Lithic Raw Material Acquisition in Brú na Bóinne and the Implications for Regionality

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Abstract
This paper looks at the evidence for a wider Boyne Valley region beyond the core Brú na Bóinne area, drawing in particular on extensive evidence for settlement and landuse during the Neolithic and Early Bronze Age from a recently completed surface collection survey in the area. Also examined are the results of several other small-scale surface collection surveys previously carried out in the wider North Leinster area. Significant numbers of prehistoric sites were excavated on the M1 Northern Motorway - Drogheda Bypass, the line of which passes less than 2km to the east of the Brú na Bóinne area, suggest intense settlement activity during the Neolithic and Bronze Age concentrated especially on the corridor of the valley of the River Boyne. Recent research into the sourcing of the structural and other stones to build the major monuments in Brú na Bóinne suggests travel, possibly on a routine basis, along this corridor to the coast. Metrical and distributional analysis of material from the surface collection survey points to a coastal origin for much of the flint raw material used for tool manufacture within the Brú na Bóinne area.

Archaeology of Brú na Bóinne

Brú na Bóinne has a long and detailed sequence of activity, primarily related to ceremony and ritual but also including some evidence of settlement. The earliest evidence of a human presence in the area that is currently on record is in the form of thirty-three broad flakes, including diagnostic butt-trimmed forms and Bann flakes, excavated from the ground in front of the monument at Newgrange (Lehane 1983, 142-6). Conventionally, these date to the Later Mesolithic period, (6500-4000 cal BC) (see Costa *et al*. 2005, 19-21). The oldest surviving monuments in Brú na Bóinne are passage tombs and the area is widely seen as one of the most important areas for passage tombs in Europe both because of the scale, complexity and numbers of the monuments themselves and also because of the wealth of material evidence that accompanied them (Eogan 1986). Passage tomb construction in Brú na Bóinne probably did not start before 3350 cal BC and the main building phase, if not the actual use of the tombs, could have lasted until around 2900 cal BC (Grogan 1991, 128-9). They appear in clusters around the three largest tombs: Newgrange, Knowth and Dowth. In recognition of its importance, the area was awarded UNESCO World Heritage Site status in 1993 and a management plan for the area has been published (Dúchas 2002; Stout 2002, 181). Based on Sheridan's developmental sequence for passage tombs, Cooney has suggested a broad four-phase sequence for the construction of the passage tombs in the Brú na Bóinne complex (Sheridan 1985/6; Cooney 2000, 153-6).

Extensive archaeological excavations have taken place at the major monuments at Newgrange and Knowth, with some limited work having been carried out at Dowth (Eogan 1968; 1974; 1984; Eogan and Roche 1997a; 1997b; 1998; Lynch 1989; 1990a; 1990b; Macalister 1943; O'Kelly 1982; O'Kelly *et al.* 1983). At Newgrange and Knowth, evidence of extensive activity outside of the timescale of the construction and use of the passage tombs was found. A number of other sites in the area were also excavated (Eogan 1963; Liversage 1960; O'Kelly *et al.* 1978; Ó Ríordáin and Ó hEochaidhe 1956; Shee and Evans 1965; Sweetman 1976; 1985; 1987) contributing to the current picture of the way that Brú na Bóinne functioned as a focus for ceremony, ritual and settlement over the millennia of the earlier prehistoric period.

The Boyne Valley Region

Taking the distribution of passage tombs as the main indicator, Eogan has suggested that there is a wider Boyne region outside the confines of Brú na Bóinne, a region containing up to seventy examples of passage tombs. He has drawn particular attention to megalithic art as a defining characteristic of the area (2007, 134, figs. 1 and 2). The discovery of stone decorated with megalithic art during the excavation of a late first millennium AD souterrain at the site of Lismullin on the route of the proposed M3 motorway near the Hill of Tara, Co. Meath (O'Connell 2013) is a recent addition to this distribution. The passage tombs fall within a well-defined area which measures approximately 40km east-west by a maximum of 20km north-south. It is focused on the lower reaches of the River Boyne and its tributary the River Blackwater, and extends from the Irish Sea coast at its eastern edge inland as far as the Loughcrew hills (Slieve na Callaigh).

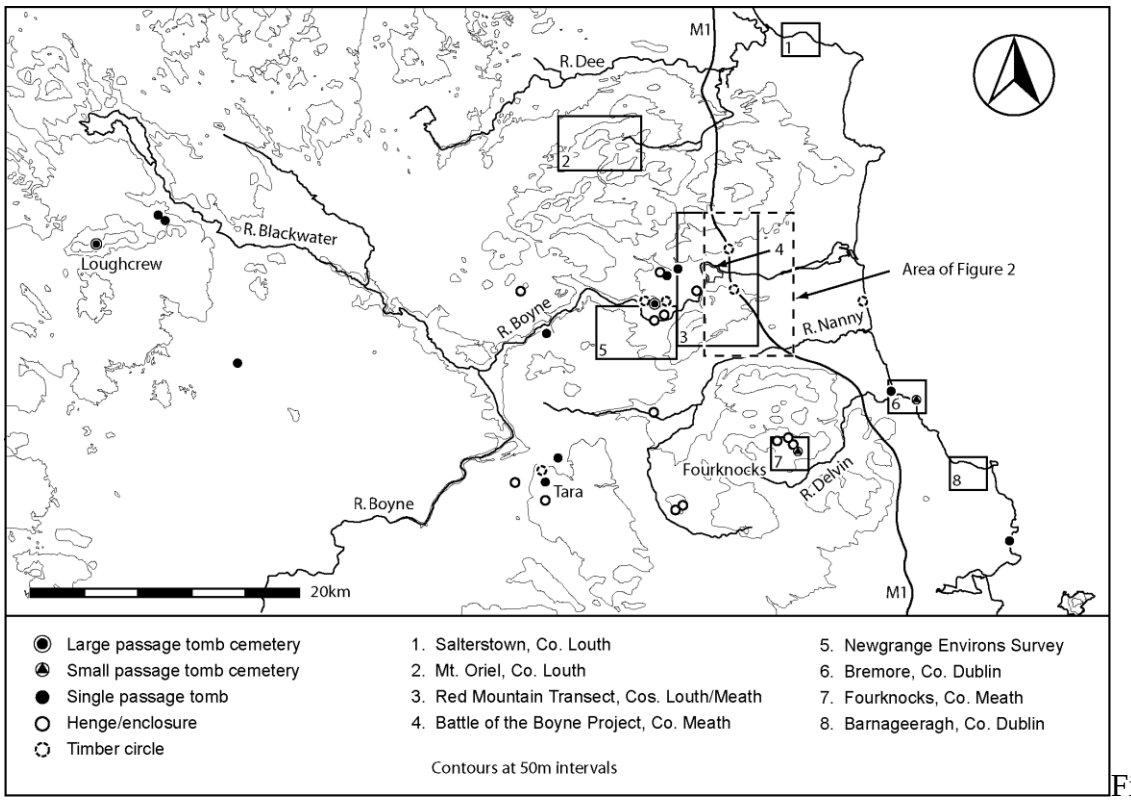

Figure 1: Map of the Boyne Valley region with locations of fieldwalking surveys.

Activity continued after this time into the Late Neolithic/Beaker with the construction of a range of new monument types commencing, broadly speaking, around 2900 BC and may have extended over several hundred years (Cooney 2000, 165). Stout has drawn attention to the presence in the same area of a group of earthen enclosures conventionally dated to the Late Neolithic/Early Bronze Age (1991; see also Condit and Simpson 1998). Thirteen of these monuments are known in the Boyne region, four of which are located at Brú na Bóinne, and their distribution corresponds closely with that of passage tombs in the region suggesting a continuity of ritual practice with new monument forms. While radiocarbon dates from Brú na Bóinne currently suggest a chronological gap between the construction of the passage tombs and the later monuments, it is likely that there was continuity between the two periods (Grogan 1991, 129-131). The location of this activity in an already monumentalised landscape has parallels elsewhere, e.g., Orkney and Wessex, and the constant references made to the existing monuments, including actual reuse in some instances, is strongly suggestive of cultural continuity (Cooney 2000, 167). For example, the enclosure at

Monknewtown was partially excavated and among other features, thirteen burials were uncovered here. One of these, Burial No. II which contained the cremated remains of a child in a Carrowkeel bowl, was placed in a natural hollow 'close to the tail of the bank' immediately inside what would have been the line of the bank. (Sweetman 1976, 28-9). Although the stratigraphical connection between the burial and the bank is less clear that might be hoped for, the association of a classic passage tomb pottery vessel with the bank of the enclosure may be an indication of a close chronological relationship between the two monument types in Brú na Bóinne. Further excavation and dating of appropriate sites in the Brú na Bóinne complex is required and is likely to blur this artificial chronological distinction. A range of low-visibility enclosures has recently been discovered in the analysis of the Meath County Council LiDAR data for the area and with further follow-up work it seems likely that some of these will also be confirmed as earthen enclosures in the henge tradition (Megarry 2010; Davis *et al*. 2013).

Other ritual enclosures in the henge tradition are also known in the Boyne region, including the large pit circle or 'woodhenge' to the immediate southeast of the main passage tomb at Newgrange (Sweetman 1985), a timber circle immediately to the west of the same monument (Sweetman 1987), and a timber circle immediately outside the entrance to the eastern tomb at Knowth (Eogan and Roche 1994; 1997a). Similar monuments have been discovered in recent years at Balgatheran 4, Co. Louth (Ó Drisceoil 2003, 255-7), Rathmullan, Co. Meath (Stafford 2003, 329-30), both discovered during advance archaeological work on the corridor of the M1 Northern Motorway-Drogheda Bypass, and also at Bettystown, Co. Meath (J. Eogan 2000) close to the mouth of the River Boyne on the coast. All sites produced both Grooved Ware and Beaker pottery. While a relatively full distribution of henges and earthen enclosures is available (Condit and Simpson 1998, 46) the low-visibility nature of the remains of timber circles means that it is likely that this site type will become increasingly significant as more come to light in the wider Boyne region. An additional possible timber circle site has recently been identified from aerial photographs in Newgrange townland between Site A, a probable passage tomb enclosed within a ploughed-out earthen enclosure, and Site P, another ploughed-out enclosure on the bank of the river Boyne (Brady 2007b, 131, fig 4.5).

Sourcing of the Newgrange Structural Stones

The sources of the structural and other stones used to construct the monuments in Brú na Bóinne may be taken as indicating the extent of a region within which the tomb builders routinely moved (Cooney 2000, 136-8, fig. 5.2). Geological examination of several of the additional stones at the monuments of Newgrange and Knowth has demonstrated that they were transported very significant distances. The granitic cobbles were transported from as far away as the Cooley and Mourne Mountains over 60km to the north, while at least some of the quartz from Newgrange came from a vein source in the Wicklow Mountains 80 to 90km to the south (Meighan *et al.* 2002; Meighan *et al.* 2003; Mitchell 1992). Recent geological work on the origin of the greywacke structural stones in the main monuments in Brú na Bóinne has concluded that the source in all likelihood was Clogher Head (Phillips *et al*. 2001; 2002). This work has also provided possible evidence of transport of the large structural stones by boat along the River Boyne, which may have been tidal as far inland as Newgrange during the Neolithic (Mitchell 1995; Phillips *et al*. 2002). This not only suggests that there was direct travel to and from each of these areas in order to transport the stones used in the settings and the major tombs in Brú na Bóinne, but that there must have been regular communication over a relatively long period in order to prospect for and locate sources of the various stone types used and then collect or extract the material actually required. Taking into

account the probability that the passage tombs were constructed over several centuries and the likelihood that stone from these sources was also used for features associated with tombs other than Knowth and Newgrange where this preliminary geological work has been carried out, it appears highly probable that there was regular channel of communication from Brú na Bóinne to the coast and onwards to these locations. Although large quantities of shells have been found at Cairn H in the Loughcrew passage tomb cemetery in Co. Meath indicating contact with the coast, no shells have been recovered in Neolithic contexts in any of the excavations of passage tombs in Brú na Bóinne (Herity 1974, 235).

Recent Excavations on the M1 Northern Motorway - Drogheda Bypass

A very significant body of excavated material has been amassed following the extensive programme of archaeological monitoring testing and excavation carried out in advance of the construction of the M1 Northern Motorway - Drogheda Bypass over the years 2000 and 2001. This work took place in a north-south corridor positioned as little as 2km from the eastern edge of Brú na Bóinne and the core area of the UNESCO World Heritage Site. The entire project was roughly 21km long, and linked up with other sections of the same motorway – the Dunleer bypass to the north and the Balbriggan bypass to the south. Over 100 separate excavation licences were issued over a two-year period and more than 120 sites were resolved. This gives an approximate rate of six sites per kilometre constructed or one site every 175 metres. The summary accounts in *Excavations 2000* (Bennett 2002) and *Excavations 2001* (Bennett 2003) give broad outline indications of the nature and date of each of these sites. Most of the sites have only been given broad preliminary period dates; only a small number of sites had 14C dates at the time of their publication in *Excavations*. A number of sites produced evidence of more than one phase of activity and in some cases this activity was from a significantly later period. At the time of writing none of these sites had been comprehensively published apart from two papers by Ó Drisceoil (2003; 2007).

Ninety-two (76%) of these sites were classified as prehistoric, although some of these may also have seen activity during the historic period (Table 1). Although producing no finds, one of these sites was assigned a Late Mesolithic date on the basis of a radiocarbon determination. A further twenty-six were assigned a date in the Neolithic and twenty-seven sites were listed as producing evidence of activity dating to the Bronze Age based on artefacts recovered and site morphology. Three sites produced evidence of activity during the Iron Age. Forty-five of these sites were classified only to the prehistoric period as more precise dating evidence was not available when the relevant *Excavations* bulletin was published and some of these have the potential to alter the distribution of sites for each period once post-excavation work is completed and results become available.

While the overall number of sites identified is extraordinary, even more remarkable is the very high proportion of these which were dated to prehistoric times. Many were very ephemeral – sections of ditches, single pits or groups of pits, individual post holes or groups of post-holes, burnt mound material – while other sites were more significant indicating more intensive activity and seem to have been significant focal points within their local landscapes. This, no doubt, is due firstly to the processes of motorway route selection which generally seek to avoid known archaeology and

Period	No. of Sites	Sites with lithics	Sites with pottery
Late Mesolithic	1	0	0
Early Neolithic	7	6	5
Early-Middle Neolithic	1	0	0
Early Neolithic, Bronze Age	1	1	1

Early Neolithic, Middle Neolithic, Early Bronze Age, Middle Bronze Age	1	1	1
Neolithic	6	5	4
Late Neolithic	3	3	3
Late Neolithic-Middle Bronze Age	1	0	1
Late Neolithic/Early-Middle Bronze Age	3	3	2
Late Neolithic/Early Bronze Age	4	3	3
Early Bronze Age	6	1	1
Early-Middle Bronze Age	1	0	0
Middle Bronze Age	1	0	0
Middle-Late Bronze Age	3	1	1
Bronze Age	3	2	2
Late Bronze Age	2	0	2
Late Bronze Age/Early Iron Age	1	0	0
Iron Age	2	0	0
Prehistoric	45	22	6
Totals	92	48	32

Table 1: Prehistoric sites on the M1 Northern Motorway - Drogheda Bypass by period.

secondly to the 'corridor' nature of this type of archaeology which limits excavation to the extent of the road-take. The sheer density and variety of these sites points to the range of ways in which the landscape was being used during prehistory and highlights the lack of appreciation of the true complexity of the prehistoric social landscape in the Boyne Valley region. Some of the sites, even where composed of numerous

details of post-excavation work carried out on material from these sites is available a more complete discussion of the implications of these results may be possible. The distribution of sites is clearly focused on the area of the river valley (Figure 2). Of the 92 prehistoric sites identified during the pre-development excavations, approximately 50 of them (54% of the prehistoric sites identified) are located within 3km of the River Boyne (i.e. 28% of the total length of the development). There is a second focus of prehistoric activity a couple of kilometres to the south in the Nanny valley where 15 or so sites are located.

Surface Collection Survey in the Boyne Region

A number of surface artefact collection surveys have been carried out in the Boyne Region over the past two to three decades (Figure 1). These include work at Mount

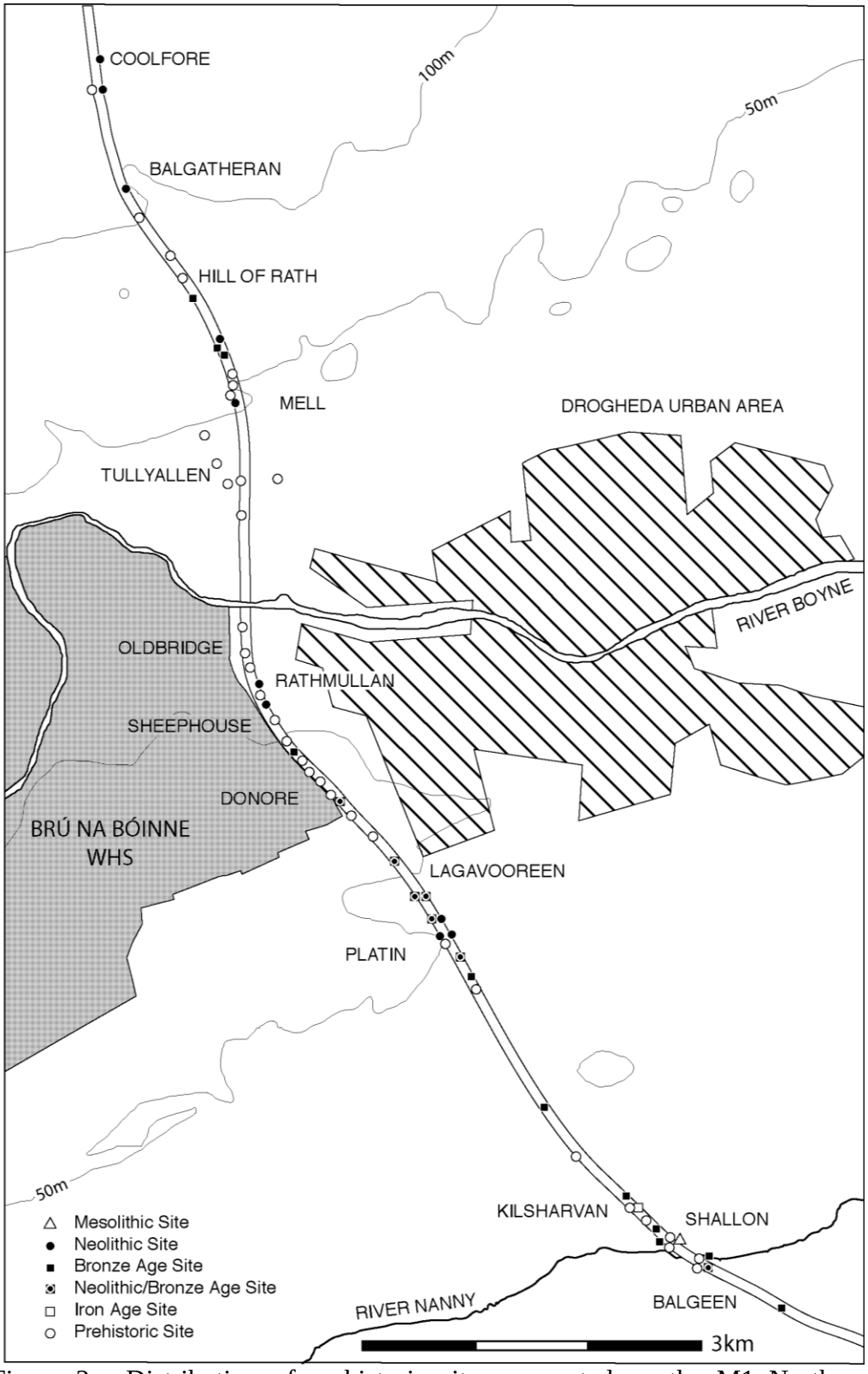

Figure 2: Distribution of prehistoric sites excavated on the M1 Northern Motorway - Drogheda Bypass.

Oriel, Co. Louth (Cooney 1990), various test locations along the County Louth coast and Salterstown (Hodgers 1973; 1975; 1979; 1992; 1994), Fourknocks, Co. Meath (Cross 1991), Barnageeragh (Guinan 1992) and Bremore, Co. Dublin (Collins 1997) the Red Mountain Transect, Cos. Louth and Meath (Cooney and Brady 1998) and the Battle of the

Boyne survey (Brady *et al*. 2008; Cooney *et al.* 2002). The broad pattern of assemblage size and composition suggests that there are very high-density scatters of material along the coastal strip which were produced mainly by large-scale raw material procurement and initial working. Retouched or modified tools, often taken as indicative of settlement activity, are present throughout these scatters but in relatively small proportions. Although these proportions appear to be low, when the sheer volume of material recorded for the coastal strip in these surveys is taken into account, it appears likely that they actually represent relatively significant levels of settlement activity which are diluted by the very large amounts of industrial debris. Large numbers of pebbles and nodules, both unworked and tested or prepared, are features of these coastal assemblages (Tables 2 and 3). Moving inland densities fall dramatically and the proportions of finished tools tend to increase. (Brady 2007a)

	Nodules	Split Pebbles	Cores	Flakes	Chunks	Retouched
Salterstown	—	—	28.3%	69.5%	—	2.2%
Mount Oriel	4.0%	—	4.7%	47.2%	28.1%	16.0%
Red Mountain	11.0%	2.9%	8.7%	24.4%	48.7%	4.3%
Bremore	18.3%	5.1%	11.5%	21.8%	40.7%	2.6%
Barnageeragh	4.2%	—	9.4%	20.4%	62.0%	4.0%

Table 2: Boyne Region surface collection survey comparative assemblage composition.

	Primary	Secondary	Tertiary
Salterstown	4.7%	89.5%	5.8%
Mount Oriel	—	—	—
Red Mountain	19.2%	34.5%	46.3%
Bremore	19.0%	40.7%	40.3%
Barnageeragh	24.7%	30.3%	45.0%

Table 3: Boyne Region surface collection survey comparison of core reduction sequence.

The Newgrange Environs Surface Collection Survey

The principal objective of the current research was to build on the results of the Red Mountain Transect Project (Cooney and Brady 1998) and take a landscape approach to the Brú na Bóinne area, exploring the evidence for settlement and landuse in the form of surface-collected lithic distributions and to provide a settlement context for the monuments. The study area chosen was limited in size to a simple 6km by 4km quadrat positioned to straddle the River Boyne in order to be able to compare lithic densities inside and outside the core area. All available tilled land in the study area was walked – amounting to 623ha out of a total area of 24km^2 – roughly a 25% sample. Individual fields were used as sampling units and tilled land was relatively well distributed across the study area. Transects were set out across each field at 10m intervals giving 20% coverage of surveyed ground ensuring comparability with many other fieldwalking studies carried out in Ireland. Each transect was subdivided into stints 25m long and lithics finds were recorded by individual stint. All data were stored and analysed in a GIS model and each stint was georeferenced using Irish National Grid coordinates (Brady 2007a; 2007b).

The Lithics Data

An assemblage of over 8600 worked lithics was recovered during the survey. Figure 3 shows the raw distribution of these finds across the study area. The analytical approach taken to the composition of the lithics assemblages was carefully structured to be comparable to the excavated assemblages from Knowth (Dillon 1997) and also other Irish surface collection assemblages, for example the Bally Lough survey, which examined the Mesolithic-Neolithic transition in south-east Ireland (Green and Zvelebil 1990; Peterson 1990; Zvelebil *et al*.

1987). The study area was split into ecological zones to explore the relationships between the lithics distributions and the landscape (Brady 2007a, 215-6, fig. 19.2).

Examination of the distribution of lithic artefacts revealed significant variation both in density and in sampling unit assemblage composition. The areas surveyed in Newgrange townland on the northern side of the river were the most significant and an almost continuous high-density blanket of material was recorded there. Densities were typically in the order of 70 to 100 artefacts per hectare for individual fields. There were also many areas of significant density on the southern side of the river, with peak values between 40 and 50 artefacts per hectare for individual fields. Many significant scatters on the southern side were located within 500m of the river and occupied either elevated locations on top of the steep shoulder of the river valley overlooking the core monumental zone or were positioned on the first fluvioglacial terrace above the floor of the river valley. Other scatters were located on south-facing slopes further away from the river.

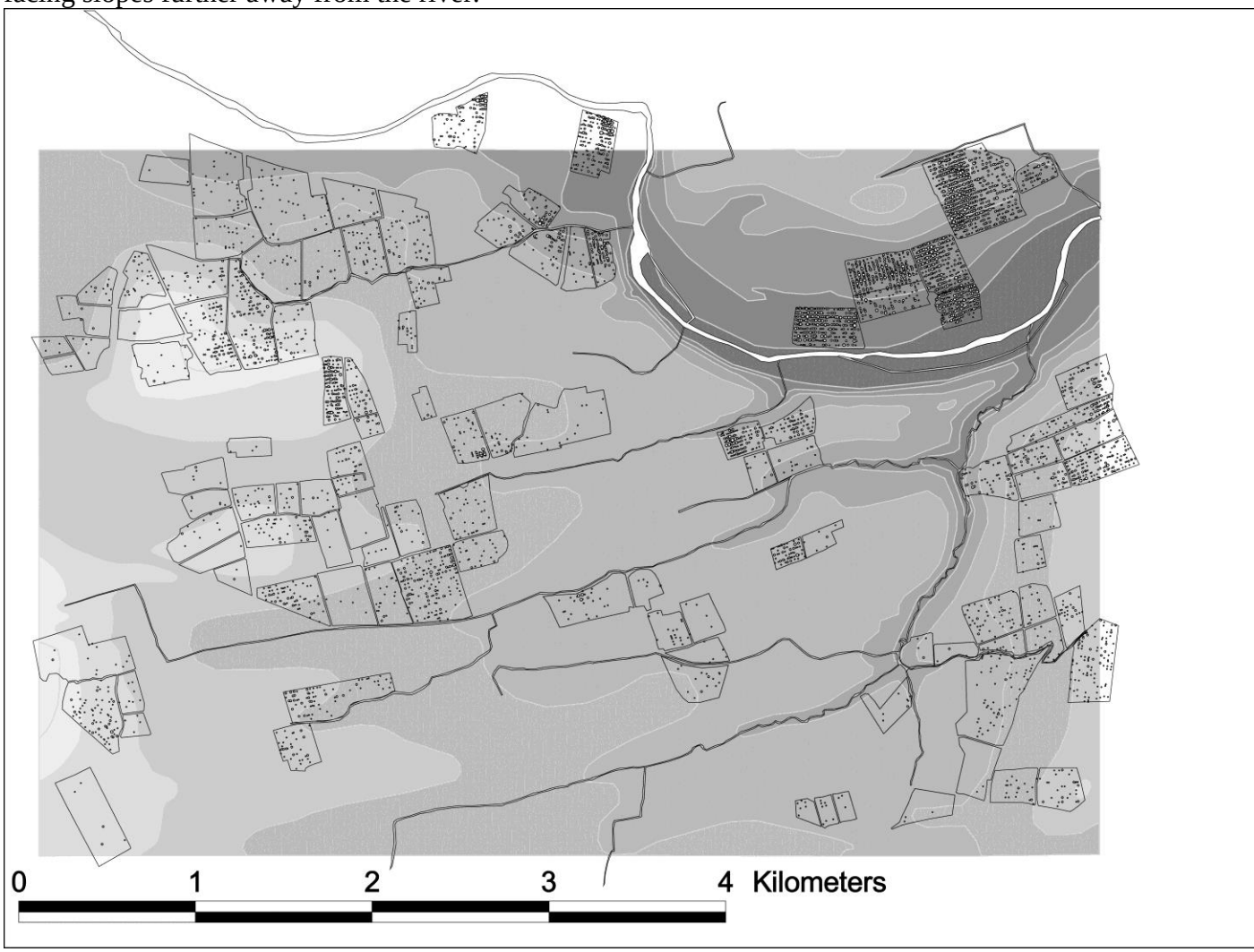

Figure 3: Finds distribution map, Newgrange environs survey.

	No. of Fields*	Area Sampled (ha)	Total Lithics	Density per ha.
Grey Brown Podzolic-North Side	2	23.20	1708	73.62
Alluvial-North Side	5	34.65	2415	69.70
Alluvial-South Side	3	18.23	644	35.32
Grey Brown Podzolic-North Facing Slope	17	104.16	537	5.16

Gley-Southern Valley Shoulder	9	43.78	652	14.89
Gley	41	179.27	1034	5.77
Tributaries	31	202.67	1631	8.05
Grey Brown Podzolic-South	2	17.77	27	1.52
Totals	110	623.73	8648	13.86

* Excludes Field 87 which fell completely outside the study area boundaries.

Table 4: Summary of fieldwalking data by ecological zone

The composition of the assemblage varied considerably at both at the scale of the individual fields and at the scale of the ecological zones and data are presented here at the level of the ecological zones (Table 4). The composition of the assemblage varied considerably from field to field and between ecological zones. It is clear from analysis of the assemblage composition that most of the initial processing was taking place outside the study area as proportions of material relating to these activities was consistently low and field level and ecological zone assemblages did not have an industrial character. This did vary, however, and pockets of material with a more industrial character were occasionally identified in the assemblages at certain points in the landscape, especially on the northern side of the river. Greater variation between ecological zones is apparent in the proportions of material relating to production and while there is also variation in the proportions of retouched material and 'formal' tools across the zones in the assemblage, these are consistently significant, above 10.4% (Table 5). Certain parts of the landscape have quite significant numbers of retouched artefacts, e.g., the Tributaries zone, and may reflect a marked preference as a location for certain types of activity possibly including residential settlement. Diagnostic artefacts as a proportion of the assemblage were low and it appears that for certain periods the numbers of diagnostics recovered are unlikely to be a true reflection of activity in the landscape of the study area for those periods. The nature of the diagnostics and their distribution across the study area as well as the detailed analysis of the assemblage and its relationship to the landscape are discussed elsewhere (Brady 2007b, 217).

Ecological Zone	Selection		Production		Flakes & Blades		Tools		Misc.		Total Lithics
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%	
Grey Brown Podzolic-North Side	137	*8.0*	60	*3.5*	871	*51.0*	229	*13.4*	411	*24.1*	1708
Alluvial-North Side	173	*7.2*	108	*4.5*	1309	*54.2*	272	*11.2*	553	*22.9*	2415
Alluvial-South Side	21	*3.3*	47	*7.3*	430	*66.8*	67	*10.4*	79	*12.3*	644
Grey Brown Podzolic -North-Facing Slope	33	*6.1*	51	*9.5*	230	*42.8*	79	*14.7*	144	*26.8*	537
Gley-Southern Valley Shoulder	26	*4.0*	76	*11.7*	303	*46.5*	124	*18.9*	123	*19.0*	652
Gley	29	*2.8*	125	*12.1*	569	*55.0*	182	*17.5*	129	*12.6*	1034
Tributaries	65	*4.0*	153	*9.4*	815	*50.0*	334	*20.2*	264	*16.4*	1631
Grey Brown Podzolic -South Side	2	*7.4*	1	*3.7*	12	*44.4*	9	*29.6*	3	*14.8*	27
Total	486	*5.6*	621	*59.7*	4539	*52.5*	1288	*14.9*	1714	*19.8*	8648

Table 5: Assemblage composition by ecological zone

Non-Flint Lithic Raw Materials

Although non-flint raw materials may be underrepresented in the surface-collected assemblage because of the relative difficulties of recognising these artefacts on the surface of a field, their occurrence was found to vary across the study area. Table 6 outlines the distribution of raw material types across the study area by ecological zone. The evidence from Dillon's (1997) work on the contexted lithics assemblages from Knowth identified a changing emphasis on the mix of lithic raw materials used during different periods which suggests that there may be a chronological element to the deposition of the lithics in certain parts of the study area. The most diverse of the Knowth assemblages in terms of raw material composition is that dating to the Decorated Pottery complex of the Middle Neolithic where flint, including pebble and chalk flint, accounted for just 79.3% of the assemblage. The remainder, over 20%, was made up of non-flint raw materials including chert and quartz. There is also a high degree of diversity in the Grooved Ware phase assemblage where flint accounts for 91.6% including chalk, pebble, nodular and burnt. The remainder, 8.4%, is made up of non-flint materials (*ibid*. figure 39, 199). These materials are available in the local tills and are often assumed to have been used as a second-best alternative to flint. However, it is possible that the use of these materials may have fulfilled more symbolic than functional roles (Cooney 2000, 176-7). Although no quantification of unworked quartz was undertaken during fieldwork for the present survey, small quantities, both worked and unworked and including pebble quartz and more angular lumps, were noted as being present in the fields during this survey. It has been demonstrated that quartz may have been transported considerable distances for the construction of the feature on the front of the Newgrange passage tomb and for inclusion in the settings at Knowth (Meighan *et al.* 2003; Mitchell 1992, 128-9). Some of the lithic artefacts collected during the survey may have been manufactured from the same imported material.

Ecological Zone	Pebble Flint		Chalk Flint		Chert		Quartz		Misc.*		Total Lithics
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%	
Grey Brown Podzolic-North Side	1388	*81.3*	200	*11.7*	59	*3.5*	54	*3.2*	7	*0.4*	1708
Alluvial-North Side	2056	*85.1*	279	*11.6*	27	*1.1*	45	*1.9*	8	*0.3*	2415
Alluvial-South Side	561	*87.1*	43	*6.7*	23	*3.6*	17	*2.6*	0	*0.0*	644
Grey Brown Podzolic	427	*79.5*	33	*6.2*	24	*4.5*	52	*9.7*	1	*0.2*	537

-North Facing Slope										
Gley-Southern Valley Shoulder	487	*74.7*	54	*8.3*	65	*10.0*	35	*5.4*	11	*1.7*	652
Gley	837	*81.0*	85	*8.3*	63	*6.1*	46	*4.5*	3	*0.3*	1034
Tributaries	1238	*75.9*	113	*8.2*	175	*10.0*	96	*5.4*	9	*0.6*	1631
Grey Brown Podzolic -South Side	21	*77.8*	2	*7.4*	1	*3.7*	2	*7.4*	1	*3.7*	27
Total	7015	*81.1*	809	*9.4*	437	*5.1*	347	*4.0*	40	*0.4*	8648

* Miscellaneous includes rock crystal, silicate, sandstone, limestone, granite jasper, siltstone, shale and porcellanite.

Table 6: Assemblage raw material by ecological zone

Chalk Flint

Chalk flint was found throughout the survey area but its density varied (Table 6). There was a significant difference between the occurrence of chalk flint on the northern and southern sides of the river with the north side having between 3% and 5% more. Dillon, in her analysis of the lithic evidence from Knowth (1997), demonstrated that for certain periods, significant quantities of chalk flint were being imported directly from the north-east of Ireland, the only source of this type of flint in Ireland. The particular phases where it was an important component were the Decorated Pottery phase associated with the construction and use of the passage tombs, when it accounted for 10% of that assemblage and the Grooved Ware phase associated with the construction of the timber circle outside the entrance to the eastern tomb where it accounted for 47% of that assemblage (Dillon 1997, 199, fig. 39). Dillon carried out additional work reassessing two assemblages from Brú na Bóinne – the Late Neolithic/Beaker settlement at Newgrange and the henge at Monknewtown – where she identified significant proportions of chalk flint (Dillon n.d.). Chalk flint has also been identified elsewhere in the Boyne region, most notably the timber circle excavated by James Eogan at Bettystown Co. Meath where it accounted for 7% of that assemblage (Brady 2000). This lithic raw material is likely to be significant component of the assemblages excavated on the M1 Northern Motorway - Drogheda Bypass as many of these sites date from the Later Neolithic (see Table 1).

Pebble Flint

Looking in detail at the pebble flint element of the assemblage, it has been stated that flint is a component of the glacial erratic element in a number of the glacial deposits of the Boyne Group indicating that it constitutes less than 0.5% of the local tills (McCabe 1973, 362-3; 383 table 2). In order for this source of lithic raw material to be accessed, the surface of the soil must first be broken. In prehistoric times this would have been done in conjunction with cultivation or tree felling and land clearance in preparation for cultivation. Soil cultivation in the Neolithic and during the Bronze Age was shallow in comparison to modern ploughing and this would have been a major factor limiting accessibility to any soil lithic raw material component. A further limiting factor is the likely extent of cultivated ground at any one time during the earlier prehistoric period. Cultivation plots are likely to have been small and dispersed, quite unlike the distribution of modern arable land (Monk 1985/86, 31-3). Nor is it likely that deforestation and land clearance was a long-term source of a significant amount of raw material because pollen studies from the excavations of the tombs at Newgrange and Knowth indicate that major clearance must have taken place at a relatively early stage in the Neolithic (Groenman-van Waateringe 1984; Groenman-van Waateringe and Pals 1982; Monk 1982). Similarly, because of their small scale, river gravels, tree casts and cattle scrapes are unlikely to have been significant contributors to the quantity of material available in the area. The occurrence of unworked pebbles in the survey assemblage is presented in Table 7. While there is some variation across the study area, with proportions ranging from 1.84% up to

7.03%, the average for the assemblage as a whole is 4.37% or 378 individual unworked pebbles. It seems, therefore, that the use of the erratic flint component in the local glacial drifts, where it exists, is unlikely to have contributed any significant proportion of raw material to the lithic assemblages in the area.

Ecological Zone	No. of Pebbles	Total Lithics	%
Grey Brown Podzolic-North Side	120	1708	7.03%
Alluvial-North Side	146	2415	6.05%
Alluvial-South Side	14	644	2.17%
Grey Brown Podzolic-North Facing Slope	23	537	4.28%
Gley-Southern Valley Shoulder	17	652	2.61%
Gley	19	1034	1.84%
Tributaries	38	1631	2.33%
Grey Brown Podzolic-South Side	1	27	3.70%
Totals	378	8648	4.37%

Table 7: Unworked pebbles as a proportion of total assemblage by ecological zone

Pebble flint was the most significant type of raw material used for artefact production in the study area and usage averaged 81% (Table 6). In addition to the figures for availability in the local tills discussed above, examination of the nature of the lithic distributions across the study area also appears to indicate that the bulk of this type of flint was not procured within the study area. The distribution of complete pebbles followed the distribution of all other artefacts very closely suggesting that pebbles were imported into the area and stockpiled and used in those parts of the landscape where lithic working was taking place. Pebble, core and flake dimensions were examined and compared in order to shed some light on the question of the origins of this raw material (Tables 8-10). Analysis of maximum length dimensions for each of the critical and related categories – pebbles, cores and flakes – suggests that they all came from the same population.

Length	Pebbles		Split Pebbles		Tested Pebbles	
<=15mm	25	*6.6%*	1	*1.3%*	0	*0%*
16-20mm	49	*13.0%*	2	*2.5%*	0	*0%*
21-25mm	78	*20.6%*	14	*17.7%*	0	*0%*
26-30mm	70	*18.5%*	25	*31.6%*	2	*14.3%*
31-35mm	63	*16.7%*	11	*13.9%*	4	*28.6%*
36-40mm	36	*9.5%*	11	*13.9%*	2	*14.3%*
41-45mm	27	*7.1%*	4	*5.1%*	1	*7.14%*
46-50mm	12	*3.2%*	4	*5.1%*	3	*21.4%*
51-55mm	8	*2.1%*	1	*1.3%*	0	*0%*
56-60mm	5	*1.3%*	3	*3.8%*	2	*14.3%*
61-70mm	3	*0.8%*	2	*2.5%*	0	*0%*
>71mm	1	*0.3%*	0	*0%*	0	*0%*
missing	1	*0.3%*	1	*1.3%*	0	*0%*
Totals	378	*100.0%*	79	*100.0%*	14	*100.0%*

Table 8: Length classification of pebbles

Length	*Bipolar Cores*		Single Platform Cores		Dual Platform Cores		Multi Platform Cores	
<=15mm	0	*0%*	1	*1.9%*	0	*0%*	0	*0%*
16-20mm	5	*8.1%*	1	*1.9%*	0	*0%*	1	*0.7%*
21-25mm	18	*29.0%*	4	*7.7%*	0	*0%*	7	*4.7%*
26-30mm	19	*30.6%*	10	*19.2%*	1	*6.7%*	24	*16.1%*
31-35mm	11	*17.7%*	7	*13.5%*	5	*33.3%*	30	*20.1%*
36-40mm	3	*4.8%*	14	*26.9%*	3	*20.0%*	31	*20.8%*
41-45mm	3	*4.8%*	8	*15.4%*	1	*6.7%*	31	*20.8%*
46-50mm	1	*1.6%*	2	*3.8%*	3	*20.0%*	13	*8.7%*
51-55mm	1	*1.6%*	2	*3.8%*	0	*0%*	6	*4.0%*
56-60mm	1	*1.6%*	2	*3.8%*	1	*6.7%*	3	*2.0%*
61-70mm	0	*0%*	0	*0%*	1	*6.7%*	3	*2.0%*
>71mm	0	*0%*	1	*1.9%*	0	*0%*	0	*0%*
Totals	62	*100.0%*	52	*100.0%*	15	*100.0%*	149	*100.0%*

Table 9: Length classification of cores

Length	Primary		Secondary		Tertiary		Totals
<=10mm	0	*0%*	2	*1%*	24	*5.3%*	26
11-15mm	5	*5%*	24	*12%*	89	*19.7%*	118
16-20mm	15	*15%*	29	*14.5%*	117	*25.8%*	161
21-25mm	18	*18%*	41	*20.5%*	87	*19.3%*	146
26-30mm	20	*20%*	50	*25%*	64	*14.2%*	134
31-35mm	20	*20%*	25	*12%*	33	*7.3%*	78
36-40mm	8	*8%*	14	*5%*	19	*4.2%*	41
41-45mm	8	*8%*	7	*3.5%*	8	*1.8%*	23
46-50mm	5	*5%*	4	*2%*	9	*2.0%*	18
51-55mm	1	*1%*	3	*1.5%*	2	*0.4%*	6
56-60mm	0	*0%*	0	*0%*	0	*0%*	0
61-70mm	0	*0%*	1	*0.5%*	0	*0%*	1
>71mm	0	*0%*	0	*0%*	0	*0%*	0
Totals	100	*100%*	200	*100%*	452	100	752

Table 10: Length classification of complete flakes

The overall analysis strongly suggests that the principal raw material procurement strategy being followed during the earlier prehistoric period was that flint pebbles were being collected outside the study area, most likely along the shingle beaches on the Irish Sea coastline, and transported to settlements within the area in an unworked state.

Discussion

These M1 excavations add considerable texture and detail to our knowledge of the prehistoric archaeology of the wider Boyne Valley and the results of these excavations are of major importance in illustrating the character of settlement and landuse associated with the monumental focus at Brú na Bóinne. They may be considered indicative of the potential pattern of intact subsoil archaeological features within the study area. It is probable that within the Brú na Bóinne area and the study area there is a similar distribution of sub-surface features to that uncovered along the line of the road. Indeed, it is likely that the intensity of the occurrence of evidence for prehistoric activity increases as one approaches the Brú na Bóinne core area. However, the picture at the moment is based on the study of a narrow corridor of land – a slice through the landscape – and while the picture that emerged from this work is hugely informative, it does not give us a complete rounded landscape view of prehistoric settlement in the Boyne Valley. The shortcomings of this kind of evidence as a basis for landscape reconstruction emerging from such linear development projects have recently been alluded to by Armit *et al*. (2003).

The analysis of flake lengths suggested that all found could have come from the raw material and cores found during the survey. The information Lehane gives about the lengths of unutilised waste flakes from the Late Neolithic/Beaker Period settlement at Newgrange suggests that 95% were less than 40mm long. Of the utilised waste flakes, 88% of blunted flakes and 94% of serrated flakes were less than 50mm long (Lehane 1983, 124). On the information available, it appears that most, if not all of the flakes in the assemblage from the Late Neolithic/Beaker settlement at Newgrange could have come from the same type of raw material collected during this fieldwalking survey. While there is evidence of raw material having been imported in the form of chalk flint, the importation of blank flakes from outside the area does not seem to have taken place to any appreciable extent.

Dillon has suggested for the assemblages from various levels at Knowth that the pebble flint component could have come form the local area (Dillon 1997, 33). Similarly, Lehane suggested that raw material for the Newgrange assemblage was procured in the local glacial tills and along the east coast beaches (1983, 121). The very small number of cores found there resulting in the highly anomalous core to flake ratio of 1:282 suggests significant off-site production of blank flakes perhaps elsewhere in the local area or along the coast (ibid, 123). Hodgers (1992, 160) also explores this point and suggests that the coastal margins of counties Louth and Meath are likely to have served as both quarry sites and initial processing areas with the transport of a mix of raw material, blanks and perhaps finished tools inland to Brú na Bóinne. Indeed, two hoards of flint flakes are known from Brú na Bóinne: one from Site 2 at Knowth (Eogan 1984, 24-6) and one from outside Newgrange (Hartnett 1954, 182), and these may represent caches of material being moved inland from such areas. Analysis of the composition of lithic assemblages from other excavated sites in Brú na Bóinne shows that artefacts associated with the selection, testing and initial preparation and production of flakes and blades are grossly underrepresented (Brady 2007a, 153-4). The assemblages from coastal surface collection surveys suggests that there was also a residential element to the activities carried out there. It seems likely from this evidence that there was a permanent year-round presence in these areas and it is likely that there was routine contact between Brú na Bóinne and the coastal zone. Coastally-sourced resources appear to have been important in the creation and maintenance of ritual and ceremonial features at monuments in the Boyne Valley although it currently appears from stable isotope analysis of human remains of the period that a full exploitation of all marine resources including food resources, may not have been a feature of subsistence strategies at the time (see Richards and Hedges 1999 and Schulting 2004).

Conclusions

The lithic distributions from the surface collection surveys are extremely useful and informative in that they provide detailed data on day-to-day settlement and landuse both within areas with clear distributions of monuments, and also in areas that at first glance may appear to be archaeologically blank. In many cases it is possible that lithic distributions are the only surviving archaeological trace of former activity in a landscape. Their importance in providing baseline archaeological data about the prehistoric settlement of a given area must not be overlooked or underestimated.

The major lesson to be drawn from the data provided by the M1 excavations is that we should not expect Brú na Bóinne to have functioned as an island of settlement. The M1 results and the results of the Red Mountain Transect survey clearly show that there were very significant concentrations of activity, especially spanning the Later Neolithic/Early Bronze Age, dispersed along the river valley. Thus, activity need not be seen as being exclusively

concentrated on the area of the monuments and the landscape should be examined at a larger, regional, scale. Brú na Bóinne was a focal point in a much wider region, with routine travel to the coast and occasionally much further afield evidenced by the importation of chalk flint, greywacke structural building stones, and exotic quartz, siltstones, granites and granodiorites. Much of this travel is likely to have been channelled through the corridor of the valley of the River Boyne. Although much of the focus of the research to date has been on the landscape between Brú na Bóinne and the Irish Sea, it should also be remembered that the region also extends far inland, at least as far as Loughcrew, and that much remains to be learned about settlement and landuse in these areas. Metrical analysis of pebbles, cores and flakes from the study area and comparison to the material collected from excavated sites and during other surface collection surveys has emphasised the likelihood that travel to coastal areas to gather lithic raw material and other resources was a routine activity.

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