

Recent survey work at Lough Gur, Co. Limerick

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A survey project aimed at examining and chronicling monuments in their landscape setting using modern survey technology was undertaken at Lough Gur in 2008-9. The results show that an archaeological landscape with little surface expression exists and that the visible monuments in the survey target areas are part of a greater monument complex of archaeological remains.

Introduction

Lough Gur has a variety of field monuments ranging in date from the Neolithic up to the late medieval period. Various surveys from antiquarian to modern scientific methods and archaeological excavations have established a broad chronological framework for the monuments. The absence of tillage has contributed to the survival of a huge amount of earthworks and this was confirmed by the Bruff aerial survey² undertaken in the 1980s where the number of known monuments was increased by 68.5% (Doody 1993; 2008).

Landscape Setting

The lake is located south of the Shannon estuary and accessible in the prehistoric period via the Mague River and its tributaries, the Morningstar and Camoge Rivers and the Mulkear River to the east (Fig. 1). These rivers were pivotal for accessibility into the hinterland of the Shannon estuary in the prehistoric period. The lake is, at present, the largest inland water body in the East Limerick area and was attractive to early settlers. Low-lying tracts of land in the environs of broad, flat river valleys to the south of Lough Gur also included lakes, some of which survived into the historic period (Synge 1966, 19). These low-lying areas are now boggy areas between higher ground. The 'Red Bog', which is in close proximity to the southern shore of Lough Gur, was probably also a relatively large water body. Water logging has resulted in gley soils and these soils in the valley west of the Grange Stone Circle complex also suggest former lakes.

The lake is 'C'-shaped and fed by a spring and drains through a rock cave or crevice at Pollavaddra on the south-east side of Knockfennel Hill. Prior to a Famine Poor Law Relief drainage scheme in 1847-8, the lake almost completely surrounded Knockadoon Hill.³ The drainage reduced the lake in size to about 80% of the original extent and several artefacts including the late Bronze Age Lough Gur shield were recovered from the lakeshore immediately after the lake was lowered.⁴ The old shore line is traceable along the edge of Lough Gur and the water is now c.2m below the original lake level.

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² Survey undertaken by the then OPW and Department of Archaeology UCC.

³ Du Noyer's (1817-1869) sketches confirm the lake extent in the early nineteenth century (Hayman 1868-9, 414-15); the First edition OS survey was undertaken in 1840 (published 1844) also shows pre-Famine lake levels.

⁴ An account of the retrieval of artefacts from the lowered lake edge is given by Mary Carbery in *The Farm by Lough Gur* (Cork, reprint 1973).

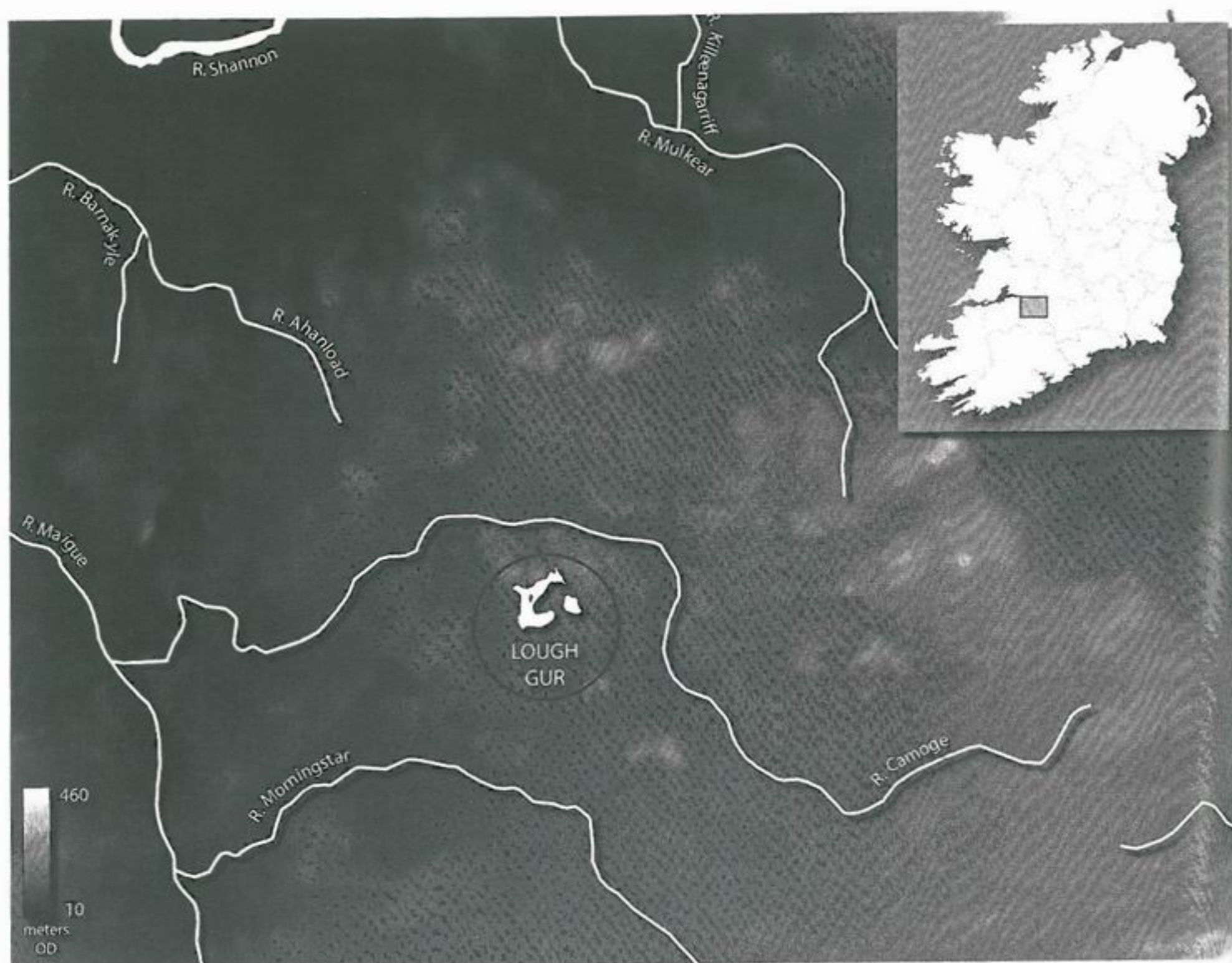


Fig. 1 Site location

Geology and soils

The geology of the Lough Gur area of Co. Limerick includes a mix of rock types within a syncline known as the 'Limerick Basin'. The Carboniferous series in the region comprises shales and limestones that surround the lake. The limestone hills in the immediate environs of Lough Gur are Knockadoon which is surrounded by the lake, Knockfennel to the north, Ardaghlooda to the west and Grange Hill further to west of the stone circle complex at Grange. The ground also rises to the north and east and the contours enclose the lake in a bowl-shape. The complex geology of a ring-dyke complex is to the north and east of the lake and these volcanic rocks are igneous rocks ranging from alkaline syenites to basic basalts and are known as the 'Limerick Volcanics'. These igneous rocks are interbedded with layers of volcanic ash (tuffs) as well as Carboniferous limestone and shale. The volcanic complex is visible as conical volcanic plugs to the north and east of Lough Gur and these interrupt an otherwise flat plain surrounding the lake. The volcanic activity has a negative impact on geophysical prospection as volcanic rock creates magnetic anomalies that obscure potential archaeological features.

The availability of raw material for axe-head manufacture and flint⁵ and chert for stone tools made Lough Gur attractive to early settlers. The lithic assemblages from

⁵ Woodman and Scannell (1993) have noted that although chert is readily available in Lough Gur, there was a marked preference for glacially-derived nodular flint.

many excavated sites included artefacts manufactured from flint derived from the glacial tills and chert from the Carboniferous limestone. The extinct volcanic plugs provided glacial erratics used in monument construction, principally at the Great Stone Circle in Grange townland.

The last glacial advance⁶ shaped the East Limerick landscape. As the ice retreated, a limestone-derived boulder-clay plain was laid down. In the area around and to the north and east of Lough Gur, this drift contains an abundance of pebbles derived from the volcanic outcrops. The majority of the survey area in Grange townland (Area 1, Fig. 2) is in the well drained Grey-Brown Podzolic soils of the Elton series which were developed mainly from glacial drift of limestone derivation (Finch and Ryan, 1966). The survey in the vicinity of Circles O and P (Areas 3–5; Fig. 3), located approximately 500m to the east of the lake, is in a region where the Elton Series podzolic soils merge with Brown Earths of the Derk Series, the latter being developed from glacial drift of predominantly volcanic origin (*ibid.*). The light soil cover in Lough Gur was easy to cultivate in pre-historic times and must have facilitated early farming methods. The modern vegetation is mainly grassland.

Previous surveys

Antiquarian interest in the Lough Gur region is known since at least the eighteenth century when the area was visited by Ware and others (Cleary 1983). Dinely's 1681 drawings (published in 1870) of some of the Lough Gur monuments include the north-west side of the lake and the entrance to Bouchier's Castle. The castle, gate-house, outer defences and pigeon house are depicted as well as the now-infilled moat that linked the north-east and south-east sides of the lake to completely surround Knockadoon Hill. A late eighteenth century illustrative survey of Lough Gur housed in the Cooper collection in the National Library provides plans of monuments in the Grange complex, albeit the accuracy of these is questionable (Ó Nualláin and Cody 1996). Du Noyer's (1817–1869) sketches show Bouchier's Castle on the east side and Black Castle on the south-east side of the lake with the causeway extending to the south from Black Castle. Croften Croker, a nineteenth-century antiquarian compiled an illustrated survey of some of the monuments and published this in 1833. Lowering the lake in the post-famine period heightened antiquarian interest in the area and many artefacts were collected from the new shoreline.

The Ordnance Survey mapped the Lough Gur area in *c.* 1840 (published 1844) and this provided the basis for further studies. Specific monument surveys were first conducted in Lough Gur by Windle (1912) and an extensive field survey by M.J. O'Kelly in the early 1940s surveyed over 500 monuments in the Barony of Small County and provided measured drawings of the upstanding monuments (O'Kelly 1942; 1945). Medium altitude aerial survey of the Bruff region was undertaken in 1986 increasing the number of known monuments by over 1000 (Doody 2008). Of the newly recorded sites in the Bruff aerial survey, the largest increase was in the number of enclosures (472 [87.1%] new sites) in contrast to the 542 previously known sites (*ibid.*, 67). The known number of circular enclosures has increased by almost 60% but the most marked increase has been in the number of sub-circular, 'D'-shaped, oval and sub-rectangular enclosures where site numbers have increased from 68 to 153 (225%). While the probability that many of the circular enclosures are Early Christian period ringforts, the other enclosures may be of any date.

⁶ Weichsel (Mitchell 1976).

Archaeological Excavations

The first excavation in Lough Gur was carried out in the 1860s and published in 1869 by J. Harkness, then Professor of Anatomy in UCC in Circle J⁷ on Knockadoon Hill. The excavation was in the centre of the enclosure, west of a standing stone and uncovered a small cist grave with two burials. The first scientific archaeological excavations began in 1936 under the direction of Professor Seán P. Ó Ríordáin and the work continued until 1954 (Ó Ríordáin, 1949, 1951, 1954; Grogan and Eogan 1987). More recent work by one of the authors was carried out in the 1980–90s (Cleary 1980, 1982, 1983, 1995, 2003, 2006) and with the benefit of C¹⁴ dating these have established a broad chronological framework for the various monuments.

The earliest known sites are Neolithic houses excavated on Knockadoon Hill. These were excavated prior to C¹⁴ dating but by cross reference to more modern excavations that have produced similar pottery, the initial period of Neolithic occupation can be estimated at c.3700BC.⁸ A feature of the Neolithic landscape in Lough Gur is the virtual absence of megalithic tombs. Site E near Grange Stone Circle may be a possible court tomb and the remaining megalithic monuments are wedge tombs of Late Neolithic date.

Excavation in the Grange area was at the Great Stone Circle undertaken in 1939 by Seán P. Ó Ríordáin. The construction date of the stone circle is obscure and Ó Ríordáin (1951, 72) concluded 'we are left to wonder if the Beaker Folk were in fact responsible for inspiring the building of the stone circle or were only a contributing group in erecting the monument'. The date range for construction may extend from the Late Neolithic (Grooved Ware/Beaker period) to the Late Bronze Age (Roche 2004). The site is located on the crest of a low ridge that rises from the lake on the east and slopes downwards to a stream valley to the west. The site comprises a ring of contiguous orthostats with an internal diameter of 45.7m and a 9m wide by 1.2m high earthen bank backing the inner stone circle. The number of original stones in the inner ring is 113 and these vary in height, the tallest at 4m being in the north-east quadrant and recorded on the Ordnance Survey maps⁹ as '*Rannach Croim Dubh*'. The stones are both set in sockets and on the old ground surface and supported by packing stones around the bases and the embankment. An entrance on the east side is stone-lined along the sides and the stones are set against the bank terminals while two large stones mark the internal entrance to the circle. A setting of two stones almost opposite the entrance has an intermediary 'V'-notch. This setting may have a celestial significance and have been constructed to view a solar, lunar or stellar event. The central area has an introduced soil layer of c.0.6m that may have been brought from the lakeshore. This layer covered the packing around some of the circle stones. Construction features confirmed to Ó Ríordáin that the monument was built in a single phase.¹⁰

The survey areas

The areas chosen are to the east and west of Lough Gur. Areas 1 and 2 (Fig. 2) of the survey are adjacent to Grange Stone Circle extending eastwards to the lake shore and west to include the sites recorded on the OS maps as 'Stone Circle (site of)' and 'Stone Avenue'. Areas 3–5 are located to the east of Lough Gur in the environs of Circles O and P.

⁷ Windle's 1912 monument nomenclature is used as site designations throughout this paper.

⁸ The date is based on a similar ceramic assemblage excavated at Tullahedy, Co. Tipperary which is located north-east of Lough Gur, close to Lough Derg on the river Shannon (Cleary and Kelleher 2011).

⁹ 1903 and 1924.

¹⁰ Roche (2004) has argued that the site is Late Bronze Age in date, based on the identification of Ó Ríordáin's Class II ware as Late Bronze Age and the construction of the monument in a single phase. This hypothesis is based on the assumption that almost 90% of the ceramic assemblage is residual from an earlier phase of site use.

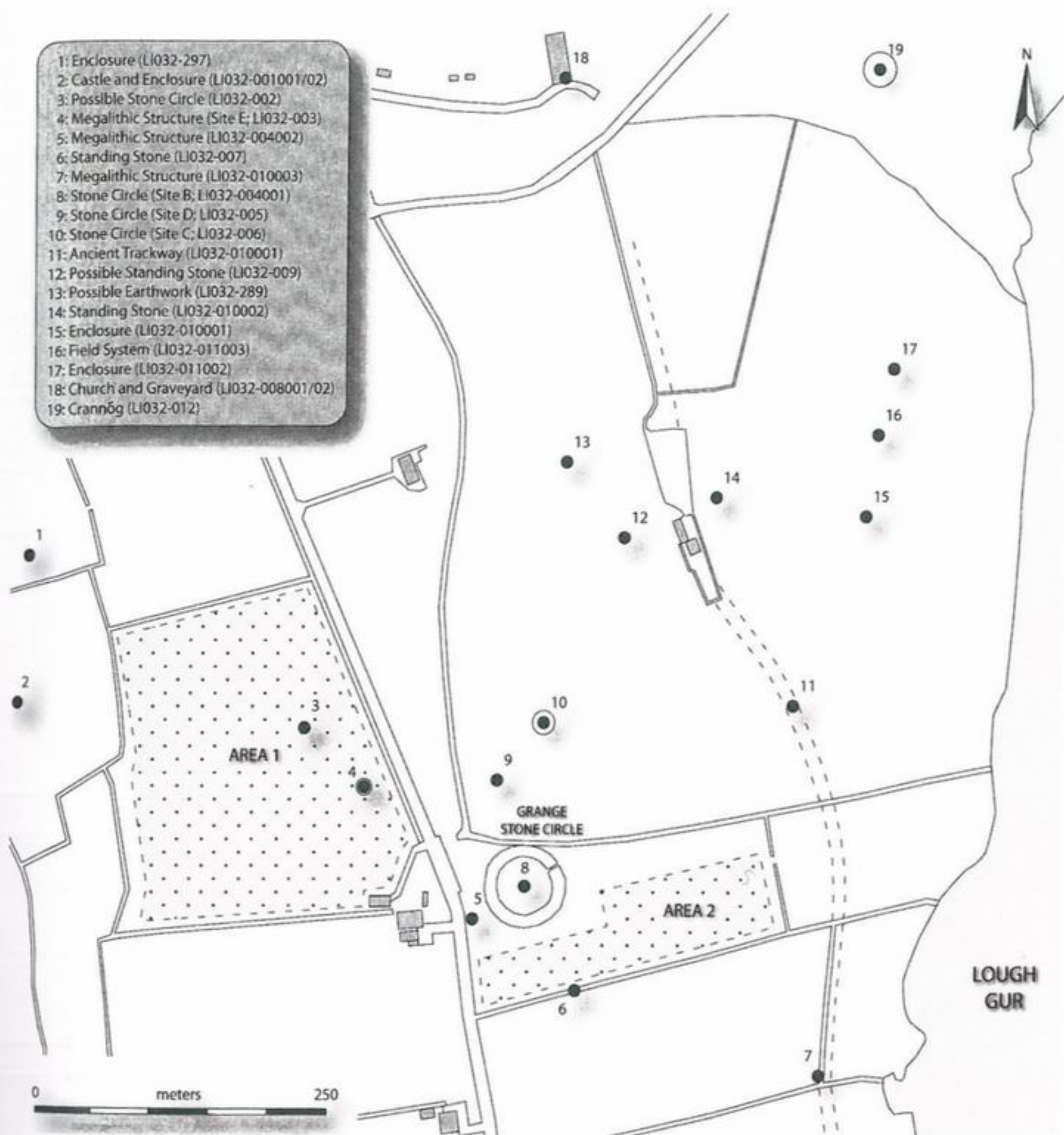


Fig. 2 Archaeological sites in Grange townland and location of Areas 1 and 2 of survey

Areas 1 and 2: Grange

Grange townland on the western shores of Lough Gur includes a number of archaeological monuments of which the Great Stone Circle (Circle B¹¹) is the best known (Fig. 24). This density and variety of archaeological monuments highlights the importance of the Grange landscape from prehistoric times. Area 1 of this survey is located north-west of Stone Circles B, C¹² and D.¹³ The remains of Grange Castle¹⁴ on top of a prominent rock

¹¹ RMP LI032-00400.

¹² RMP LI032-006.

¹³ RMP LI032-005.

¹⁴ RMP LI032-001002.

outcrop are located 150m to the west. Area 1 includes two recorded monuments – Site E (LI032-003) and the site of a stone circle (LI032-002) immediately to the north-west. Site E was not shown on the 1844 Ordnance Survey map but was marked as ‘*Stone Circle*’ on the 1902 25” scale map and ‘*Stone Avenue (Site of)*’ on the 1924 6” scale edition. The description of Site E as an ‘avenue’¹⁵ was originated by Lynch (1895) who was followed by Windle (1912). Lynch believed that the ‘avenue’ led to the stone circle. Ó Ríordáin (1951) and Ó Nualláin and Cody (1996) suggest that Site E was a possibly court tomb. The site comprises a 6.5m long row of five stones (two of which are *ex-situ*) on the north and a 23m long line of twelve stones to the south. The stone lines converge to the north-west with intermediary distances of 7.3–8.3m and there is a large stone positioned centrally toward the northern end. The stones are generally low and heights vary from 0.35–0.7m high with the exception of two stones on the east end in the southern row which are 1m and 1.75m high. Two stones on the south-east end were interpreted by Ó Ríordáin (1951, 39) as a curved façade of a forecourt.

A large sub-oval enclosure¹⁶ identified during the Bruff aerial survey is the location of the Stone Circle mapped in 1924. The enclosing bank is often only faintly visible, particularly along the western perimeter and there are no surface traces of a fosse. The maximum diameter of the monument is 102m (NE–SW) by 85m (NW–SE), and the height of the bank ranges from 0.4 to 1.5m (from interior). Ó Nualláin and Cody (1996) have interpreted the site as a henge monument.

Area 1 of the survey area lies within a large sub-rectangular pasture field which encloses c.5.3ha. The field is bounded on its southern, eastern and northern sides by earth and stone banks, crowned with thick vegetation. The western extent has no formal boundary, but is defined for the most part by a natural ridge and a marked change from dry, grazed land to lower-lying marshy ground which may have once been a lake. The land slopes gradually from east–west (c.78–65m OD) before the ridge creates a sharper drop-off to wet ground. A working farmyard occupies the south-eastern corner of the field and a farm track runs the length of the eastern boundary. Presently, temporary electric fencing sub-divides the field into three long strips running west-southwest–east-southeast. The 1902 and 1924 Ordnance Survey map editions record the field as being a large open area, while the first edition map depicts the field as having been subdivided in the 1840s.

This soil cover, which appears to thin toward the western edge of the field, overlies a solid geology of Waulsortian Limestone and there is one instance of an exposed rock outcrop occurring in the survey area. It is likely that a number of hollows and notable undulations in the field are the result of formations in the underlying bedrock. This also appears to be the case with a linear gully-like depression which extends almost halfway into the field from the west.

Area 2 was over the southern half of a large, flat, sub-rectangular field and measured 200m east/west by 60m north/south. Grange Stone Circle is in the north-west quadrant of the field and there are no upstanding archaeological remains within the area investigated.

Areas 3–5: Circles O and P

Circles O and P are set in a broad valley where the terrain rises steeply to the east and less so the west (Fig. 3). Circle O was excavated by Ó Ríordáin in 1936 and 1937 and Circle

¹⁵ Dowd (1896) and Harkness (1869) thought the stones at Site E had originally formed part of Stone Circle D.

¹⁶ RMP LI032-297; Bruff Survey Site Number 282 [01]).

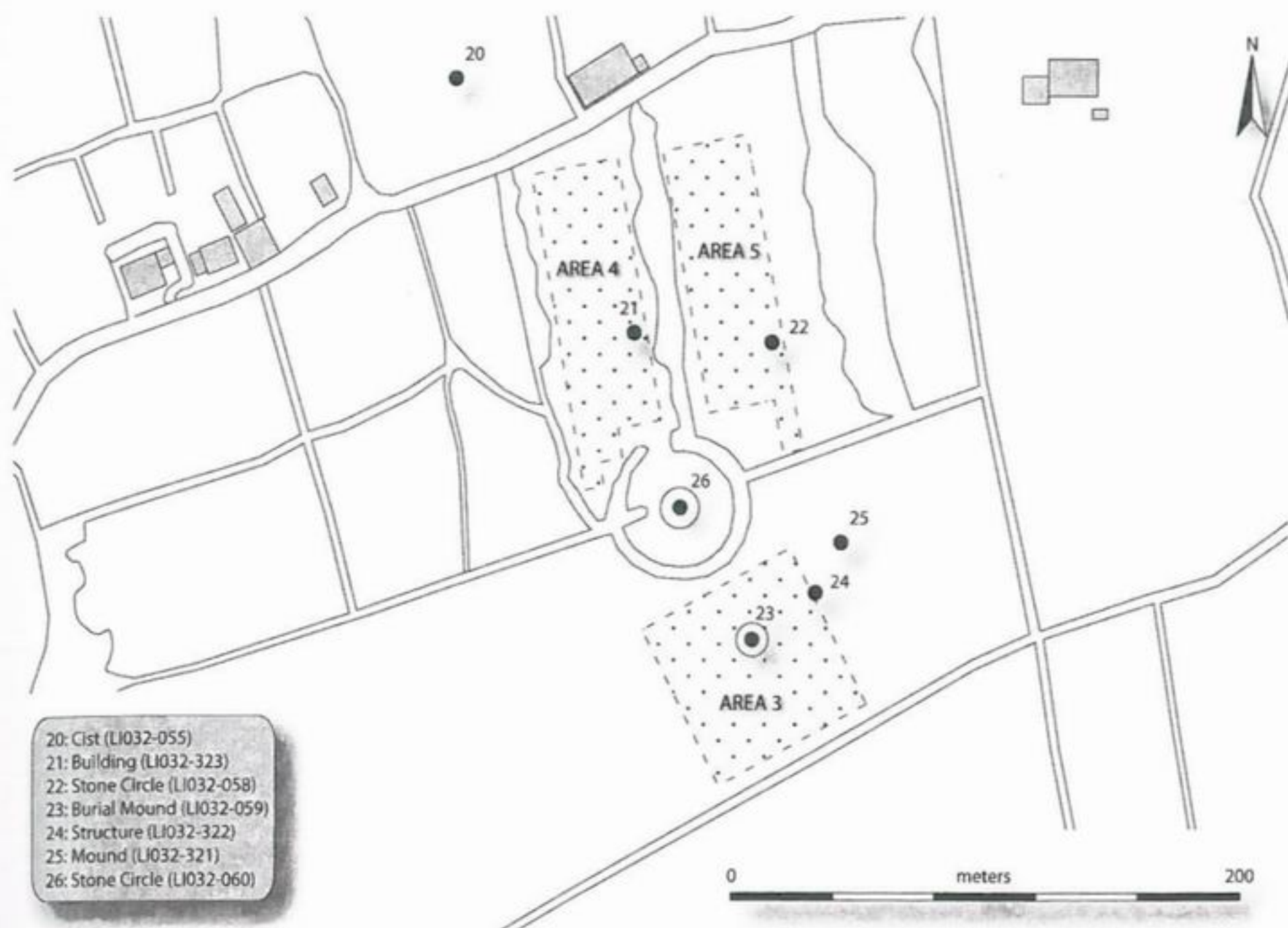


Fig. 3 Archaeological sites in Lough Gur townland and location of Areas 3–5 of survey

P in 1936 (Ó Ríordáin 1936, 1937; Grogan and Eogan 1987, 496–501). These sites were the first excavations carried out in Lough Gur by Seán P. Ó Ríordáin and that at Circle O was undertaken in a four week period in 1936 with a team of 22 men.¹⁷ The site archive was incomplete at the time these were published by Grogan and Eogan in 1987.

Circle O is a circular enclosure with a maximum diameter of 54.4m. The enclosure is a c.4.2 wide earthen bank faced internally and externally with contiguously-set orthostats. An internal ditch, concentric with the outer bank and inner circle was exposed and partially excavated. The ditch had completely silted up and was not visible on the surface prior to the excavation. Grogan and Eogan (1987, 496) refer to a 'setting of stones in an arc between the outer bank and inner ring on the eastern side', but this is not referred to by Ó Ríordáin in the 1936 typescript or published note and does not appear on the published plan (Grogan and Eogan 1987, fig. 77). The central inner circle of orthostats has an overall diameter of 15m. The south-eastern segment of the inner circle has an infill, described by Ó Ríordáin as 'an accumulation of large stones which may be a collapsed megalith but investigation of this feature had to be postponed' (1936, 30). The feature was tentatively interpreted as a 'platform' by Grogan and Eogan (1987, 496). The stone

¹⁷ Typescript in the Department of Archaeology, UCC. The information differs from the published note in the *North Munster Antiquarian Journal* (Ó Ríordáin 1937) in small details but is a fuller account. Ó Ríordáin (1938, 125) also refers to the funding which allowed the work to be carried out under a Government Employment Scheme and consequently much of the workforce were probably inexperienced in archaeological methods and techniques.

accumulation may have been an unfinished feature originally designed to be similar to Circle P where the area enclosed by the orthostats is infilled to form a flat-topped cairn. Cremated bone was found under the outer bank (Ó Ríordáin 1937, 82). Grogan and Eogan (1987, 496) refer to randomly dispersed post-holes within the inner circle. These are not mentioned by Ó Ríordáin although they appear on the published site plan (ibid. fig. 77). Circle O is now heavily overgrown.

Circle P is a 1m high flat-topped cairn located 30m south-east of Circle O and has an outer ring of 29 contiguous orthostats enclosing an area with an average circle diameter of 10.3m. The cairn infill is of stones mainly adjacent to the inner side of the orthostats and clay inside this. The infill included animal bone and a single human bone from a child. Post-holes were recorded under the infill and included a centrally-set post-hole interpreted as having held a post to set out the circumference. Two cremation burials with associated urns were excavated under the old ground surface and one urn burial disturbed the earlier urn burial. The urns were undecorated. The two-phase urn burials under the later infill suggest that Circle P was a multi-period site, albeit in use perhaps over a short time span. Indeed the inner clay fill of Circle P could also indicate that the monument was initially an earthen tumulus with a secondary phase of a cairn enclosed by an orthostatic kerb.

The ground slopes away from the monument and there are no visible surface features surrounding the circle. 'None of the stones, even the largest was well bedded in the underlying clay, their upright position being maintained by their being well balanced and when necessary banked with clay on the outside' (Ó Ríordáin 1936, 1). The site was excavated in quadrants and these appear to have extended to at maximum c.5m outside the stone circle. There is no reference to a further enclosure outside and encircling Circle P. The magnetic gradiometer survey has detected an outer enclosure.

The survey Areas 3–5 were within relatively flat, sub-rectangular fields, divided by a combination of stone walls, hedges and wire-fencing, and presently under pasture. Area 3, to the south incorporated the mound known as 'Circle P'. Area 4 was to the north-west of the embanked stone circle ('Circle O') and Area 5 was to the north-east (Fig. 3).

Methodology

The project focus was to survey sites with a particular reference to the landscape in which they are located. The methodology included topographical surveys followed by geophysical prospection and was undertaken in September 2008 and August and September 2009. A programme of topographic recording¹⁸ was undertaken prior to the geophysical survey to record the landscape setting of the survey and provide an accurate area plan and contour model. *DGPS* (*Differential Global Positioning System*) technology was employed in this recording. This recording was enhanced by Total Station technology in areas where DGPS was hindered by various impediments such as trees and areas with limited views of the sky. A Total Station survey of Site E ('stone avenue'/court tomb [?]) in Area 1 was also undertaken and later tied into the main survey. A number of subtle relief features were noted during field recording and data processing. The topographic dataset was integrated with the geophysical results, geological and Ordnance Survey mapping and orthorectified aerial photography to aid feature interpretation.

¹⁸ The current DGPS survey used a Trimble system comprised of an R8 Rover Unit and TCS2 data-logger coupled with a 4700 Base Receiver. *RTK* (*Real Time Kinematic*) was employed which involves using an independent base station and rover unit for the survey. The rover unit is sent corrections from the base station and accuracy levels of $\pm 0.02\text{m}$ can be achieved. Location records were made relative to the Irish Grid, with heights above sea level relative to Malin Head Vertical Datum.

Geophysical Survey

Geophysical survey was undertaken in order to investigate both the upstanding monuments and their immediate surroundings. Ground conditions were relatively dry, albeit somewhat rutted from cattle puddling previously wet terrain. The collection of geophysical data was carried out using a series of adjoining 20m x 20m survey grids.

Magnetic Gradiometer Survey

Magnetic gradiometer¹⁹ survey relies on buried archaeological features having a different magnetic signature than their surroundings and is ideally used in the detection of a wide range of features such as denuded banks, ditches, hearths, pits, kilns, fired brick and post-holes. This technique was employed in survey Areas 1–5. The units of measurement used in magnetic gradiometer survey are referred to as nT (nanoTesla). The magnetic gradiometer survey in Area 1 covered an area of c.36000m² (3.6 ha); Area 2 adjacent Grange Stone circle encompassed an area of c.12000m² (1.2ha) and the survey in Areas 3–5 adjacent to Circles O and P was c.11500m² (1.15ha). Data was collected in parallel mode by walking along traverse lines spaced 1m apart. Readings were taken every 0.25m along these lines. Prior to commencing survey, a position in the field with a low magnetic gradient was located and this became the common reference point where the gradiometer was ‘zeroed’. In order to avoid magnetic ‘drift’, the gradiometer was rechecked at this position after every third survey panel and readjusted as necessary. A significant amount of magnetic ‘noise’ was encountered during the survey, due mostly to near-surface geology, ferrous litter and some collection inconsistencies in rough ground. Consequently some processing was required in order to enhance the data for final presentation.

Earth Resistance Survey

This method relies on buried materials altering the way an electrical current will flow through the ground. For instance, buried masonry will normally hinder the passage of an electrical current and is therefore referred to as a high resistance feature or anomaly. A buried waterlogged ditch will typically provide an easier passage for an electrical current and is referred to as a low resistance feature or anomaly. When archaeological features provide different resistances than their surroundings they can be detected using the right equipment and methods. Units of resistance are referred to as Ω (Ohms).

Earth resistance prospection²⁰ was used only in Area 1 of the present survey where an area of c.8200m² (0.82 ha) was surveyed and was centred on Site E (‘stone avenue’/court tomb) and the earthen enclosure or possible henge to the north-west of Grange Stone Circle. The remote probes were located c.15m from the survey area and spaced 1.5m apart. The recording sensitivity of the meter was set at 1 Ω (Gain x1) and the resolution for data collection was set at 1m traverse lines, with readings taken every 1m along these. A zig-zag data collection pattern was used and c.8200 individual data points were recorded.

Magnetic Gradiometer Survey – Results and Summary Interpretation

Pre-processed gradiometer data collected in the field extended to the gradiometer’s range (i.e. between -3000 and 3000 nT). These large data values were the result of occasional ferrous litter and farm machinery within the survey area. The mean value of the pre-processed dataset was 4.52nT.

¹⁹ A Bartington Grad 601 magnetic gradiometer system was used for this survey.

²⁰ Geoscan RM15 with twin-probe configuration (0.5m separation) was employed.

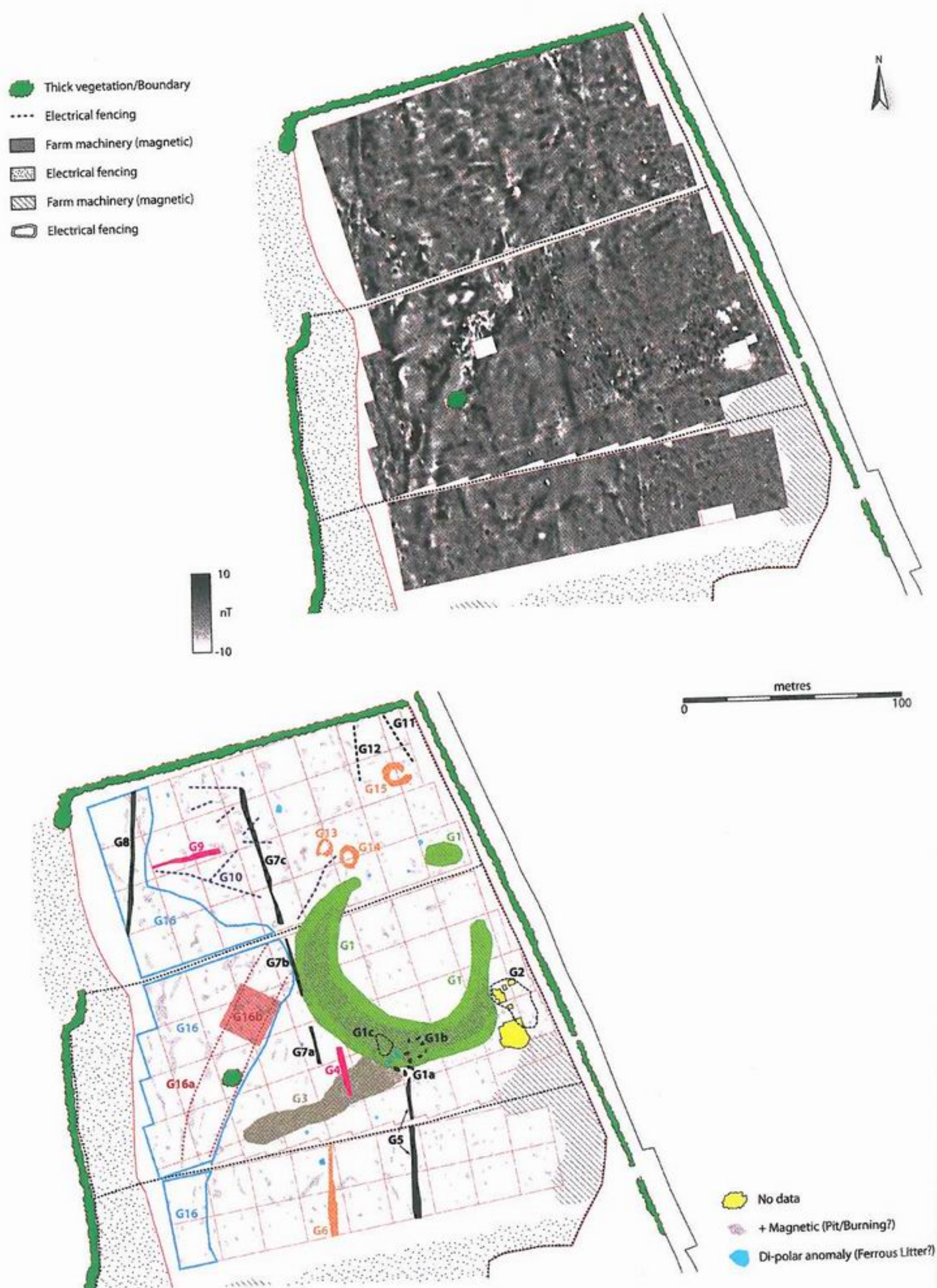


Fig. 4 Area 1. Greyscale image of processed gradiometer results (top) and summary interpretation (bottom)

Area 1 (Fig. 4)

A body of magnetic responses (G1; Fig. 4) broadly equates with the enclosing bank of the visible earthwork. The extent of this anomaly is also represented in the resistance results as R1 (Fig. 5). Magnetic responses at G1a and G1b are sub-circular arrangements of discrete anomalies which may indicate the remains of pit-like features such as post-holes or stone sockets. G1a and G1b can be interpreted as forming a single feature such as adjoining structures or perhaps the vestiges of the stone circle recorded on OS mapping. There is a diffuse spread of enhanced magnetism at G1c which corresponds to the extent of the feature at R1a (Fig. 5), interpreted as a possible small enclosure.

The extent of magnetic enhancement centred on the 'stone avenue' is recorded as G2 which corresponds with the resistance results at R11 (Fig. 5). Entire coverage of this area with the gradiometer was not possible due to the upstanding stones of Site E and an immovable farm machine. A number of the upstanding stones are imaged as features of high magnetism, with further instances of enhancement suggesting possible stone sockets. This high magnetism suggests that the monument (Site E) may originally have been larger, but no definitive patterns (linear or otherwise) can be discerned from the results. These anomalies may also be interpreted as the remains of pits or areas of burning, which may be coeval with the original use of the monument.

The largely negative magnetic anomaly at G3 is consistent with a shallow gully recorded on the topographic survey. There appears to be a greater accumulation of soil in this lower-lying area and at the time of survey the ground within the gully was particularly wet. A linear anomaly (G4) which would normally suggest a buried ditch/dug feature extends to the north from the base of the magnetic anomaly (G3). This location on the ground is characterised by a rising slope and thinning soil and therefore, the anomaly may also result from a response to underlying geology.

Linear anomalies at G5, G6, G7 (a-c) and G8, recorded on the topographic survey appear to represent field fences; G5, G7 and G8 are recorded on the 1844 Ordnance Survey map. G6 is not depicted on the early OS maps, but the parallel alignment and proximity to G5 suggests broad contemporaneity. Further anomalies in this area (G9 and G10) may indicate the remains of levelled field fences although at G9 the anomaly corresponds with a natural depression on the ground and therefore may also be a response to underlying geology. Two further linear anomalies (G11 and G12), are located in the north-eastern corner of the survey area. The anomaly at G12 is the more pronounced of the two and is on a similar alignment with field fences at G5, G6 and G8. G5 and G12 were also recorded on the topographic survey as a subtle linear feature.

Three sub-circular anomalies (G13, G14 and G15) were located north of the earthwork. G13 and G14 abut the northern edge of the earthwork and comprise rings of enhanced magnetic material suggesting that they may once have been dug features representing a possible small enclosure/structure. G15 is located in the north-eastern corner of the survey area adjacent to the levelled field fences, G11 and G12. This feature comprises a ring of material characterised by negative magnetic readings and may indicate the presence of a buried enclosure/structure, although the proximity of a modern farm track may suggest that G15 is of recent origin.

A significant magnetic activity (G16) along the sloping ground at the western edge of the survey area may be derived from the underlying bedrock which is close to the surface and triggers the majority of magnetic responses at this location. The localised geology also appears to result in the anomalous curvilinear pattern at G16a and the intense magnetic activity at G16b where bedrock outcrops. An archaeological origin for magnetic anomalies in this zone cannot, however, be ruled out. There are many other instances of

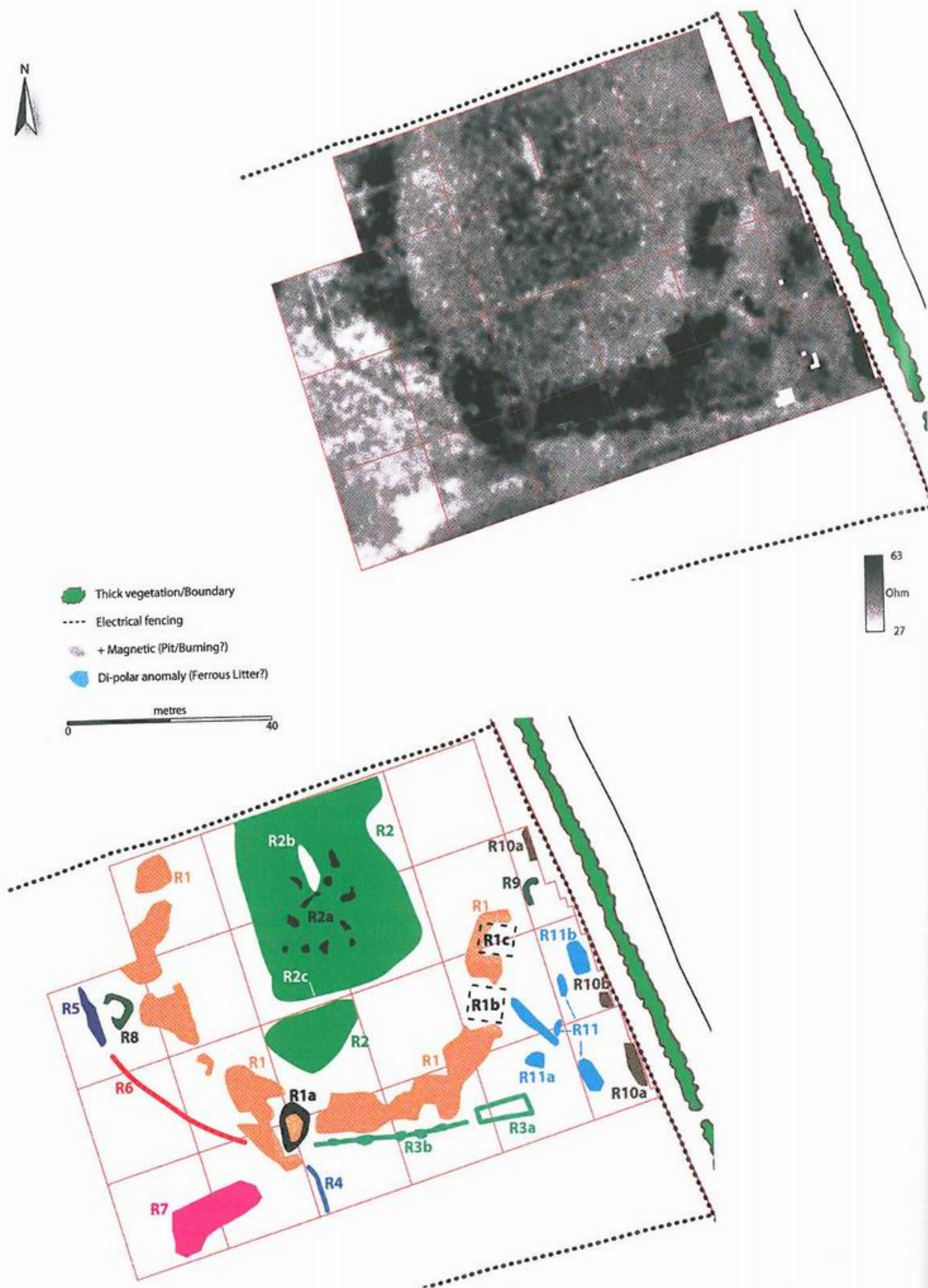


Fig. 5 Area 1. Greyscale image of processed resistance results (top) and summary interpretation (bottom)

magnetic enhancement outlined in Fig. 4 and each can potentially be of archaeological interest such as discreet pits, areas of burning, etc. A number of significant dipolar anomalies were also encountered during the survey. These anomalies typically indicate the location of relatively recent ferrous litter, but may also be of archaeological significance.

Earth Resistance Survey – Results and Summary Interpretation (Fig. 5)

Pre-processed resistance data collected in the field ranged between 25 and 164 Ω and had a mean value of 46 Ω . During the movement of the remote probes, which occurred on eight occasions, a consistent background reading was maintained (normalisation). This process enabled the collection of a seamless dataset.

A well-defined band of higher resistance readings (R1) is consistent with the line of the extant earthwork. The high resistance readings typically suggest an enclosing bank built of stone or compacted soil. The anomaly is not continuous and is interrupted by areas of significantly lower resistance readings. The bank is obscure along the north-eastern perimeter although recorded on the topographic survey as a low-visibility earthwork. This may indicate areas of erosion/destruction, or may also represent the locations of breaks in the original construction to accommodate features such as entrances, particularly in the southern perimeter at R1b. A sub-circular area of marked lower resistance (R1a) is recorded within the earthwork (R1). This may represent the remains of a small enclosure, but may also be the result of disturbance at the junction of two field fences depicted on the 1844 Ordnance Survey map. A well-defined C-shaped area of significantly lower resistance (R1c) located at the western end of the earthwork (R1) may mark an area of later clearance/erosion, but may also represent part of the bank. Interestingly the C-shaped feature opens to the east-south towards Site E, the 'stone avenue'.

An area of enhanced resistance (R2) is located centrally in the interior of the earthwork. It may be interpreted as the result of past human activity such as a central compacted surface relating to an entrance in the south-west, but could also be explained by a response to underlying geology. A number of discrete high resistance anomalies (R2a) may indicate the remains of a central internal feature or structure. Prominent lower resistance anomalies also occur at R2b and R2c.

A rectangular-shaped anomaly (R3a) abuts the south side of the earthwork. It may indicate the presence of a buried structure, but may also be interpreted, in conjunction with R3b, as part of the sub-surface remains of a field fence recorded 1844 Ordnance Survey map. Linear features (R4 and R5) correspond to field fences indicated on the 1844 Ordnance Survey map. The arcuate feature (R6) is not depicted on the Ordnance Survey maps but may also indicate the remains of a levelled field fence, and it appears to join R5 to the north. The line of R5/R6 broadly respects the curvature of the earthwork possibly suggesting contemporaneity.

A low resistance anomaly (R7) corresponds with the base of a shallow gully feature recorded on the topographic survey and this area was marshy the time of survey. An arc of enhanced resistance readings (R8) opening to the west is adjacent to the location of the possible field fence (R5). This anomaly may indicate the remains of a small enclosure, but may also have been caused by ground disturbance associated with the field fence. An anomaly (R9) on the west side may also depict the remains of a buried structure. It is located in the immediate vicinity of a recent farm track and similar to R10 and R10a may be the result of ground disturbance.

The anomalies at R11 and R11a–b indicate pockets of high resistance localised in the area of the 'stone avenue'. Although there is no clear geophysical evidence for individual stone sockets, the areas of higher resistance extending beyond the upstanding stones may suggest that the monument was originally larger and more elaborate in nature.

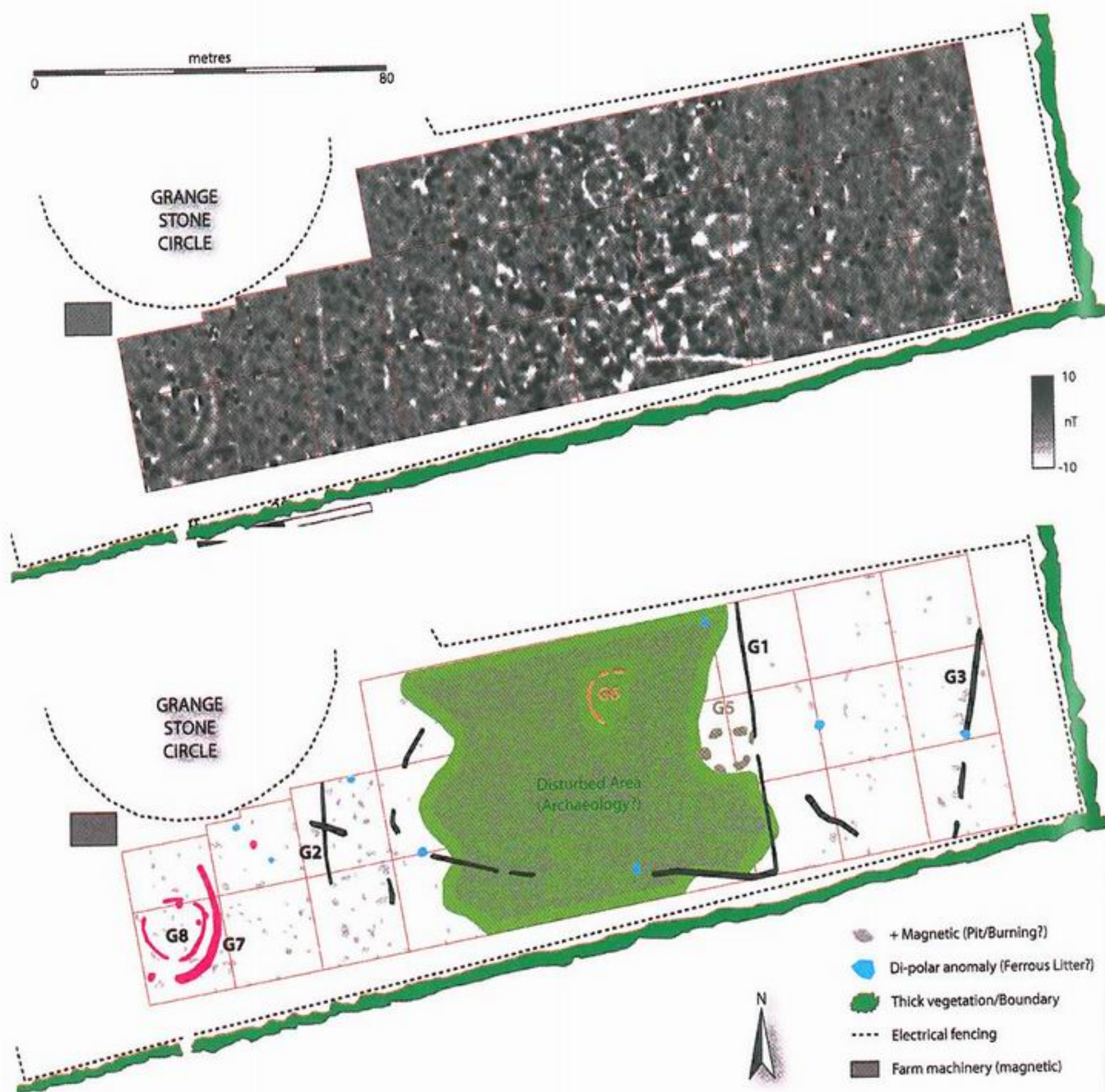


Fig. 6 Area 2. Greyscale image of processed gradiometer results (left) and summary interpretation (right)

Area 2 (Fig. 6)

The densest concentration of magnetic responses occurs at the centre of Area 2 and is bordered by a series of negative linear responses that may be field fences of unknown antiquity. Two linear anomalies (1-2) are aligned roughly north/south while a third (3), of similar magnitude is north-east/south-west. A more fragmented linear anomaly (4), aligned west-northwest/east-southeast intersects with 1 and 2.

The area bounded by 1, 2 and 4 contains a concentration of pit-type responses and less classifiable linear, arcuate and amorphous anomalies which may be archaeological in origin or a response to the underlying geology or recent disturbance. A series of discrete, negative magnetic anomalies and weak negative responses (5) on the east form a circle measuring *c.* 13m in diameter. The anomalies average 2-3m in width and vary from about -12 to -18nT in magnitude. A single discrete, pit-type anomaly is also visible on the east

side. The western boundary is defined by a fainter band of negative responses, possibly suggesting disturbance by the field fence, 2. The magnetic expression and layout of these anomalies may indicate of a buried stone structure. A narrow, semi-circular arc (6) of negative magnetic gradient is recorded to the north and measures *c.* 12m long and 0.5m wide. This anomaly may be the remains of a circular structure where the footing is defined by a stone wall or a bedding trench where the fill is less magnetic than the surrounding soils.

A large, sub-circular anomaly (7) on the west end appears to extend outside the survey area. The magnetic expression and layout suggest some form of enclosure, possibly defined by earthen and/or stone boundaries. The anomaly is defined by two closely-set bands of negative magnetic gradient; the inner band is *c.* 1m in width and encloses a sub-circular area of *c.* 12.5m. The outer band is *c.* 2m in average width and over 20m in diameter and is concentric with the inner ring from the south-west to the north-east; the band thereafter diverges from an elliptical course and extends northwards for 3–4m before petering out. A semi-oval arrangement of discrete magnetic anomalies (8) of lesser magnitude (< 20 nT) is visible within the enclosure and flank the western outer edge of the inner boundary. These can be interpreted as a series of pits containing magnetically-enhanced fills although their function and relationship to the enclosure (7) cannot be confirmed. Similar anomalies also occur to the north and east of the enclosure (7) and may also be of archaeological significance. Several intense magnetic anomalies (> 60 nT) recorded in the survey area probably relate to near-surface ferrous litter.

Area 3 (Fig. 7)

Three newly identified features were recorded in the vicinity of Circle P, principally a large enclosure (1) that encircles the mound. A broad, negative magnetic linear anomaly [4] that crosses the survey area from north-west to south-east marks the line of an old field boundary recorded on the 1844 Ordnance Survey map and visible on aerial photographs. There is no geophysical evidence to indicate that the field boundary continues across the interior of the enclosure (1) surrounding Circle P, suggesting that the enclosure was still extant when the field boundary was erected and that the field fence on the eastern side may have been incorporated into the existing enclosure. A slight outward curve in the line of the field boundary at this location is recorded on Ordnance Survey 25" scale maps. Discrete, dipolar anomalies along the length probably relate to modern ferrous litter.

The enclosure (1) which encircles the mound (Circle P) measures *c.* 4m in width and 30m in diameter and is evidenced as a broad, negative magnetic annulus (with average values of -15 nT). A diffuse ring of enhanced magnetic gradient flank the enclosure and within this is a series of interrupted amorphous positive responses and more discrete, pit-type anomalies; these display a weaker signal on the eastern side of the monument, where they appear to be obscured by an intense ferrous response along the line of the field fence (4). Negative magnetic values were also recorded around the perimeter of the mound, at a distance of *c.* 4m inside the line of the enclosure (1).

The magnetic signature of this enclosure, coupled with its relationship with the field fence (4) and the distinctive, embanked morphology of Circle O, 15m to the north-west suggest that Circle P was also enclosed by an earthen and possibly stone bank. Some of the pit-type anomalies flanking the perimeter of the enclosure may represent stone sockets (which potentially contain burnt material in their fills) and one anomaly (5) corresponds with the location of a collapsed standing stone on the outer south-west line of the enclosure. A stone kerb or revetment may also explain the remarkable definition of the inner and outer faces of the levelled enclosure bank.

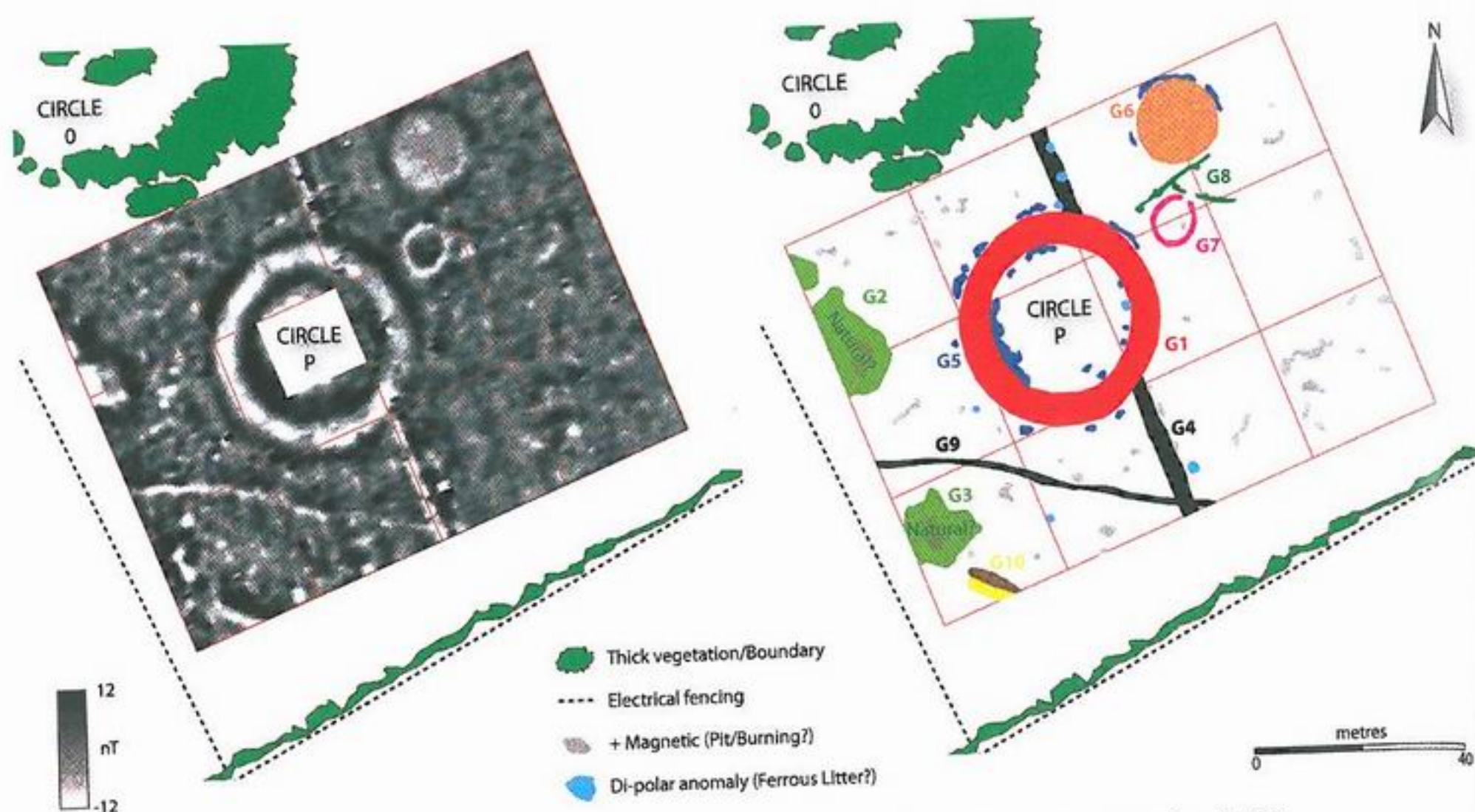


Fig. 7 Area 3. Greyscale image of processed gradiometer results (left) and summary interpretation (right)

Several conspicuous anomalies of negative magnetic gradient are also evidenced across the western half of the survey area, two of which (2–3) are amorphous in shape and surrounded by a series of strong, pit-type responses. The interpretation of these anomalies is hindered by their ill-defined nature and location at the edge of the survey and they may reflect variations in the underlying geology and soils, rather than archaeological features.

Two significant anomalies to the north-east of Circle P are of archaeological significance. The larger of the two registers as a circular area (6) of negative magnetic gradient ($< -10\text{nT}$), approximately 13m in diameter, surrounded on the north by a discontinuous band of enhanced magnetic responses. The magnetic signature of this feature suggests the remains of a destroyed mound, of similar size and form to the extant visible remains at Circle P. The second anomaly (7), located *c.* 5m to the south-west of the levelled mound (6), comprises a sub-circular ring of negative magnetic gradient, *c.* 1.5m wide and 8m in diameter and may indicate a stone structure, with a possible entrance on the north-east. A discrete pit-type anomaly occurs within the south-east quadrant of the enclosure (7) and two faint adjacent, interconnecting positive lineations (8) may represent slot-trenches for some form of fencing.

Two linear anomalies identified in the south-west quadrant of Area 3 are of potential archaeological significance. A slender, slightly sinuous, negative linear response (9) aligned north-west/south-east may be an ancient field system as it does not concur with aligned north-west/south-east may be an ancient field system as it does not concur with the layout of modern field boundaries. A broader lineation (10) to the south comprises two parallel bands of positive and negative magnetic gradient and is broadly parallel to the levelled boundary (9) and may be the remains of a stone wall with an associated ditch.

Area 4 (Fig. 8)

The survey results from Area 4 are dominated by a series of intense, broad-scale magnetic responses ($> 50\text{nT}$) which are likely to relate to igneous intrusions in the underlying

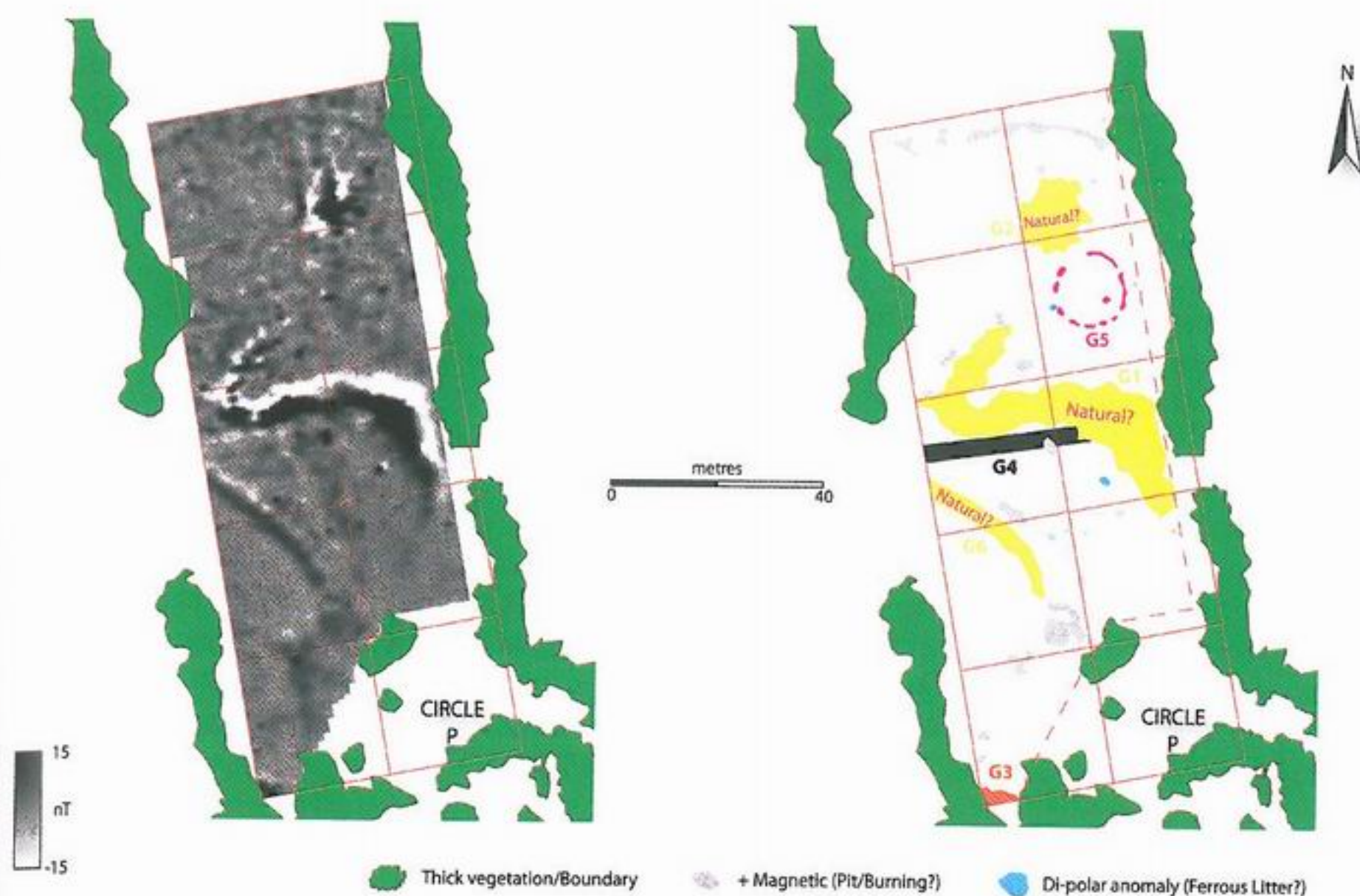


Fig. 8 Area 4. Greyscale image of processed gradiometer results (left) and summary interpretation (right)

geology. The most prominent of these is evidenced as a broad, sinuous band (1) traversing the centre of the survey area from west to east, while a smaller amorphous but similarly intense anomaly (2) is visible 12–18m to the north. In contrast to these, the strong magnetic response (3) registered at the south-western edge of the survey area is likely to relate to disturbance caused by a nearby field boundary. A number of discrete, dipolar anomalies also occur across the survey area and these are probably indicative of near-surface iron litter.

The magnetic intensity of anomalies (1) and (2) appear to have had the effect of 'drowning-out' the signature of other, nearby features, including a derelict field boundary ditch (4) located immediately to the south of the band (1). This field boundary is marked on the Ordnance Survey map of 1844 and although still visible as a topographic feature, exhibits only a weak magnetic response.

A circular anomaly (5) recorded south-east of the magnetic anomaly (2) registered as a discontinuous, enhanced magnetic annulus, approximately 11m in diameter and defined by a series of ditch/pit-type responses ($< 5\text{nT}$). The anomaly cannot be precisely interpreted but may represent the remains of a circular building defined by a slot-trench and/or post-pits for timber uprights. The broad, arcuate anomaly (6) in the south-western quadrant, may be similar to the broad band (1) recorded across the survey area and of natural, rather than archaeological origin. Other discrete, pit-type anomalies recorded across the survey area may also be of geological derivation although an archaeological origin cannot be excluded.

Area 5 (not illustrated)

Most of the anomalies identified by the survey in Area 5 appear to relate to past agricultural activity. A faint pattern of cultivation trends, defined by a series of broadly-spaced

linear responses of varying positive and negative magnetic gradient cross the survey area from north-east to south-west. These anomalies are unrelated to the modern field layout and are likely to represent the remains of a more ancient agricultural regime. Several more conspicuous, negative linear responses aligned north-east to south-west were recorded in the northern half of the survey area and may also be of agricultural origin. A significant number of discrete, pit-type anomalies were also identified but the random pattern and lack of associated archaeological features make interpretation difficult. A demolished stone circle (RMP LI032-058) recorded in the southern half of the survey area was not detected on the present investigation.

Conclusions

The surveys at Lough Gur focussed on areas where upstanding monuments exist. Area 1, on the west side of the lake, north-west of Grange Stone Circle includes a linear stone setting interpreted either as a megalithic tomb or stone avenue and a denuded earthwork/enclosure or henge monument recorded as the site of a stone circle on Ordnance Survey mapping. Area 2 immediately south of Grange Stone Circle is in a level field where there is no surface expression of archaeological remains. Areas 3–5 on the east side of the lake centred on the monuments recorded as Circle O and P. The monument setting on the west and east sides of Lough Gur is different; the Grange area is on the crest of a ridge whereas Circles O and P are located in terrain that slopes down and creates a basin-shaped landscape. Local geology comprises both limestone bedrock largely in the western survey areas and the volcanics to the east. Volcanic bedrock causes magnetic anomalies and these impede geophysical survey.

Topographic survey was undertaken in each survey area to link the physical landscape to the geophysical results. Magnetic gradiometry was the main survey tool and was used in all areas while targeted earth resistance was employed in part of survey Area 1. Both methods succeeded in imaging various subsurface features which are of archaeological potential.

The combined results of the geophysical survey in Area 1 depict a C-shaped earthwork, opening to the north-east. This contrasts with the visible remains on the ground where the enclosure appears to be complete. This apparent difference may be explained by the construction of the monument taking advantage of the natural contours of the site whereby the north-eastern perimeter incorporated the natural contour and required minimal modification to create an enclosure. The absence of a ditch in the survey results may suggest that the bank was constructed by scooping earth from the interior of the enclosure rather than excavating material from a fosse. This corroborates the interpretation by Ó Nualláin and Cody (1996) that the monument is a possible henge. The resistance survey indicated anomalies in the interior of the enclosure suggestive of archaeological features. The relationship of these anomalies can only be confirmed by archaeological excavation, although it is tempting to suggest that an internal structure was surrounded by the large enclosing bank.

A linear feature was recorded extending from the south-western perimeter of the enclosure. On the ground, this appears to be an avenue leading to the monument from the west. It is probable that this feature is a natural gully, but may have been enhanced in antiquity to create a formal access to the enclosure. This interpretation is strengthened as the resistance and gradiometer surveys record a concentration of anomalies where the gully interfaces with the enclosure.

The geophysical survey at the 'stone avenue' (Site E) to the east of the enclosure provided evidence of activity in the form of enhanced magnetic and resistance anomalies.

It was not possible to interpolate these results to provide a morphological or functional interpretation of the stone structure, although it can be suggested that areas of higher resistance beyond the upstanding stones indicate a larger and more complex monument than indicated by the surviving remains.

The Area 2 survey has identified anomalies indicative of three circular structures. One to the east may be the remains of a small stone circle of c.13m diameter; a 12m long arc on the north side of the survey area may be the vestiges of a building while two concentric rings in the south-west corner of the survey area suggest concentric banks. The concentric features enclose an overall area with a c.20m diameter with an inner enclosure of c.12m. Although speculative, the site may be the remains of a ring-ditch. In Area 3, the newly-identified enclosure encircling the mound of Circle P is reminiscent of the larger enclosure around the adjacent Circle O. This enclosure around Circle P was not detected during the excavation in 1936 and clearly confirms that Circle P is a more complex monument than hitherto indicated. A circular anomaly, also in Area 3, suggests the base of a levelled mound with a diameter of c.13m, to the north-east of Circle P and a small, possibly stone enclosure of c. 8m. diameter. Areas 4 and 5 were less conducive to the survey methods and this is likely due to the underlying bedrock, particularly in Area 5. The survey in Areas 4 and 5 recorded vestiges of ancient field systems, some of which are depicted on the 1844 Ordnance Survey mapping and others of greater antiquity. A circular feature with an 11m diameter in Area 4 may represent the foundations of a timber structure.

While some anomalies are clearly of archaeological potential, the complexity and ill-defined nature of many other geophysical responses makes it difficult to confidently distinguish anomalies of archaeological interest from those relating to modern disturbance or features of geological origin. The magnetic signatures of features of archaeological origin suggest that most comprise the remains of stone-built structures and earthworks of varying size and form and these appear to share morphological affinities with the extant stone circles. The survey project has uncovered a more complex archaeological landscape than previously known and broadened the archaeological visibility of what are essentially two areas of ritual landscapes in the Lough Gur region.

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