Bhorgastail:

- Spatial extent of the Neolithic timber phase platform/mound
- Presence/absence of any (timber?) architecture, or other features associated with the timber phase
- Depth of Neolithic stratigraphy underwater – are there layers pre-dating the timbers observed in 2021 and what are they like?
- Resolution of whether the upper brushwood layer is final Neolithic or primary Middle Bronze Age
- Refinement of our understanding of the Middle Bronze Age phase features and character/purpose of associated activity
- Presence/absence of any Middle Bronze Age material culture on the site
- Date/function of stone phase architecture
- Date of peat formation on top of context [36] (stone capping)
- Fluctuating loch levels and site formation processes
- Creation of age/depth model for terrestrial peat formation/basin infill

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