The Archaeology of sand landscapes: looking for an integrated approach

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The coastal dune systems and semi-stabilised machair of Scotland represent a vast but still largely unquantified archaeological and palaeoenvironmental resource. They are an inherently fragile, unstable and changing environment and therefore highly susceptible to erosion, providing a significant management dilemma for curatorial authorities. Few such landscapes, even in the wider context of Britain and Ireland, have yet been subjected to anything like a comprehensive characterisation study, encompassing prospection, sampling and investigation, resulting in well-informed selective preservation or mitigation strategies. Practical problems encountered during traditional excavation such as dune instability and deflation, deep and unstable sand overburdens and the consequent danger of breaking up stabilising ground cover and accelerating erosion, have meant that we have remained largely dependent on chance exposures to determine the extent of archaeological features and therefore of any intervention. However, increasing utility, versatility and affordability in combined prospection methods have begun to point towards new ways forward in tackling this type of landscape.

My own interest in sand landscapes was initially sparked some years ago by an aspect of my PhD research on Early Historic coastal trade and settlement (Griffiths 1992) which brought together a surprising number of antiquarian, and also more recent, reports of stray finds of artefacts in coastal sand dune areas in the Irish Sea Region and in Atlantic Scotland and Ireland (see also Griffiths forthcoming 2009). These vary considerably in date, detail and apparent quality, but a common factor is the presence in close proximity of ceramic, lithic or metalwork material from widely differing periods, often from the Neolithic or Bronze Age together with Early Historic or Medieval objects. Examples include the Culbin Sands, Moray (Black 1891), and Stevenston Sands, Ayrshire (Callander 1933). A further extremely important and rich site of this type is Meols, Wirral, north-west England (Hume 1863; Travis 1922; Kenna 1986; Griffiths 2001; Griffiths et al 2007). Pre-twentieth and early twentieth-century reports are characterised by little or no contextual information, concentrating exclusively, or almost exclusively, on describing the artefacts themselves.

By the mid 20th century, chance discoveries of artefacts began to be accompanied by small-scale excavation, often revealing spreads of occupation debris, hearths and middens, cultivation soils and ard-marks, and even occasionally fragments of buildings, such as at Luce Sands, Galloway (Davidson 1952, Jope 1959), and Murlough Dunes, Dundrum, Co. Down (Collins 1952, 1959). The style of the time was to treat archaeological exposures in sand as discrete sites and to excavate them using standard terrestrial techniques – there being as yet little understanding of the effects on archaeological material of the mechanisms of post-depositional change in this type of environment. The very fact that erosion and dune deflation provided the main means of identifying deposits which were subsequently investigated, means that the associated data-capture was severely affected by in situ destruction, migration and turbation of deposits. Associations of artefact and stratigraphic context are therefore potentially suspect, and furthermore, many radiocarbon determinations, particularly from the earlier decades of this technique, are affected by growing doubts over the Marine Reservoir Effect and other distorting factors (Ascough et al 2004). Consequently, through no fault of the excavators, these interventions must generally be regarded as providing less reliable and complete a record than many contemporary interventions on 'solid ground'.

Therefore, the broad approach in the less recent past to these types of landscape could be characterised as:

- ad hoc
- reactive to erosion
- responsive to in situ exposures of visible contexts leading to small-scale rescue or salvage excavation
- often dealing with already severely compromised deposits
- focused on finds retrieval

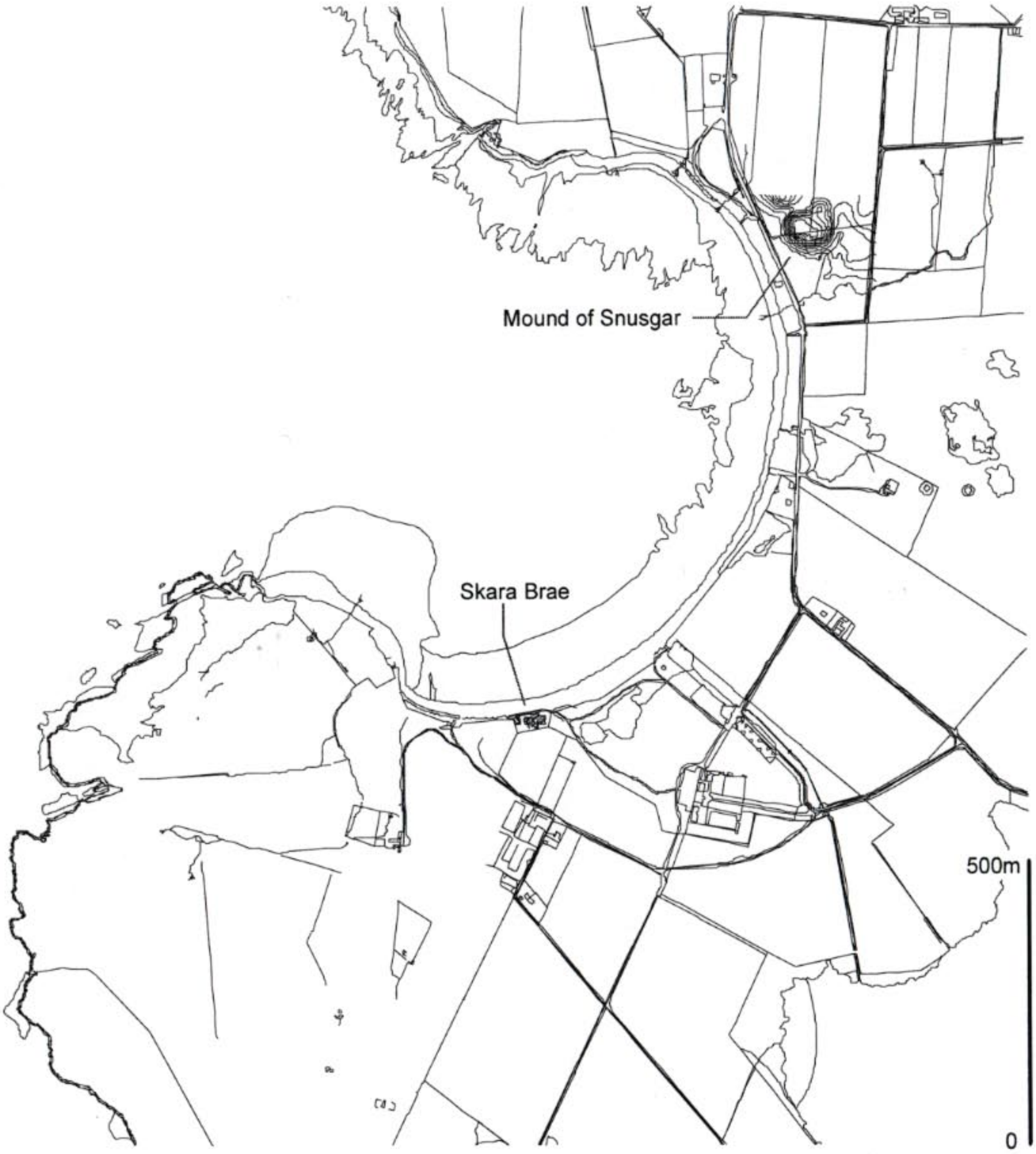
By the 1970s, growing acknowledgement of the limitations of a site-specific approach, coupled with realisation of the potential for reconstructing past landscapes and environments, led to a broadening of approaches encompassing more systematic survey and observation, selective excavation and palaeoenvironmental sampling, combined with more sustained and balanced radiocarbon programmes. A significant example of progress in tackling the archaeology of sand landscapes is the work of Trevor Cowie and others at Torr's Warren, Luce Sands in Galloway (Cowie 1997). This landscape, characterised today by a vast, and now largely stable dune system, is one of the most archaeologically tantalising and intractable in Scotland, having produced over the decades at least 8,000 artefacts of prehistoric, Roman and Medieval date. Yet years of faithful and determined observation and collecting by a handful of devoted local archaeologists had not succeeded in establishing a coherent overall context for these objects, despite the occasional discovery of individual structures and burials. The work of the Central Excavation Unit in 1977–79, led by Cowie, was confined to a development area of 75 hectares within a dune landscape of over 1,200 hectares. However, the sample covered by the investigation (approximately 6.25%) was large enough to begin to create a true landscape perspective. Machine-clearing of overburdens of up to 15m in depth allowed the excavation of buried palaeosols which had been exposed in section by dune deflation and blow-outs. The erosive mechanism by which artefacts and other archaeological matter had accumulated in blow-out hollows was more clearly documented than has been the case previously in this or any similar landscape (ibid, 15). Buried palaeosols associated with archaeological material were interlaminated with layers of windblown sand; pollen analysis from dune slack area (the results of which extended back only *c* 3,000 radiocarbon years) confirmed that changes in vegetation had been very marked, showing alternating predominance of woodland and heath since the Bronze Age. The consequent interpretation was that settlement had taken place in the Neolithic and the Bronze Age, and subsequently in the Early to High Medieval periods, on stabilised agricultural soils which were separated by intervals of gradual, but ultimately extensive, aeolian sand inundation beginning in the mid to later second millennium BC, and succeeded by another more sudden and catastrophic episode in the Later to Post-Medieval period, coinciding with the well-known effects of climatic downturn at that stage.

A further example of the growing 'landscape approach', albeit still conditioned largely by visible exposure rather than prospection-based methods, is the campaign of research mounted by Durham University at Freswick Links, Caithness, between 1979 and 1984 (Morris et al, 1995). This involved a series of sample excavations along a bay coastline badly affected by aeolian erosion, wartime disturbance, rabbit burrowing and sand quarrying, and where (as with other sites of this type), there had been a number of previous small archaeological excavations. The Freswick project included a detailed and analytical topographic survey extending 250m north–south along the east-facing bay within an overall control grid, which in itself represented an advance on the piecemeal approaches taken previously. Column sampling, augering, small-scale excavation, cleaning and recording exposed sections, all provided a broad integrated stratigraphic model for the interleaved blown sand and occupation layers encountered on the links. An extensive environmental programme was put in place which added considerably to the small stock of existing knowledge about Late Norse exploitation of marine resources in northern Scotland.

The most substantial and integrated approach to sand-covered landscapes (and adjacent sand-free areas) has been the SEARCH project initiated by Sheffield University in 1988 in the southern islands of the Western Isles. Its adequacy as a model for future approaches is discussed below. An account and bibliography of this project is provided in these proceedings (Parker Pearson et al).

One important conclusion which flows from studies at these sites, and a range of other recent fieldwork (see elsewhere below), is that humans have actively modified this type of landscape in the past. The build-ups of soil forming ancient land surfaces now buried within dune sequences are not always by-products of periods of 'natural' landscape stability – they are evidence of the deliberate creation of stasis by the spreading of pedogenic materials. In this case, therefore, we are dealing with a relative scale of past human agency – decisions to persist with soil stabilisation or to abandon the process, are conditioned by locally specific factors and affected by varying rates of continuing erosion and wind-driven inundation by sand (the 'Bad Year Syndrome' affects these landscapes as much as any other, if not more so). Identifying the tipping-points of agricultural and settlement feasibility, and winning or losing the struggle against the sand, is a critical aspect of our search for explanations for the interrupted character of human settlement in these areas. It is therefore critical that we have an informed grasp both of the general geomorphological background and also its local specifics – so building a true multi-disciplinary landscape perspective is critical here. In dune systems, past land surfaces bearing archaeological and palaeoenvironmental information of great importance are interlaminated with aeolian deposits which have very different accumulation and erosional characteristics in terms of both materials and durability. Subsequent geomorphological changes have severely compromised the integrity of these deposits, but quantifying this is an extreme challenge to conventional reconnaissance techniques.

The approach of curatorial authorities such as Historic Scotland and English Heritage in more recent times is to recognise the need for informed management strategies based on an effective method of auditing the survival and loss of resource – and it is this need for coherent and statistically viable bodies of data from both exposed and eroded, and unexposed and intact contexts, which presents archaeologists with their current challenge. The most pressing need now is to continue to develop a suite of prospection methods which can move well beyond visual exposure as the starting point for the archaeological response. An effective means of 'seeing beneath the sand' is needed not only to find, locate, characterise and map a new realm of archaeological information currently more or less out of our reach, but also to set the state of known archaeology (including exposed traces along coastlines, records of former excavations and upstanding earthworks which have yet to be investigated) into a more comprehensive data-set covering the whole landscape under study.



Illus 1. Map: Bay of Skaill, Sandwick Parish, Orkney

The various projects discussed below are all of direct interest to the wider question of how we build a more representative and informative sample of archaeology in aeolian areas.

A recently begun research project of my own at Birsay Bay and the Bay of Skaill, two extensive low-lying and sandy erosive openings in the Atlantic frontage of the West Mainland of Orkney, has started to build up a wider landscape perspective using integrated geophysical and topographical survey, around an archaeological landscape characterised previously by small-scale reactive excavations in the coastal erosion zone.

The choice of field research locations in Orkney was driven, apart from basic requirements such as permissions for access and likely geological feasibility for magnetic survey (afforded in this case by the predominance of the Stromness Old Red Sandstone, see Mykura 1976), by the aim to test and exceed the scope of existing archaeological data. A short but intensive programme of magnetometry survey, topographical survey and (in Birsay only) magnetic susceptibility topsoil mapping was carried out in June–July 2003 with funding from Orkney Islands Council. In 2004–08, with funding from Historic Scotland and with further support from Orkney Islands Council, the geophysical survey across the northern side of the Bay of Skaill was extended substantially, combined with ground probing radar

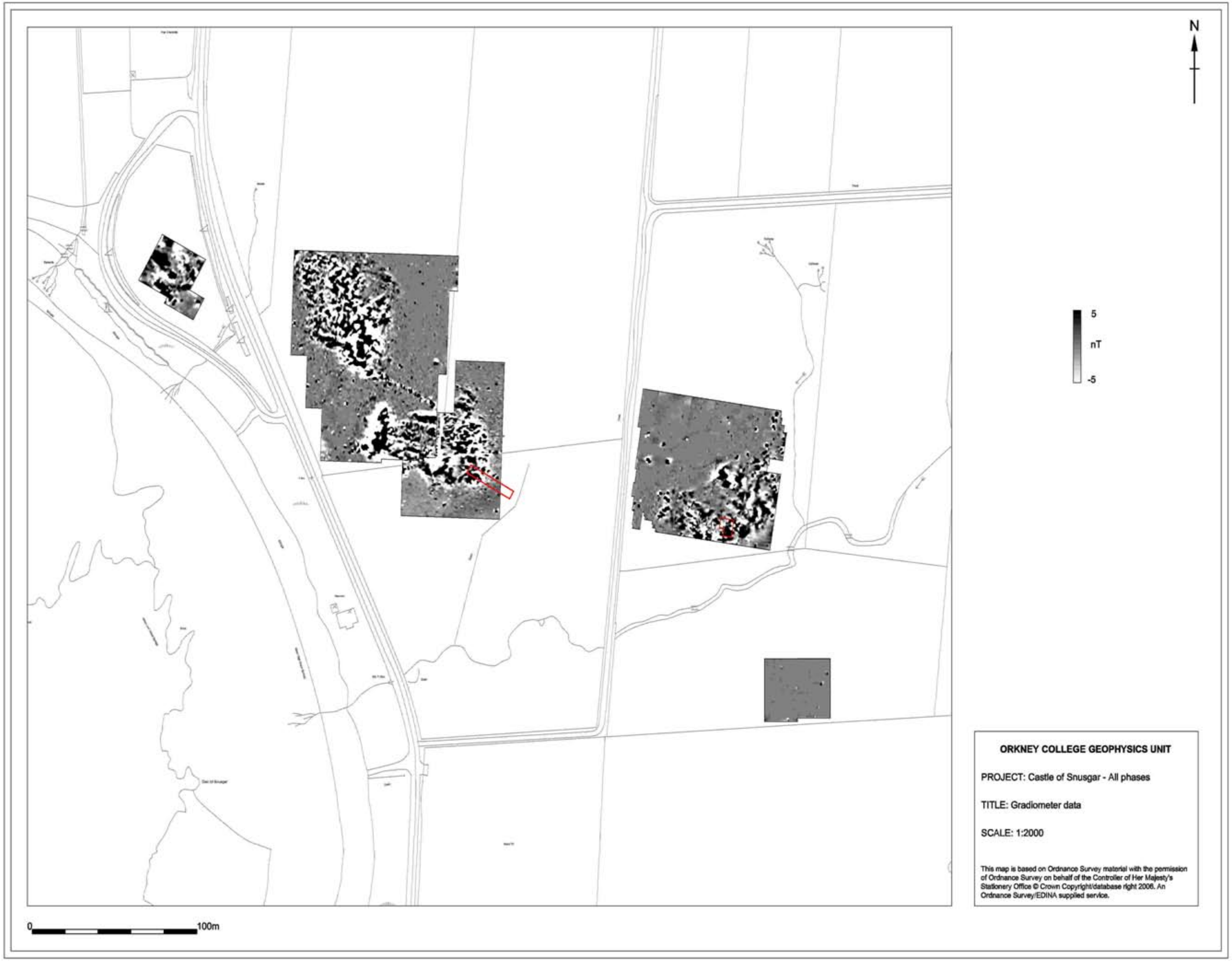
(GPR) survey, and small-scale excavations at the Point of Buckquoy, Birsay, and at the 'Castle of Snusgar' on the north side of the Bay of Skaill, which tested the nature of the 2003 results in more depth and detail than geophysics can provide on its own. This project is ongoing and a recent interim report covers the details of the results of the first season (Griffiths 2006).

Birsay Bay and the Bay of Skaill are both locations of known significant archaeological potential – in the case of Skaill extending to part of the Orkney World Heritage Site (WHS) buffer zone around the designated site of Skara Brae on the south side of the bay. Yet in both cases, the current state of archaeological knowledge is highly site-specific, based on small-scale intensive excavation strategies in the past, and the ad hoc discovery of stray finds and deposits. The excavation strategy of the 1970s, whilst successful in that it produced a high-quality record of the sites investigated (Ritchie 1977, Morris 1989), was essentially reactive to rapid erosion patterns and dependent on an acute 'rescue' ethos. Moreover, the area percentage of the archaeological landscape investigated in detail by this means was tiny. The predictive element which might be afforded by a more detailed insight into the archaeological potential of the landscape, within and away from the immediate erosion zone, was not readily available at the time. Two to three decades on from the hey-day of coastal rescue excavation in Orkney West Mainland, greatly enhanced techniques of prospection offer the opportunity not only to effect new and informative data (which, by concentrating on the 'gaps' between known sites, could not only find new foci but contribute to the re-evaluation of existing evidence), but to contribute to an updated and informed curatorial strategy which seeks to audit and manage the effects of coastal change, rather than merely to react to them. Testing the wider applications of landscape prospection in Orkney was also a factor; several surveys have taken place in and outwith the WHS area, but, although growing, the proportion of coverage is still lower than for other high-profile archaeological areas of Britain such as Wessex.

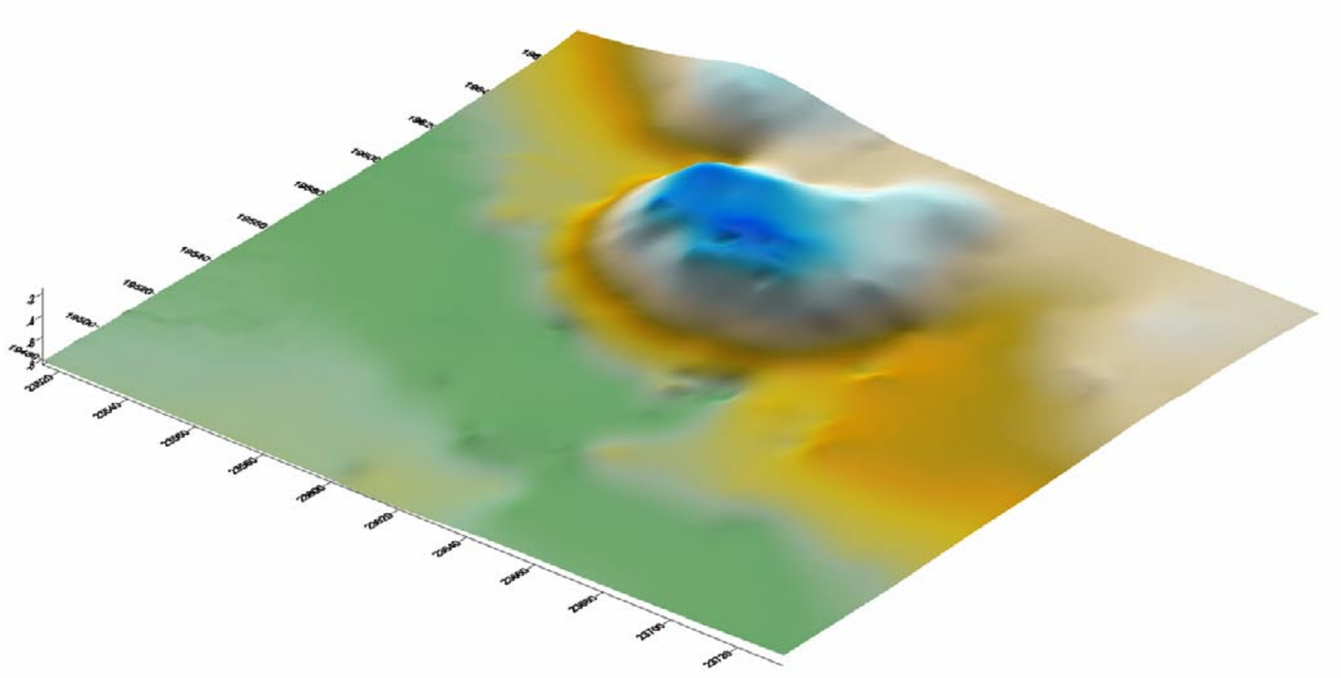
For the purposes of this paper, given the scope and coverage of the project so far, the Bay of Skaill is the more appropriate case-study, being a true aeolian landscape, whereas the Point of Buckquoy at Birsay (where the survey has hitherto been concentrated), although a classic eroding landscape, lacks the same extent of wind-blown accretions. The central and southern hinterland of Birsay Bay is of course another classic example of an aeolian landscape, but one which has yet to be studied in detail as part of this particular project. The Bay of Skaill, which is also an active erosion zone, is characterised by higher ground to the north and south with fresh water sources, which acted as past settlement attractors. The centre of the bay is characterised by extensive blown-sand deposits at Sand Fiold, some of which is improved land. In the centre of the low-lying bay hinterland is a group of tumuli, at least one of which was opened by Sir Joseph Banks in *c* 1772 (NMRS HY21 NW15). To the north of the bay is a scatter of discrete sites including a broch, the 'Knowe of Verron' (NMRS HY21 NW22) and an enigmatic mound or knowe known as the 'Castle of Snusgar' (NMRS HY21 NW21, NGR 2361 1960), near which was discovered the tenth-century Skaill Viking silver hoard, a chance find in 1858 brought about by a local man delving into rabbit burrows which had colonised a thick layer of sand on the flanks of the mound (Graham-Campbell 1995). Further inland to the east, on a higher zone of the Sand Fiold, vehicle movement associated with sand quarrying accidentally revealed a rock-cut pit within which was a cist grave (NMRS HY21 NW35, Dalland 1999). The wider context within the Sand Fiold of this unusual prehistoric structure has not yet been explored.

The Snusgar mound has been the focus of continuing research in 2003 and 2004 (Griffiths 2006). Snusgar is mentioned in NMRS, but is otherwise unscheduled and falls outwith the WHS buffer zone. There are even some cautionary suggestions that the mound may be a natural geomorphological feature (eg Morris 1985, 85) .The 'castle' name is probably connected to the visible remains of a stone building which was noted in 1795 (*Old Statistical Account of Scotland* 16, 458), standing on the north-west sector of the mound. Norse 'castles' in the form of small masonry fortifications do exist in Orkney, but there is no conclusive evidence to support the identification of one here. Certainly no in situ masonry is visible today, but a microtopographical survey (illus 3) showed a flat platform on the north-west sector of the summit with a shaped and graded slope on west and north, about where the 'castle' may have stood. Rabbit burrowing has disturbed and turbated areas of the summit and flanks. Other notable features mapped here include a north-east spur of the mound above a depression to the east where a spring is located, and a dry gully to the north-west dividing the Snusgar mound from another topographical rise, albeit a lower and less well-defined one.

Geophysical investigation in 2003 comprised approx. seven 30 × 30m grids of magnetometer survey both on and off the mound flanks and summit. The area of sandy scrub around the base of the mound proved unresponsive – presumably because any measurable deposits are masked by more than 1m of aeolian sand. However, the upper part of the Snusgar mound itself proved to be a viable prospect for magnetometry survey, producing results of dense contrast, revealing it to be a highly complex, and apparently largely archaeological structure (for a detailed overview of the results, see Griffiths 2006). In 2003, some limited further reconnaissance and magnetic scanning of the area to the north-west of the Snusgar mound, on both sides of the road, suggested that these midden-type deposits may be more widespread.



Illus 2. Magnetometer survey on north side of Skaill Bay, 2003–06



Illus 3. Mound of Snusgar: topographic survey model (viewed as from SE)

Further geophysical survey in July–August 2004 comprised resistance and magnetometry surveys carried out in conjunction with Dr Susan Ovenden, the recently appointed geophysical field officer at Orkney College/UHI. The mound of Snusgar itself, including the area of coverage of the 2003 magnetometry survey, was surveyed using a Geoscan RM15 resistance meter. This was undertaken partly in order to test the theory that the 'castle' mound was a shaped or even fortified structure, and also to provide control for the 2003 magnetometry results. Further magnetometry survey was carried out over the neighbouring mound or topographical rise which is located across a narrow dry gully to the north-west of Snusgar, and where limited augering had shown a further concentration of midden-type deposit in 2003. Two further large mounds, one yet further to the west (NGR HY 2345 1970), which is cut by the road, and one to the east of Snusgar (HY 2075 1960), were also surveyed using magnetometry. The westernmost mound, cut by the present Skaill–Quoyloo road, attracted our attention because it had been the scene, when the road-cut was created in *c* 1934, of the reported discovery (alas going largely unrecorded) of stone structures and burials of clear archaeological interest (NMRS HY21 NW23). By contrast, the mound to the east of Snusgar, which is very badly scarred by rabbit burrowing, exposing a large eroding section across its west side, was selected as a control exercise as it was strongly suspected of being all, or largely, a sand dune (this assumption turned out to be erroneous, see below, with further investigations producing substantial archaeological features).

Work on the geophysical data is still ongoing and will be reported more fully elsewhere, but preliminary results on Snusgar itself indicated that there was a band of higher resistance partly surrounding the base of the mound on the east and south sides – the reason for which is as yet unknown. A spread of lower resistance characterised the top of the mound, but coherent hints of structures were only visible in the north-west sector of the mound, where excavation was not planned to take place in 2004. The 2004 magnetometry survey showed that the mound or rise immediately to the north-west of Snusgar is of considerable potential archaeological interest, confirming our 2003 field observation of hints of midden layers and masonry rubble exposed in rabbit holes. Very much as at Snusgar itself, a dense cluster of contrasting anomalies was mapped on this neighbouring mound. The mound further to the west produced some potential archaeological anomalies, but the survey response was compromised by high levels of later surface disturbance and litter caused by the fact that a large part of its generally flat surface has been used in recent memory for animal burials and also (unwittingly) as an unofficial tourist campsite.

Accompanying the extended geophysical campaign in summer 2004 was a three-week excavation on the north-east flank of Snusgar aimed at understanding the 2003 magnetometry results (Griffiths 2006). Firstly, beneath the sandy topsoil was evidence of relatively recent activity in the form of two *c* 1m-deep animal burial pits (estimated to date from within the last 150 years), and a discrete spread of dense red-black burnt soil with coal inclusions, located above small and crude bowl pits. A probable explanation for the latter is kelp burning – which occurred widely in Orkney in the 19th century. Secondly, below and outwith the relatively discrete imprint of these modern intrusions, the character of the upper layers of the mound began to emerge in the form of a series of peat-ash layers within stone-layered features which were laminated within thin bands of wind-blown sand. Although some of the stone features as yet lack clear definition, there was clear evidence of substantial double-faced walling running east–west across the area, which was congruent with the clearer traces evident in the north-west sector of the 2003 magnetometer plot. The peat-ash layers and associated stone features contained large quantities of well-preserved animal bone and were provisionally dated by a range of stone, bone and antler artefacts to the Early Middle Viking period (*c* 800–1100 AD). Further work in 2005 and 2006 showed that Viking-period material constitutes the upper part of an archaeological 'core' within the mound (Griffiths 2004–05). Midden material had been used to stabilise successive occupation and cultivation layers, which were regularly inundated by incoming wind-blown sand. This has given us a significant insight into the process of mound formation, where human intervention in building up stable and cultivable surfaces using domestic refuse produces a favourable situation in the short term. However by doing so, this activity exacerbates the problem of creating an upstanding sand-trap, which ultimately makes the situation worse in the long run by inflating the mound and its flanks with further sand accumulations.

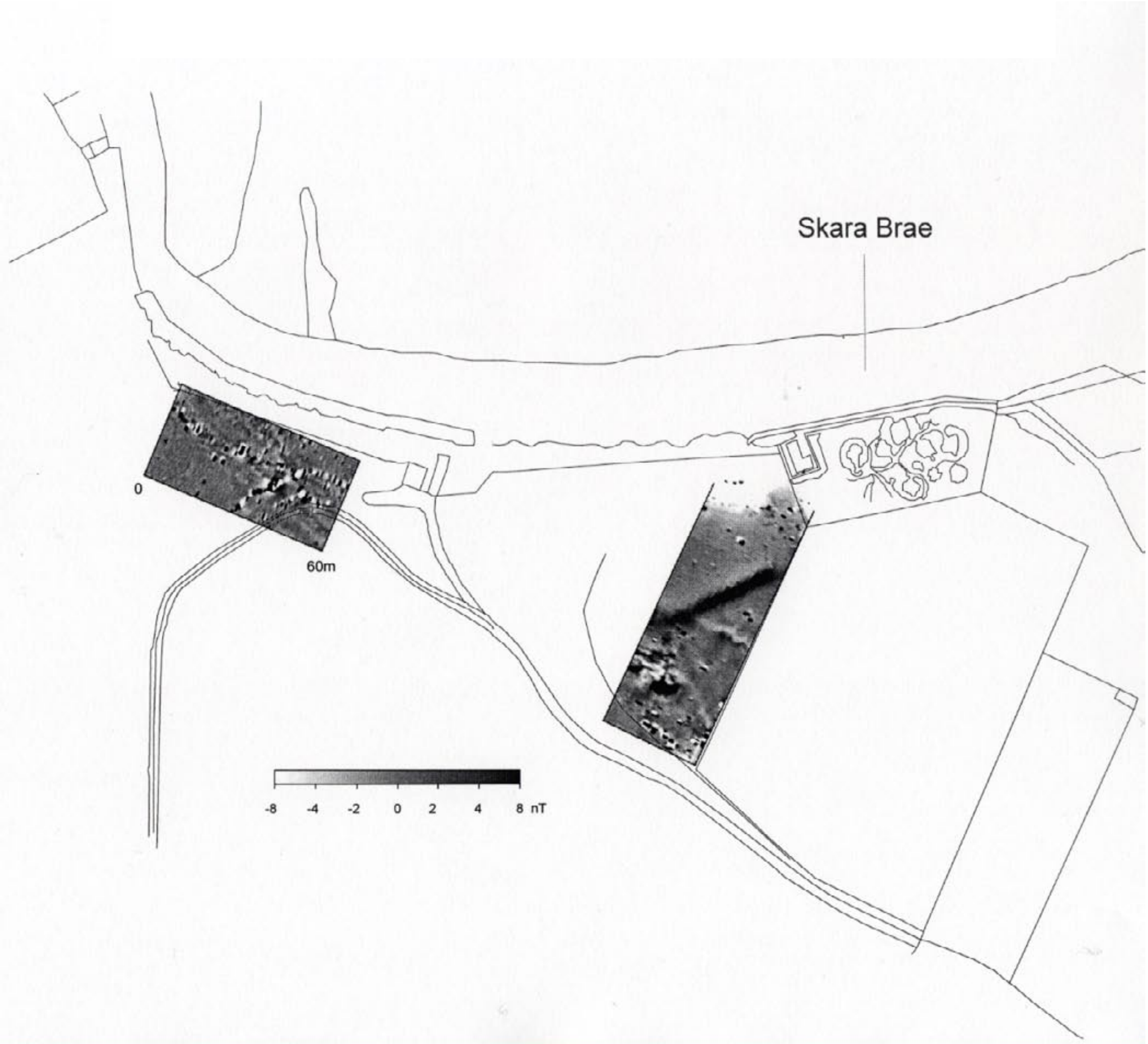
The results from the further mound some 100m to the east of Snusgar produced only a very general expectation that it might contain any archaeological potential, in the form of a generally raised magnetic signature but without any apparent structural coherence. However, a small 10 × 5m test trench was dug here in 2005, and this, which was extended in 2006 to 2008, has revealed substantial and well-preserved stone buildings which have been dated to the Viking/Norse period (see www.conted.ox.ac.uk/research/birsay-skaill). These had been abandoned and filled up with wind-blown sand to a depth of 1–1.5m, which explains why the magnetometer had registered a general spread of potential here but had been unable to filter out the structural pattern later revealed by excavation from the local background.

Skara Brae, at the southernmost point of the bay's circumference, was discovered in 1850 after marine erosion of aeolian sand deposits which had built up over the site in prehistory. The Neolithic 'village' (perhaps more accurately described as a 'tell'), which was largely exposed and cleared of overburden under the archaeological supervision of V Gordon Childe in 1929–30 (Childe 1931), and is now partly reconstructed and in guardianship, was previously deeply buried in a combination of archaeological and aeolian sand horizons within an upstanding mound (itself now all but gone from view, but still commemorated of course by the 'brae' name). Another large mound some 100m to the west is currently undergoing severe erosion (Morris 1985). Half or more of this mound has now gone, leaving only a landward portion behind a full-height semi-vertical erosive section which is visible facing the bay, in which are exposed layers of stone masonry and middens interleaved with deep sand accretions (perhaps, one imagines, bearing some similarity to the appearance of Skara Brae *c* 150 years ago).

Consent to carry out survey within the Skara Brae section of the Orkney WHS buffer zone was obtained, but targeted prospection was also deployed on a wider basis in an attempt to build a more comprehensive landscape overview for the bay. Within such a large area, a survey target zone comparable to the more coherent Buckquoy Peninsula did not immediately suggest itself, so work began by targeting known locations of archaeological potential and exploring their environs. A geophysical survey had been conducted here in 1973 by A Clark and A Bartlett of the Ancient Monuments Laboratory, in the field immediately to the south-west of Skara Brae. Their survey, from which an unpublished stack-trace plot remains on file in the Sites and Monuments Record (SMR) at Orkney Archaeological Trust, was inconclusive, but did show a very pronounced linear anomaly running WSW from Skara Brae. This proved to be an igneous dyke apparently running beneath the southern edge of Skara Brae. Whilst obviously counterproductive to magnetic reconnaissance, the presence of this feature is not without archaeological interest in such close proximity to a major Neolithic site.

The southern 30 × 30m grid in the survey closest to Skara Brae did show some hints of stone archaeological features, but these were partly masked by extensive ferrous metal contamination and modern drainage installations (this area is very close to Skaill House Farm, and the low cliff-tops and dunes to the west of Skara Brae are also scattered with bits of fishing equipment, fencing and parts of old sheds). However, the mound to the west did show more promising results. A Viking burial was found here in 1888 and a cist grave in 1994 (James 1999, 771 ff). The grey-scale plot shows a reasonable indication of the extent and shape of the southern part of the mound, and there are hints of discrete secondary structures remaining in its periphery, which would accord with the previous finds of burials. The 2003 Skara Brae Magnetometer Survey has since been superseded by a much more extensive survey carried out by Orkney College Geophysics Unit on behalf of Historic Scotland and the WHS management programme.

In the right conditions and as far as possible free of relatively recent ferrous contamination from fishing and barbed-wire fencing, and spreads of kelp-burning detritus (which often limits its potential in



Illus 4. Magnetometer survey of Bay of Skaill, near Skara Brae, 2003

coastal margins), conventional fluxgate magnetometry can work wonders in up to 1m of blown sand. This is demonstrated by an example from Harlyn Bay, Cornwall, which has now been ground-truthed in the sense that it was fully excavated for a pipeline – revealing beneath the sand extant Medieval ridge and furrow overlying Iron Age round houses; here, magnetic susceptibility topsoil mapping might have worked in probe form but the 100mm surface coil is too shallow to reach the buried palaeosols (Oxford Archaeotechnics, see http://dialspace.dial.pipex.com/town/terrace/ld36/grad.htm). One way forward might be the Geonics EM31 Electrical Conductivity system (www.geonics.com), used to some effect in desert sites in the Middle East (such as the National Museums of Scotland Saqqara Project in Egypt – see www.nms.ac.uk/royal/saqqara), which penetrates up to 6m deep – and is easy and quick to use when combined with GPS. This helps us to realise a need for a faster and more extensive prospection technique which could more effectively translate into a three-dimensional digital terrain model.

Current work therefore shows the potential, but also the limitations of techniques of conventional magnetometer survey coupled with topsoil magnetic susceptibility mapping and topographical survey. This is very good for targeting surface exposures and settlement mounds, but where sand depth reaches over *c* 1m, its coverage becomes more patchy and difficult to interpret, leading to a loss of ability to model a coherent landscape sample. A sustainable methodology for modelling and ground-truthing both the visible and subsurface deposits is needed, which combines the potential for visualising archaeological deposits both in demonstrable areas of potential and also in the 'gaps' between. Moreover, this must be one which in the case of sand areas does not in itself increase dune instability.

For an integrated approach, therefore, the way forward would include a combination of the following methodological objectives:

- building rapid and cost-effective means of modelling the archaeological and palaeoenvironmental resource through survey and GIS.
- developing sustainable methodologies for ground-truthing and dating the resource.
- providing an enhanced and more widespread multi-disciplinary understanding of ongoing geomorphological processes and potential for sudden change.
- auditing preservation and loss of deposits.

The proceedings published below provide a resource of experience, results and references which are intended to promote the four objectives as outlined above.

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