

# An Iron Age crannog in south-west Scotland: underwater survey and excavation at Loch Arthur

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## ABSTRACT

*As part of the second phase of the South West Crannog Survey, the crannog in Loch Arthur, New Abbey, Dumfries and Galloway, was surveyed and small-scale excavations were carried out on submerged eroding deposits. The crannog was seen to be at threat from erosion for a number of reasons, including insect infestation, aquatic plants and wave action. The eroding deposits were sampled and their ecofactual content analysed and structural timbers from various positions in the crannog mound were radiocarbon dated. The results suggest that the site is a massive packwerk mound that was constructed in the second half of the 1st millennium BC, most likely in one event. After an apparent period of abandonment, the site was reoccupied in the later medieval period.*

## INTRODUCTION

Underwater survey, excavation and monitoring was conducted on an artificial island or crannog in Loch Arthur from 2002 to 2004 as part of the second phase of the South West Scotland Crannog Survey (Henderson et al 2003; 2006). The work was conducted primarily to evaluate the condition and stability of the organic deposits surviving on the site prior to the establishment of an environmental monitoring programme. Crannogs are a much understudied resource in Scotland and the underwater excavations conducted at Loch Arthur are only the second to have been carried out in the country and represent the first such investigations in south-west Scotland. Little is known about the construction and taphonomy of Scottish

crannogs generally, giving the study of the excavated deposits at Loch Arthur crannog presented here an added importance in terms of the overall development of crannog studies (Crone et al 2001).

## HISTORY OF RESEARCH

Loch Arthur is located in south-west Scotland, in the parish of New Abbey c 10km south-west of Dumfries (illus 1). The loch is approximately 915m in length by a maximum of 460m in breadth; it covers an area of 30 hectares and at its greatest depth is approximately 15m deep. The loch contains just one crannog situated close to the northern shore at Nat Grid Ref NX 9028 6898. The crannog appears above water as a small tree-

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ILLUS 1 Loch Arthur, New Abbey – location map

covered island, some 30m in diameter, and is connected to the shore by a muddy reed bed. The island first came to the attention of archaeologists between 1840 and 1844 when two medieval bronze tripod cooking pots were

recovered from the loch, the precise location of which was not recorded.

The island attracted attention again during the hot summer of 1874 when the level of Loch Arthur was exceptionally low:

[The island] is about 100 feet in diameter, and is approached by a stone causeway about 30 yards long, which was laid bare last summer (1874) by the lowness of the lake. The artificial nature of the island may be seen by the remains of the oaken piles driven in rows, with horizontal beams between, which can still be traced in the water round the north-east and south sides. The lines of two small enclosures can be followed on the south side of the island (Gillespie 1874–6: 23).

A large dug-out canoe featuring an elegant animals-head prow was discovered at this time, on the shore opposite the island. The bow end of the vessel was recovered, and is now displayed in the National Museum of Scotland in Edinburgh. A radiocarbon determination for the log-boat was returned at  $2501 \pm 80$  BC, calibrating at 355 BC to AD 125 (using OxCal v4.1.7, r.5), though the true date for the vessel is thought to be in the later part of this range, based the location of the dating sample with respect to the rings of the source tree: a date range *c* 150 BC–AD 200 seems most likely (Close-Brookes 1975; Mowat 1996: 52, fig 18). The fragment of a dug-out canoe reported during the South West Crannog Survey Phase 1 work at Loch Arthur (Mowat 1996: 52) could not be re-located in August 1992 during diving by Niall Gregory (see Canmore ID 654681; Site Number NX96NW 1), and was also not seen by the present authors during the 2002–4 seasons.

Small-scale exploratory terrestrial excavations were carried out on the top of the island in 1966–7, revealing the footings of drystone/clay-packed walls that the excavator interpreted as the stone undercroft of a wooden-framed building (Williams 1971: 123). Despite an absence of finds, Williams suggested a 15th to 16th century AD date for the crannog, based on two bronze tripod cooking pots recovered from the loch in the 19th century.

In 1989, the site was visited and dived as part of the South West Crannog Survey Phase 1 (Barber & Crone 1993: 527). A vertical birch (*Betula* sp) pile off the northern side of the site was sampled for C-14 dating and provided evidence of Iron Age activity at the site (GU-2463,  $2260 \pm 50$  BP, calibrating at 400–200 BC; GU-2644,  $2240 \pm 60$  BP, calibrating at 410–160 BC).

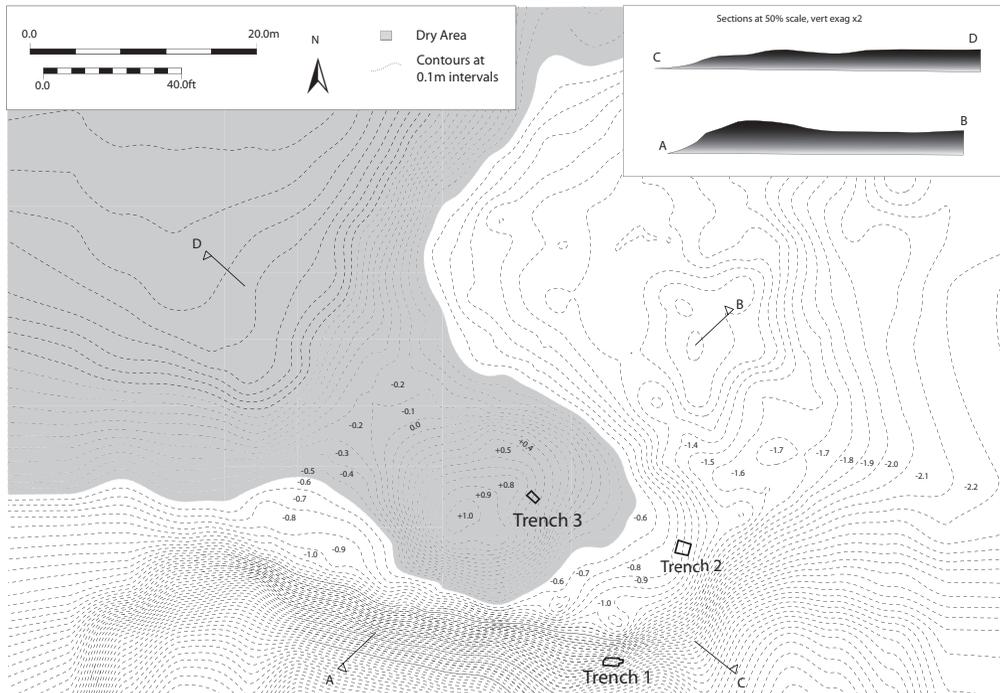
The current phase of work in Loch Arthur reported here is part of the South West Crannog Survey Phase 2 (Henderson 2004: 175–9). The first phase of the survey, carried out in 1989, demonstrated that in addition to the accelerated organic decay of sites on drained land, submerged crannogs were also at risk of decay due to the infestation of underwater plant and animal life caused by high levels of biological activity present in certain lochs (Barber & Crone 1993: 528). Loch Arthur was revisited in 2002, 2003 and monitored throughout 2004 to establish the condition and stability of the organic deposits surviving on the site. This was part of the overall aim of the South West Crannog Survey second phase: to establish an effective system of monitoring the rate of organic decay on crannog sites in an effort to provide accurate data on the sustainability of the crannog resource in the area (Lillie et al 2003; 2004; 2008; Henderson 2004; 2007). As well as being part of the wider survey project, the new work at Loch Arthur had the specific archaeological research aims of clarifying the dating and structure of the site. Williams' medieval dating was based on the circumstantial finds of two bronze tripod cauldrons from the loch, not the crannog itself, while the position of the pile sampled in 1989 was unknown. Although the monitoring work is reviewed, this paper focuses on the archaeological findings from the site resulting from the most recent campaigns of fieldwork.

## THE SURVEY

Diving in 2002 revealed that the majority of Loch Arthur crannog lies underwater and is much larger than the tree-covered island (on which mature oak and beech trees are growing) visible from the shore. The island was seen to sit on top of a much larger mound which lay entirely underwater. The two features could be distinguished by their composition, the upper mound (the island) being built primarily of large boulders within a well-developed soil, and the lower, submerged, mound of timber (alder and oak), organic deposits and stones. Both horizontal and vertical timbers were visible throughout the lower mound, suggesting it was of artificial construction, with the horizontal timbers arranged radially from the centre of the site. Around the eastern base of the mound *c* 30 piles were noted,

eroded flat to the loch bed (*c* 0.13–0.2m diameter). Rich organic deposits, consisting of bracken, twigs and comminuted plant matter were exposed over the upper surface of the lower mound. Most of the exposed timbers were covered in vegetation which appeared to be accelerating erosion: the condition of the timbers varied from freshly exposed timber bearing no vegetal growth, timbers covered in vegetation, to timber in advanced stages of decay.

At up to 3m visibility, the water quality in Loch Arthur was amongst the best encountered during the South West Crannog Survey, largely because the land around the loch is managed organically and is not therefore subject to the heavy use of fertilisers, which could be seen to greatly increase biological activity adversely affecting the visibility in a number of other lochs examined during the survey (Barber



ILLUS 2 Loch Arthur crannog – contour survey and location of trenches

& Crone 1993: 528; Henderson et al 2003). Despite these more favourable conditions in Loch Arthur, organic deposits and timbers on the site were actively being exposed and plant growth appeared to be causing the degradation of exposed timbers. Aquatic plant infestation of exposed timbers could be seen throughout the upper surface of the lower mound.

A detailed contour survey of the site was carried out in 2003 to assess the size of the site, and the relationship between the two artificial mounds. The work revealed that the tree-covered island is sitting on a long promontory running NW/SE from the shore which may be, if not entirely, then at least partly, artificial (illus 2). From the modern shoreline of the loch to the drop-off at the deepest part of the promontory is 81m, while the probable artificial extent of the promontory is 46m across – indicating that Loch Arthur crannog is a site of very substantial construction. The upper surface of the lower mound lies only 0.3m below the water level. Though no structural timbers could be traced deeper than 3.5m, the base of the artificial mound could not be identified due to the heavy coverage of silt below 3.5m in depth.

## THE EXCAVATION

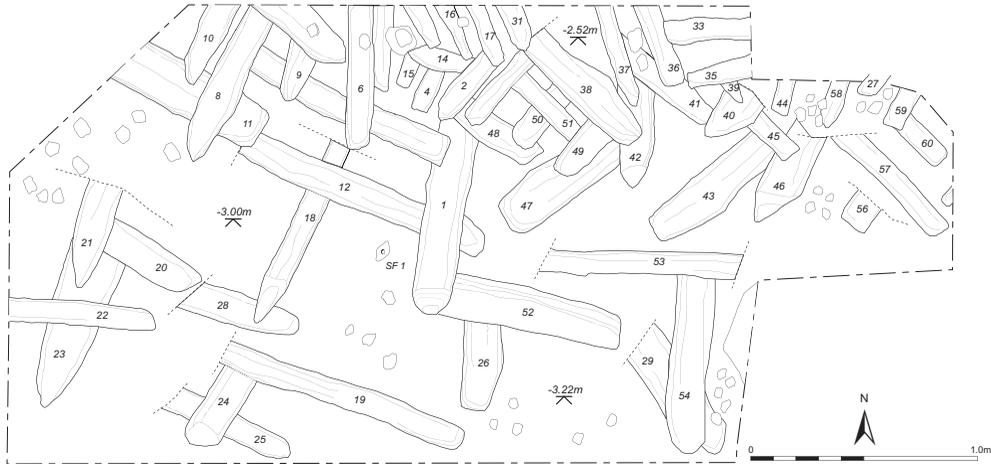
Small-scale underwater and terrestrial excavations were carried out in 2003 to both stabilise and sample eroding submerged deposits and to attempt to clarify the dating and structure of the crannog mound. Trench 1 and Trench 2 were located over the two actively eroding submerged sections noted during the 2002 season, while Trench 3 was located on the dry portion of the island, in an effort to ascertain the relationship between upper and lower mounds identified during the survey. Both the submerged trenches were located to the south-east of the upper island; one on the

southern edge of the submerged promontory in 2.5 to 3.5m of water and the other on the flatter top of the submerged mound in 0.75 to 1m of water (illus 2).

Underwater visibility on the deeper parts of the site (deeper than 1.5m) was often very poor as the fine loch silts which cover much of the site could be easily disturbed. Visibility was also found to be dependant on weather conditions as wind (creating sediment movement) and rain (causing run-off into the loch) could quickly reduce visibility in the loch to zero. Usually visibility varied from between 1.5 to 0.5m. Underwater excavation proceeded through the removal of the soft lacustrine silts overlying the trenches using a Venturi system water dredge (cf Dean et al 1992: 211–13). This method of spoil removal is well suited to archaeological work in shallow water, being both efficient and capable of delicate stratigraphic excavation around sensitive archaeological deposits. Suspended silt in the water made recording (particularly photography) extremely difficult, though sections and plans of the timbers were drawn at 1:1 scale on Perspex sheets underwater and reduced to 1:10 on land. Visibility on the shallower (less than 1.5m), upper parts of the mound was better, usually c 2–3m, but the shallow conditions again made photography difficult as the trenches could only be photographed by constructing mosaics of photographs taken at very close range. After each trench had been recorded and sampled, efforts were made to consolidate them to prevent further erosion.

### *Trench 1*

An area of 8.5m<sup>2</sup> comprising a 2.5m section was investigated on the southern edge of the crannog mound where actively eroding horizontal alder timbers had been identified extending from it. A layer of very soft, largely organic lacustrine silt (context 1001) overlay



ILLUS 3 Loch Arthur crannog, trench 1 plan

the deposits in this trench. This silt was grey-green in colour, and was easily disturbed by the movement of divers around the working areas of the site. The deposit averaged around 10–20cm in depth and contained twigs and leaves of modern origin, as well as living aquatic plants and algae. The unstable nature of this deposit suggests that these silts, particularly in the shallower areas of the site, are frequently disturbed by water movement in the loch and are replaced by natural accumulation as suspended particles settle on the crannog and

loch bed. This silt was observed to be much thicker on the deeper areas of the site (below c 2m water depth), where water movement as a result of wave action is much less significant.

Removal of this silt revealed over 50 alder (*Alnus glutinosa*) timbers (illus 3). These timbers were arranged in horizontal layers, radially into the centre of the mound. Each layer of timbers was laid at approximately 30–60° to the layer below, in a matrix of twigs and comminuted organic material containing hazelnuts and wood chips as well



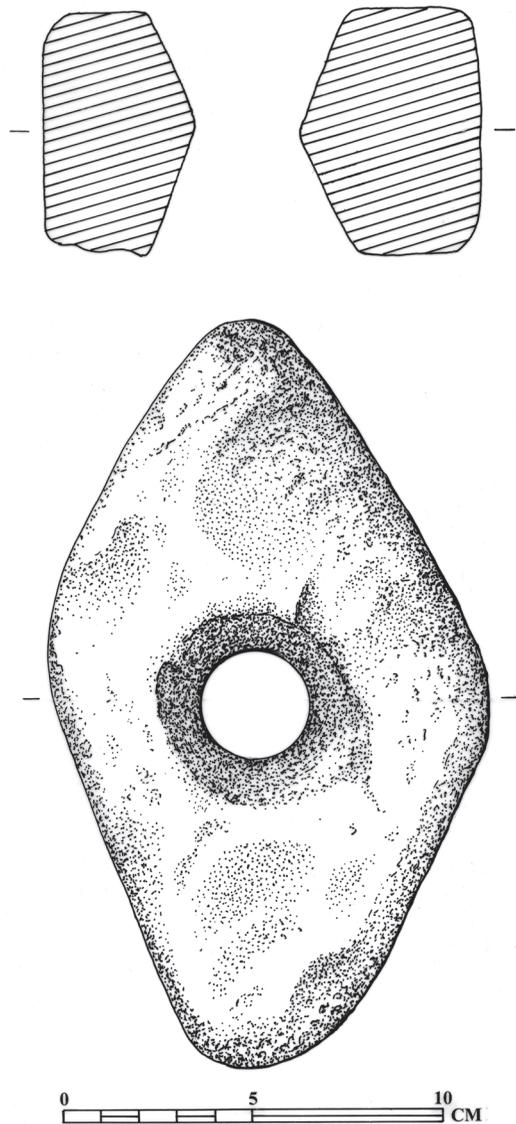
ILLUS 4 Photo mosaic of exposed section, trench 1

as many fire-cracked stones (most likely used in cooking and dumped onto the site from occupation above). The timbers in the upper layers averaged 10cm in diameter and the layers were closely spaced, becoming larger, averaging *c* 20–25cm in diameter and more widely spaced towards the bottom of the mound (illus 4). No vertical piles were present in this area of the site.

Parts of the area investigated around the exposed timbers were overlain by rounded boulders, averaging 30 to 50cm in diameter (context 1002). There was no evidence of deliberate placement of these boulders, and they certainly did not represent a coherent deposit over the entire site which could be compared with the stone capping seen on Highland crannogs (Morrison 1985: 39). Instead, small groups of boulders were found in a random distribution across the site. A worked stone object was recovered from amongst these boulders in Trench 1 (marked on illus 3 as SF 1). The object is trapezoidal in shape and measures 21.5cm × 12cm and is 6cm thick (illus 5). Perfectly circular holes have been drilled using a wood drill from either side of the object creating an hour-glass form in section. Damage on the pointed ends suggests that the stone has been used as a hammerstone. The object may relate to the Iron Age occupation of the crannog, but due to its insecure context it may equally have been deposited later and come to rest on context 1002.

Underlying contexts 1001 and 1002 was a layer of stones, averaging 10cm in diameter, and

containing many fire-cracked and burnt examples. This layer also comprised smaller stones (averaging 2–5cm) and small patches of inorganic gravel and sand. Similarly to context 1002, this deposit was not continuous across the area investigated, but was found in irregular patches of varying depth. On average this deposit was *c* 20cm in depth.



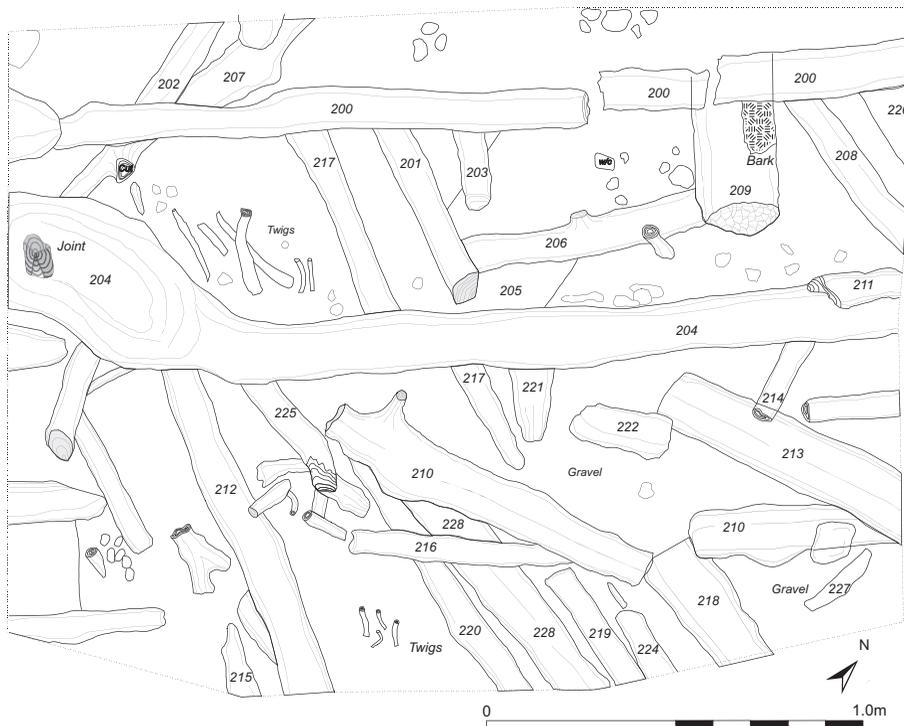
ILLUS 5 Perforated stone object (SF 1)

The horizontal layers of timbers were seen to be sitting within a rich homogenous organic matrix (context 1004). This context comprised various organic materials, principally large twigs (av 5–15cm length; 30%), twig and wood fragments (30%), hazelnuts and hazelnut shells (10%), wood chips (10%), small stones and inorganic grit (10%) and comminuted leaf and plant material (10%). The deposit was moderate-loosely compact and disaggregated in the water where active erosion could be seen to be taking place.

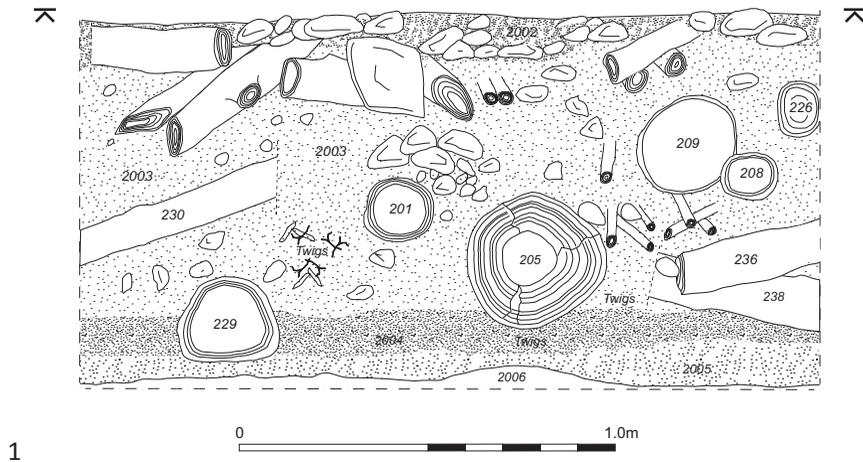
### *Trench 2*

Trench 2 was placed over several large eroding horizontal alder timbers on the flat area of the submerged mound, toward the south-east corner of the site in *c* 0.75m of water. This area of erosion was photographed

in 2002 (Henderson & Crone 2002: 28, pl 7), and from comparison to this record it is clear that the erosion is active as the timbers could be seen to be in a more advanced state of decay in 2003 (Henderson 2004: 178–9, fig 6; Henderson & Cavers 2003: 10; 2004: 5–6, pl 4). It is possible that this is due to the fact that these timbers are located on the edge of a slightly raised area on the site, which may have increased the frictional erosion of wave action, and would, furthermore, be exposed above water during periods of lower loch-level. This raised feature was interpreted as a possible jetty structure by Williams (1971: 123). Little indication of a different form of construction for this feature could be discerned underwater, but the increased use of stone may indicate it relates to the stone-capping constructional phase on the

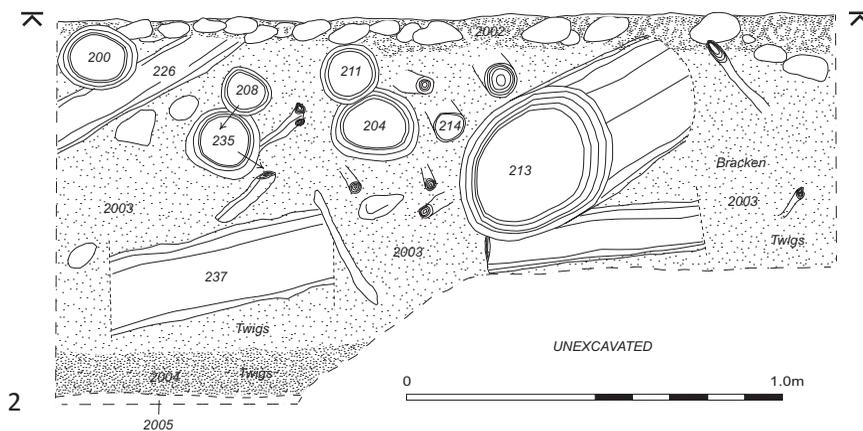


ILLUS 6 Loch Arthur crannog, trench 2 plan



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ILLUS 7 Loch Arthur crannog, trench 2 sections 1. North-west section; 2. South-east section



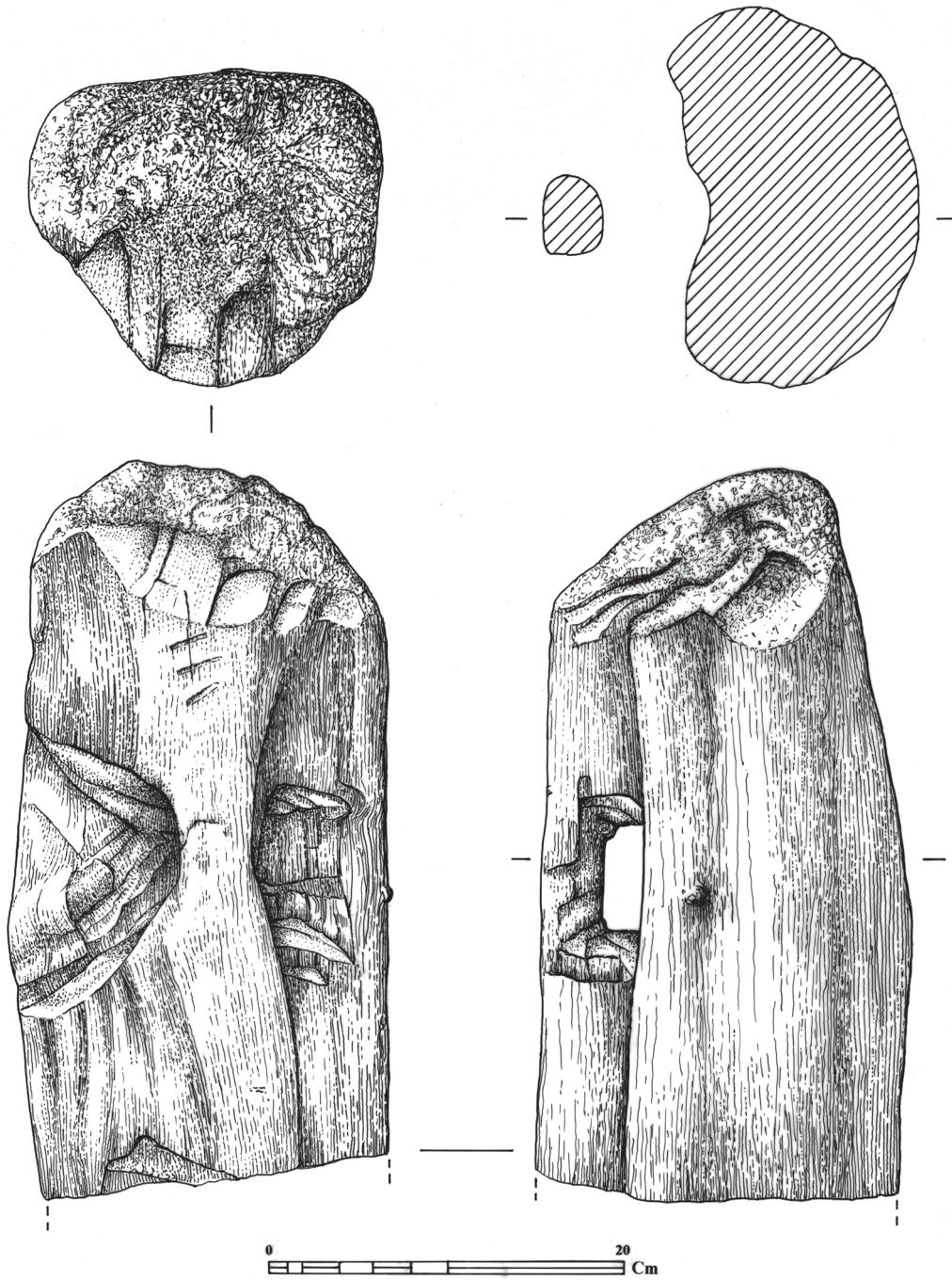
2

dry island interpreted here as a medieval construction (see below).

Excavation of an area of 2m × 2m around the exposed eroding timbers encountered a mixed layer of rounded boulders and stones (context 2001), averaging 20–30cm in diameter and showing no evidence of deliberate arrangement or placement, sitting in loose gravel and inorganic sand (context 2002), averaging 5–10cm in diameter. Significantly, this layer also included some fire-cracked and burnt stones. The maximum depth of this deposit was 15cm and it covered

the whole trench where timbers were not protruding from it.

Removal of this layer revealed over 30 alder (*Alnus glutinosa*) timbers arranged in horizontal layers, with each layer laid at approximately 30–60° (in plan) to the layer above and below (illus 6 & 7). Several of the large timbers had mortise joints cut through them, though there was no evidence of any tenon or other structural purpose of these joints (illus 8). It is possible, given the rough nature of the mortise joints, which were rather weak and lacked any tenon or obvious structural purpose



ILLUS 8 Detail of a roughly hewn mortise joint from timber 204, trench 2

in their current position, that these holes were cut into the ends of timbers simply for the purpose of dragging them on to the site. No other artefacts were recovered in this area, and undisturbed deposits of the natural diatomaceous earth of the loch bed were encountered at just over 1m from the surface of the mound.

The timbers sat within a brown-orange fibrous organic deposit (context 2003), which had a very fine particle size and was, in many respects, very similar to the organic matrix (context 1004) encountered in Trench 1. The deposit was made up of comminuted plant matter encompassing broken-down bracken and twig fragments (60%), hazelnuts and hazelnut shells (10%), and wood chips (20%), many of which demonstrated evidence for tool facets (illus 9) along with small stones (average diameter 10cm, 10%), some of which were fire-cracked. Occasional lenses of inorganic gravel and sand were also present. The deposit was moderately compact, but disaggregated immediately in water on excavation. The maximum depth of the deposit was 0.8m. This deposit overlay, contained and underlay all of the structural timbers encountered in Trench 2. At the base of context 2003 a discrete layer (context 2004) of loosely compact twigs (mainly hazel) and wood chips was encountered. The maximum depth of this layer was 15cm, and it extended across the entire trench. The twigs were in a matrix of organic deposits identical to context 2003.

Unexpectedly, the organic deposits (contexts 2003 and 2004) in Trench 2 were seen to be only 0.95m thick and sat directly on a fine, compact, blue-white clay-silt

(context 2005), which contained no organic or anthropogenic material and was interpreted as the natural diatomaceous earth of the loch bed.



ILLUS 9 Wood chips showing tool facets from context 2003, Trench 2

### *Trench 3*

The third trench to be opened was a 2m × 1m trench located on the dry area of the crannog, which aimed to determine the nature of the upper mound and record its sediment profile as well as to investigate the potential for organic preservation (illus 10).

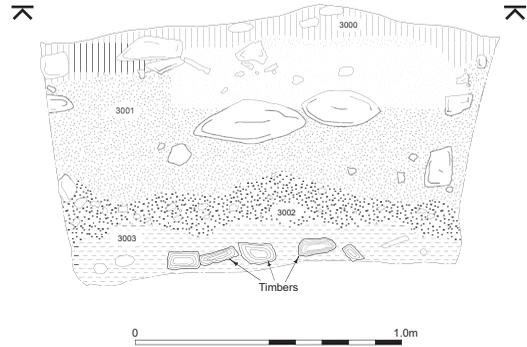
Beneath an area of topsoil consisting of grass, moss and dark brown soil averaging 10cm in thickness (context 3000), a mixture of medium (*c* 30cm) to large (>50cm) boulders in a dark brown soil matrix was encountered (context 3001). The stones in this deposit were deliberately placed to build up an artificial island platform of stone just over 50cms thick. This is likely to be the same stone layer encountered by Williams during his earlier excavations and interpreted by him as the remains of a mediaeval stone undercroft (Williams 1971: 123). The earlier excavations recovered no datable finds but during our excavation a sherd of medieval green-glazed pottery was recovered from this context providing the first definitive evidence for medieval activity recovered from the crannog.

The fabric and form of the sherd suggests a date, on comparison with other Galloway wares, of sometime in the 15th century AD or later and certainly, given the well-fired nature of the sherd, not earlier than this (identification by Lloyd Laing).

At the base of context 3001, a layer of redeposited grey, inorganic loch silts (context 3002), some 12 to 14cm thick, was encountered, which was likely formed during a period of inundation. Underlying this loch silt layer (context 3002) was a constructional layer of horizontal alder timbers (all around 8–10cm in diameter), laid in parallel lines resembling the foundations for a floor (context 3003). The timbers appeared to form a lattice-like arrangement, laid in layers with others laid on top at a perpendicular angle. The fibrous black organic material encountered between the timbers is likely to be the remains of decaying plant material. A number of hazelnut shells were recovered from this context. This deposit could be only be excavated to a depth of c 10–15cm, after which, excavation could not proceed due to water-logging. Timbers from this context were sampled for radiocarbon dating (see below).

#### *Dating and taphonomy*

The survey revealed that the dry island, measuring some 20m in diameter, is sitting on top of a promontory some 81m long and 46m wide. Examination of the submerged sections (Trenches 1 and 2) and the evidence from the terrestrial trench (Trench 3) suggest that the upper mound is constructed of stone while the more substantial submerged structure is composed of mainly organic materials deposited in layers (layers of timber, brushwood and comminuted plant matter). The medieval green-glazed sherd recovered from the boulder matrix of the upper stone mound suggests that it was built sometime in



ILLUS 10 Loch Arthur crannog, Trench 3 north-west section

or after the 15th century AD, on an existing wooden structure.

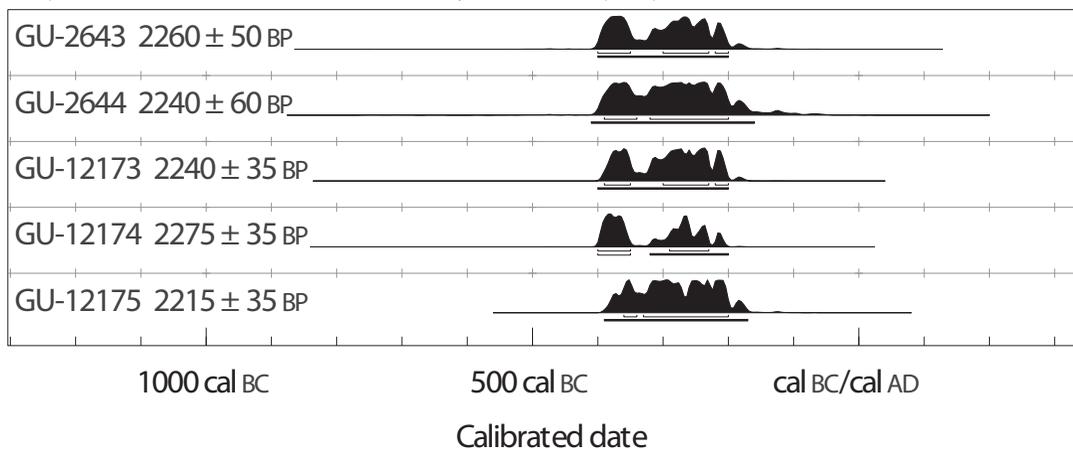
In 2003, five timber samples (all alder *Alnus glutinosa*) were submitted for radiocarbon dating from contexts in all three trenches to provide the basis for a secure chronological framework for the site. These are presented in Table 1.

The dates taken at various levels throughout the submerged mound suggest that it was constructed sometime between 400 and 200 BC; the limitations of the radiocarbon calibration curve for this period prevent closer dating, and the excavations were too limited in extent to be clearer on the longevity of occupation represented by the timber structure. The limitations of early Iron Age radiocarbon dating accepted, however, it is notable that the date of  $2240 \pm 35$  BP (GU-12173) obtained from a timber located at the base of Trench 1 (timber 19, illus 3) is identical to that obtained from the top of the timber mound, sampled in Trench 3, which provided a date of  $2215 \pm 35$  BP (GU-12175) (context 3003, illus 10). Significantly, the date from Trench 3 came from a constructional layer of alder timbers which underlay the upper stone mound, and was separated from it by a deposit of grey, inorganic loch silts (context 3002).

TABLE 1

Radiocarbon dates from Loch Arthur (GU-2643 and GU-2644 from South West Crannog Survey Phase 1, GU-12173, GU-12174 and GU-12175 from Phase 3)

Atmospheric data from Stuiver et al. (1998); OxCal v3.9 Bronk Ramsey (2003); cub r:4 sd:12 prob usp[chron]



Sample code	Trench	Timber no	Species	Age BP	±	Cal range 2σ
GU-2643	N/A	N/A	<i>Betula</i> sp	2260	50	400–200 BC
GU-2644	N/A	N/A	<i>Betula</i> sp	2240	60	410–160 BC
GU-12173	1	19	<i>Alnus glutinosa</i>	2240	35	400–200 BC
GU-12174	2	201	<i>Alnus glutinosa</i>	2275	35	400–200 BC
GU-12175	3	c 3003	<i>Alnus glutinosa</i>	2215	35	390–170 BC

This suggests that the upper stone mound derives from activity in the medieval period on a pre-existing artificial mound that relates otherwise to activity in the pre-Roman Iron Age, while the re-deposited silt layer (context 3002) that separates these two constructional events contexts is concurrent with a period of abandonment.

#### *Archaeobotanical analysis*

A sample from the rich organic matrix from Trench 1 (context 1004) was subject to botanical analysis by Dr Amy Bogaard,

University of Oxford, in an attempt to identify evidence of domestic activity at the site (Bogaard 2004). The bulk of the material in the sample consisted of waterlogged wood chips (with cut edges), twigs and wood bark fragments, bracken fronds and wood charcoal, alongside moss stems (including *Neckara* spp) and the distinctive leaves and shoots of *Sphagnum* (see Table 2). Significantly, however, evidence for the keeping of animals and the processing of cereal grains on site was also recovered. Small fragments of disaggregated animal dung thought to be

TABLE 2

Content of a random subsample of c 150ml volume from organic context 1004 from Loch Arthur. It was processed by wet sieving, with sieves ranging from 4mm to 0.3mm mesh size. 100% of the material from the 4mm, 2mm and 1mm size fractions was sorted under a low-power microscope ( $\times 7$ – $\times 45$ ); the more time-consuming 0.3mm size fraction was randomly subsampled and 12.5% was sorted (Bogaard 2004)

<i>Types (waterlogged unless otherwise stated)</i>	<i>Scale of abundance</i>	<i>&gt;1mm counts</i>	<i>0.3mm counts (12.5%)</i>
Wood chips	frequent		
Round wood	occasional		
Dung (lumps, no whole pellets)	frequent		
Bracken leaves	abundant		
Bark/bast fragments	frequent		
Charcoal	frequent		
Hazelnut shell and nutlets	frequent		
large culm	rare		
moss stems	occasional		
Tree buds including hazel	frequent		
Sphagnum leaves/shoots	frequent		
Holly leaves	occasional		
Wheat/rye bran	rare	one large fragment	few small fragments
Birch seed		1	
Calluna vulgaris buds		4	
Rubus idaeus		11	
Potentilla		2	
cf Emmer gb		11	
Emmer/spelt gb		9	
GB indet		10	
<i>Triticum</i> grain, charred		1	
Chenopodium album		12	
Galeopsis b/s/t		4	
Polygonum lapathifolium		8	
<i>Rumex</i> sp		3	
Polygonum aviculare agg		4	
Polygonum indet		1	
Sonchus asper		1	
Stellaria media		7	2
Urtica dioica		2	9
Urtica urens		2	
Cyperaceae, var types		12	
Ranunculus		7	
Viola		1	
Brassica/Sinapis		1	
Cruciferae			1

sheep/goat were identified. Waterlogged remains of emmer wheat (*Triticum dicoccum* Schübl) were recovered in the form of chaff (spikelet forks and glume bases). Glume wheat glume bases were the dominant chaff type, most likely reflecting dehusking prior to consumption of the grains. The crop material may have been stored as spikelets (ie grains still enclosed by glumes) and dehusked piecemeal throughout the year. In addition, small amounts of cereal bran (the outer layers of the cereal grain), identified as wheat or rye (*Triticum/Secale*), were recovered. These remains included some large fragments representing grain halves, reflecting either the remains of whole grains that had been broken after deposition or the remains of coarsely milled grains. The waterlogged remains of wild plants (including fat hen, bramble, raspberry and stinging nettle) could well represent in situ vegetation rather than deliberately collected plants. Some of the wild species (eg fat hen, chickweed, prickly sow thistle, etc) could also represent arable weeds harvested with crops and brought on to the site with crop material. The prevalence of glume wheat (especially emmer) in context 1004 is consistent with a prehistoric or Roman Iron Age date.

## DISCUSSION

Construction of the submerged mound at Loch Arthur appears to have been through the deposition of material in superimposed horizontal layers. Each layer consisted of timbers weighed down with plant material, brushwood and stones. There were no vertical piles in the sections examined and such piles could only be traced off-site in the surrounding silts (particularly the northern margins). Thus the possibility of external structures such as breakwaters, boat nausts

or a walkway exists, but the main mound must be considered to be of the *packwerk* construction form which is thought to characterise the crannog sites of south-west Scotland (Munro 1882). *Packwerk* sites are artificial mounds composed of peat and brushwood deposits, built to provide a base for a timber superstructure, and are traditionally thought to contrast with the stone and boulder mound types more typically encountered in Highland regions north of the Forth–Clyde isthmus (Munro 1882: 242; Morrison 1985: 20; Henderson 1998: 236–7). However, the examination of a range of sites during the current South West Crannog Survey has demonstrated that many sites in this area feature substantial stone elements in their construction and as such are difficult to separate on purely constructional criteria from highland boulder sites (Henderson et al 2003: 79–102), and the details of the taphonomy of Highland sites are still far from clear. Furthermore, the organic deposits at Loch Arthur were very similar in nature to those found at the highland site of Oakbank, Loch Tay (Dixon 1981: 19). It seems clear that the previously held type boundaries are far less clear than was once believed and are likely to have been the consequence of assumption and the lack of widespread underwater investigation (cf Harding 2000: 303).

The lack of any evidence for a perimeter palisade or any other form of retaining piles contrasts with the *packwerk* crannogs of Buiston (Crone 2000) and Loch Glashan (RCAHMS 1988; Crone & Campbell 2005), and while it would not be possible to rule out their presence at Loch Arthur without further excavation of the deep silts which overlie the base of the mound, it seems likely that the site differed from these later sites in this respect.

The importance of the dating from the Loch Arthur trenches is the demonstration

that large prehistoric crannog mounds may result from the construction of a single island in one event, rather than as an accumulation of occupation deposits over time. In this respect, Loch Arthur would appear to differ from Oakbank crannog, Loch Tay, where what was possibly a free-standing primary structure developed into a mound with the accumulation of occupation material, structural collapse and the addition of boulders as consolidation over the period *c* 800–300 BC (Dixon 1981; Sands 1997: 38–41). While the radiocarbon dates involve wide calibration ranges, the structural evidence from Loch Arthur suggests that the crannog was built in a single event.

This has implications for our interpretation of radiocarbon dates for crannogs more generally. Radiocarbon dates from crannogs must always be treated with caution since they offer only an indication of one phase of activity on the site, and without excavation it is usually impossible to be certain whether this represents an early or late horizon. This is perhaps illustrated most clearly by the crannog in Borean Loch, near Rockliffe, which has radiocarbon dates from structural piles in the 4th to 1st centuries BC and in the 7th to 9th centuries AD (Barber & Crone 1993: table 1), while artefactual evidence suggests occupation in the Roman Iron Age, probably in the early 2nd century AD (Robertson 1970: 207). Loch Arthur demonstrates, conversely, that while re-use may be a recurring feature, the formation of the main mound may not always represent multiple superimposed occupations separated in time.

The deposits revealed in the exposed sections at Loch Arthur suggest that only foundational construction material is present underwater. No evidence conclusively indicating occupation was recovered in Trenches 1 or 2 and it seems probable, from the evidence from Trench 2, that if any occupation deposits existed on top of

the submerged mound then they have since been eroded away, leaving only foundation material.

The results of the archaeobotanical analysis of the organic matrix of the mound (context 1004) provided some evidence for domestic activities (keeping animals, food-processing and consumption). While it remains a possibility that this evidence reflects off-site activity that was simply collected near the site and then used in the foundation deposit, the abundance of fire-cracked stones observed throughout the outer parts of the mound supports the idea that the botanical evidence reflects domestic activity which was taking place on the site. The evidence for the keeping of livestock and processing of crops most likely relates to occupation that was taking place on the upper surface of the mound. With this interpretation in mind, it is interesting that the density of waterlogged cereal chaff remains per litre recovered in the sample is comparable to the densities expected in ‘open contexts’ (ie gradually accumulated settlement detritus) in Neolithic–Bronze Age Swiss lake dwelling sites (eg Brombacher & Jacomet 1997). The archaeobotanical results are comparable with those obtained from Oakbank crannog (Miller 2002), which indicated that that site was engaged in a mixed arable and pastoral economy. The interpretation of Loch Arthur crannog as a farmstead is wholly concurrent with all of the available evidence for pre-Roman Iron Age crannogs so far (Cavers 2010: 74–119), and may contrast with the evidence for the Early Historic period, when the occupants of crannogs may have been of elevated status, supported by client networks and with access to valuable commodities (Crone 2000: 157–8; Cavers & Henderson 2005: 296).

It should be noted, however, that a farmstead interpretation for the Iron Age phase can only be tentatively drawn at present. The

small area of Trench 2 limits any firm assertion as to the survival of in-situ superstructures. While it is likely that the construction of the medieval mound would have badly disturbed or destroyed the original superstructure, it is possible that full excavation on the dry island proceeding beyond the medieval foundations investigated by Williams might be informative. Indeed, this is suggested by the closely set alder timbers encountered at the bottom of Trench 3 (Context 3003) which are similar to those interpreted as a floor layer at Oakbank crannog (Dixon 2004: 135) and may represent the survival of in-situ occupational deposits directly underneath the medieval boulder mound.

Evidence of artificial construction (horizontal radial alder timbers laid in platform layers, organic deposits and stones) could only be seen on the southern and eastern sides of the promontory where active erosion is occurring, presumably due to wave action. The western and northern sides of the promontory are completely obscured by soft silts, making it difficult to say with certainty that the whole promontory is artificial. Oak and birch vertical piles can be found in the silt along the northern edge of the promontory providing more evidence for artificial construction but these are not associated with the main structure of the mound.

Nothing could be traced of the stone causeway to the upper island observed in 1874 (Gillespie 1874–6: 23) but apparently obscured by 1968 (Williams 1971: 123). It seems most likely that this causeway lies underneath mud and reeds in a deposit that has built up between the closest point of the island to the shore and the shore itself. Indeed, it is this build up which makes it possible to walk to the island today, something that was certainly not possible c 1860 from the evidence of the First Edition Ordnance Survey map of Loch Arthur where the crannog can be clearly seen to be an

island. The build up of silt along the western and northern margins of the site may be the result of the re-deposition of silt carried by wave action and currents. With this in mind, it is probable that the promontory revealed in the digital terrain survey is not entirely artificial but rather a large oval artificial island which is now connected to the shore due to the relatively recent re-deposition of silt.

On saying this, however, it is clear that at 46m across, the submerged artificial structure is quite substantial. In Trench 2, on the top of the submerged island, the natural loch bed (context 2005) was encountered under timber deposits of just 1.1m suggesting that the artificial structure may have capped an existing naturally raised area of loch bed. As Trench 1 demonstrates, however, anthropogenic deposits on the southern and western margins of the site are considerably thicker, occurring at depths of at least 3.5m. Indeed, the deposits may continue deeper but unfortunately heavy natural silt accumulation around the margins of the site made further investigation impossible.

The construction of such a large artificial structure in Loch Arthur would have required a considerable amount of labour and resources. In this light, it is difficult to view the site as simply a pragmatic, self-sufficient farmstead. As a major ‘constructed’ feature built in a ‘natural’ loch during a period when watery locations are known to have had strong religious associations (Green 1986; Webster 1995; Henderson 2009), the crannog may have been a more significant structure in the local Iron Age landscape. Through combining water and monumentality, two aspects which already had profound meaning to western Scottish communities, the construction and occupation of Loch Arthur crannog may have been a way of creating a new level of identity and differentiation in the landscape. Whether Loch Arthur as a settlement legitimised the

authority of an individual or specific group or instead was used in some way that was related to the communal identity of a wider community can be only matters of speculation at this stage. Certainly the crannog in Loch Arthur would have been a socially meaningful place in the local landscape that reflected culturally specific ways of understanding the world. It would have been a structure built according to existing social conventions with meanings which could have been 'read' by the communities that constructed and used it.

The fact that two periods of construction and use, separated by at least 1,500 years, can be discerned at Loch Arthur is of interest. Occupation of crannogs subsequent to their original Iron Age construction is common in Scotland, although later historic activity is apparently more common on Highland crannogs where stone superstructures are demonstrably secondary to the main crannog mound. Activity in the late medieval period is less commonly observed on crannogs in south-west Scotland, although construction in the 11th to 13th centuries is attested by radiocarbon dates from Lochrutton (Barber & Crone 1993: 522). Island settlements certainly continued in use in the south-west and sites such as Castle Loch, Mochrum, demonstrate later medieval occupation on sites with probable Iron Age origins (Raleigh-Radford 1966).

## MONITORING

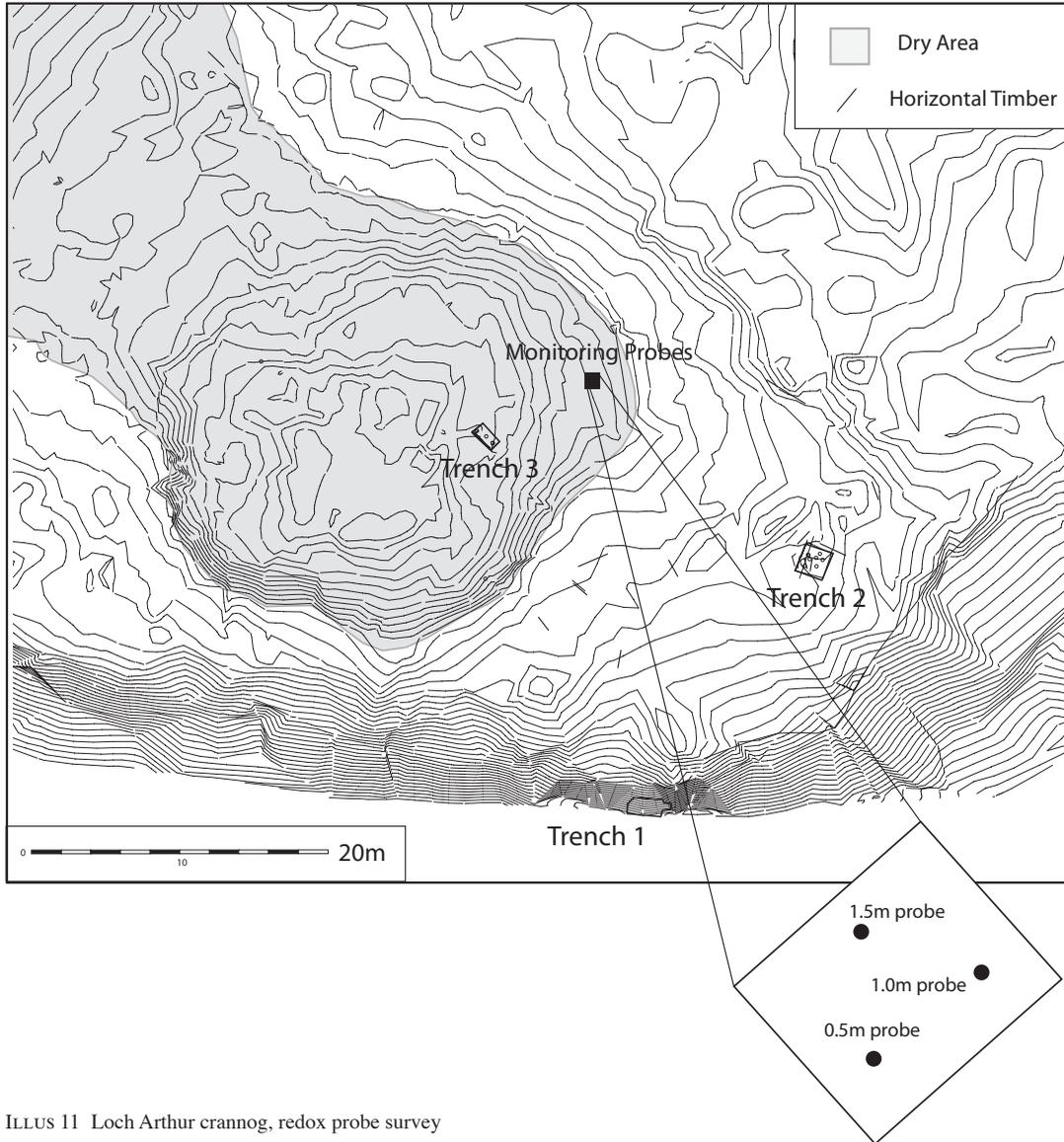
In 2004, a one-year monitoring programme was established at Loch Arthur in an attempt to identify the mechanisms and causes of organic decay at the site (Henderson 2004: 177–9; 2007: 291–3). Loch Arthur was one of four crannogs selected as part of the monitoring phase of the south-west Scotland Crannog Survey, each site providing evidence

of one or more of the threats postulated for the degradation of crannog deposits in the south-west: drainage, fluctuating water-tables, mechanical erosion, potential nitrate run-off and the effects of micro-organisms caused by active biological environments (Lillie et al 2003; 2004; 2008).

Despite the fact that Loch Arthur enjoys very good water quality, compared to other south-western lochs, and does not suffer from algal blooms (probably related to the fact that the land around the loch is managed organically), the active biological decay of timbers had been clearly identified on the crannog. In addition, there was some evidence of the mechanical erosion of organic deposits and loch water levels were reported to fluctuate throughout the year.

Alongside the examination of water table levels, the work at Loch Arthur aimed to define the overall chemical balance of the anoxic submerged deposits on the site through the examination of the pH, redox potential and conductivity – as these factors have been identified as key parameters in defining the preservative quality of waterlogged environments (Caple 1994, 1998; Caple & Dungworth 1997; Caple et al 1997). Redox probes (0.5m; 1m; 1.5m) and piezometers were established at the site in July 2004 and full monitoring took place between November 2004 and November 2005 (illus 11).

The monitoring work indicated that Loch Arthur was a pH neutral, well oxygenated mesotrophic loch; results that did not provide evidence for increased biological activity but instead suggested that conditions for the preservation of organic material should be good. Changes in water level of up to 0.5m were observed and were seen to affect the redox readings from the uppermost crannog deposits, but these changes were short-lived and were not thought to have a lasting impact on the preservative quality of the deposits. These



ILLUS 11 Loch Arthur crannog, redox probe survey

results did not tally with the visual inspections from 2002, which revealed timbers in various states of decay and biological infestation; from freshly exposed timbers bearing no vegetal growth, through timbers covered in vegetation, to timbers in advanced stages of decay (Henderson & Cavers 2004: 5–6, pl 4). These observations suggested that biological

degradation was actively in progress in the loch.

Instead, the results of the monitoring in 2004 suggested that two processes combined could be responsible for the observed areas of biological infestation at the site. First, Loch Arthur is amongst the larger lochs of south-west Scotland, making wave action a

more potent erosional force. The location of the crannog in the north-west corner of Loch Arthur means that the south-eastern areas of the site, where the eroded sections were identified, are exposed to the full affects of wave-fetch generated across the length of the loch when the prevailing winds are blowing from the appropriate direction. Second, the upper surfaces of the submerged mound at Loch Arthur are not isolated from the wind mixing of water, and were seen to be shallow enough (>1m) to permit light for plant photosynthesis. These conditions supported the growth of aquatic plants at Loch Arthur on timbers and organic deposits. In addition, wave action could also been seen to be eroding and uncovering deposits on which vegetation could then develop, causing the rapid degradation of timbers and thus further promoting aquatic plant growth and biological decay.

The monitoring work in 2004 demonstrated that submerged organic deposits on crannogs in shallow water cannot be considered to be in fully anoxic environments; certainly their outer surfaces are not in hypolimnetic water. These observations support research on waterlogged deposits which demonstrated that the presence of water is not sufficient in itself to preserve anoxic conditions and thus the archaeological value of deposits (Capple 1998). Oxygenation in shallow well-mixed water rather than dehydration is frequently the crucial factor in the destruction of waterlogged remains (Bouteljie & Goransson 1972; Matthiesen et al 2004).

## CONCLUSIONS

The small-scale investigations at Loch Arthur reveal the importance of understanding how crannog mounds were formed before attempting to date their occupation and use.

Unfortunately there was not enough excavation to fully determine the nature of the occupation at Loch Arthur but there is some evidence to suggest that the occupants practiced a mixed pastoral and arable economy. At around 50m in diameter, the construction deposits reveal the establishment of a substantial settlement during the Iron Age in what would have been a prime and highly visible location, immediately adjacent to some of the highest quality agricultural land in south-west Scotland. As a result, we can imagine that this was a symbolically important location and construction in the Iron Age landscape. In this light it is interesting that the site was re-built upon sometime in the 15th century AD, or just after. It is significant that a very large percentage of crannogs that have been investigated in Scotland have provided evidence of secondary occupation, often many hundreds of years after their initial primary phase (see Cavers 2010). The phenomenon of returning to crannog sites long after they were abandoned demands further research as we attempt to unravel the changing meaning of crannog locations through time. Finally, the key conclusion of the environmental monitoring work at Loch Arthur – that submerged crannogs in apparently stable waterlogged environments are not necessarily free from aerobic decay – highlights the importance of continuing to survey, record and evaluate crannogs and their environments throughout Scotland.

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