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Hillforts and Power in the British Post-Roman West: A GIS Analysis of Dinas Powys

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The (re)occupation of hillforts was a distinctive feature of post-Roman Europe in the fifth to seventh centuries AD. In western and northern Britain, hillforts are interpreted as power centres associated with militarized elites, but research has paid less attention to their landscape context, hence we know little about the factors that influenced their siting and how this facilitated elite power. Geographic Information Systems (GIS) provide opportunities for landscape research, but are constrained by limitations of source data and the difficulty of defining appropriate parameters for analysis. This article presents a new methodology that combines data processing and analytical functions in GIS with techniques and principles drawn from 'traditional' landscape archaeology. A case study, focused on Dinas Powys, suggests that the strategic siting of this hillfort facilitated control over the landscape and has wider implications for our understanding of patterns of power in post-Roman Britain.
Keywords: hillforts, power, post-Roman Britain, GIS, viewsheds, least-cost paths

HILLFORTS IN THE POST-ROMAN WEST

The (re)occupation of hillforts was a distinctive feature of the post-Roman (fifth to seventh) centuries across much of Europe (e.g. Kobylinski, 1988; Francovich & Hodges, 2003: 61–74; Constant et al., 2015; Tejerizo-García & Canosa-Betés, 2018). This post-Roman 'hillfort phenomenon' was complex and multi-faceted, coinciding with other changes, including the abandonment and/or reorganisation of Roman villas, farmsteads, and urban settlements (Christie, 2004; Lewit, 2004; Sami & Speed, 2010). It can be strongly linked to the evolution of power structures and the associated socio-political, economic, military, and ideological transformations that related to the end of Roman imperial control in Europe (Wickham, 2005). In northern Spain, for example, the (re)occupation of hillforts has been associated with the transition from imperial, State-backed 'extensive' power structures to more local, elite-focused 'intensive' systems of power in the fifth and sixth centuries (Tejerizo-García &

Canosa-Betés, 2018: 21–24). In western and northern Britain, hillforts are seen as loci for the negotiation of patron-client relationships through feasting, manufacture of prestige items, collection of render, and gift-exchange (Seaman, 2013; Noble, 2016). Excavated evidence comprising fine metalworking residues and imported pottery and glass, in congruence with occasional documentary references, attest to high-status occupation and in some instances ceremonial activity associated with sacral kingship (Lane & Campbell, 2000; Noble et al., 2019). These sites are interpreted as the seats of potentates (land-holding rulers) rather than community settlements and can be seen as theatres of power akin to the great hall complexes of Anglo-Saxon England and Scandinavia (Blair, 2018: 114–25; Thomas, 2018: 263).

In western and northern Britain, 'hillfort' is used as an umbrella term for a range of enclosed sites including promontory forts, duns, and ringworks (Alcock, 2003: 179–99; Seaman, 2016). They are often reoccupied Iron Age sites, but *de novo* constructions are also well evidenced. Nevertheless, site-based activities have produced limited diagnostic material and only ephemeral remnant settlement features. Alongside scarce historical documentation, this greatly constrains our understanding of the post-Roman period throughout western and northern Britain. Furthermore, such paucity inhibits the application of traditional forms of landscape archaeology, such as fieldwalking and aerial survey. Thus, most research on post-Roman hillforts has been site-focused, and there has been little consideration of their wider context. This contrasts significantly with Iron Age studies where landscape research, such as the *Danebury Environs Project*, have significantly enhanced understanding of hillforts in some regions (e.g. Cunliffe, 2000). Attempts at reconstructing the landscape context of post-Roman hillforts have so far often resorted to the problematic use of settlement evidence relating to prehistoric, Roman, and later medieval periods (e.g. Lane & Campbell, 2000: 255–58; but see Davey, 2005 for an examination of the landscape context of Cadbury Castle in Somerset in the late-Roman and early medieval periods). Together, these issues mean that our understanding of the significance of post-Roman hillforts and the factors that influenced their siting is limited.

Several recent studies have, however, demonstrated that GIS-enabled analysis can offer new ways of studying the landscape. For example, in their innovative study of the Pillar of Elise, an early medieval carved cross in Powys (Wales), Murrieta-Flores and Williams (2017) used least-cost paths (LCPs) and viewsheds to argue that the location and topographic context of the monument enhanced its significance as a place of royal inauguration and a locus of power, faith, and commemoration. Viewshed analysis by Tejerizo-García and Canosa-Betés (2018) provided perspectives on the landscape context of northern Iberian

hillforts that enabled the authors to propose new models of early medieval hillfort occupation. Finally, Semple and colleagues (2017) have used LCPs to explore the 'locational strategies' of the important Anglo-Saxon great hall complexes at Yeavering and Milfield (Northumbria) and contextualize their relationship to long-term routes of movement and communication.

The analytical power afforded by GIS promotes development beyond the traditional cartographic 'bird's eye view' way of interpreting the landscape, to what Tejerizo-García and Canosa-Betés (2018: 3) dub a 'God's eye view', espousing the accessibility to and manipulation of multiple datasets. GIS applications have the potential to significantly enhance understanding of the landscape context, especially when movement and visibility analyses are integrated (Lock et al., 2014) and used in combination with data derived from other forms of landscape research (in our case paleoenvironmental and place-name research projects: Seaman, 2017; Davies et al., forthcoming b).

The theoretical underpinning of this approach is discussed below, but from the outset we must highlight the two methodological challenges that lie at the heart of this study. First, LCPs and viewsheds largely rely on high-resolution digital terrain models (DTMs) and their derivatives. Datasets created from direct measurement of the modern landscape are readily available but, since lowland districts where most historic settlements were located have often been substantially altered by housing and infrastructure such as roads and railways, the applicability of these datasets to the post-Roman period is questionable. The impact of significant landscape change is seldom acknowledged in archaeological research, which tends to assume that, whilst the precise setting of sites and monuments is irrecoverable, the 'bones of the land' (the mountains, hills, rocks and valleys, escarpments and ridges) remain the same over the *longue durée* (e.g. Tilley, 1994: 73–74). We know this was not always the case and, if landscape changes are not adequately addressed, they could undermine the validity of GIS-derived analysis or constrain the application of these approaches to less developed, predominately upland, landscapes. Second, GIS-enabled analysis requires defining key environmental and cultural parameters, such as historic land-use patterns, palaeovegetation, or the location of river crossings and focal points within the landscape (Herzog, 2014). Without proper definition, we encounter further risks of bias and misinterpretation. Thus, the present study had two primary aims: first, to establish a methodology for the creation of datasets that are appropriate for GIS analysis of pre-modern lowland landscapes. Second, to use these data in a pilot study of the landscape context of Dinas Powys, an important and comparatively well understood post-Roman hillfort in western Britain.

DINAS POWYS: A POST-ROMAN POWER CENTRE IN WALES

Dinas Powys (ST148722, Glamorgan, South Wales) (Figure 1A) is the most extensively excavated post-Roman hillfort in Wales; it is also the richest, in terms of the quality and quantity of its material evidence, and an important type-site of the post-Roman Celtic West (Alcock, 1963; Campbell, 1991; Seaman, 2013). This site was chosen for the present study not only because of its archaeological importance, but also because it lies within a lowland landscape that has seen extensive post-medieval development, including construction of major roads and railway lines.

Dinas Powys is a small promontory fort enclosed by four sets of banks and ditches on its southern side. It occupies the now very wooded tip of a whaleback ridge, with the ground dropping-off steeply to the north. Three of the four banks (1, 3, and 4) are massive (at least 6 m wide and 4 m high from bank top to ditch base) and cover an area (0.25 ha) far larger than that enclosed by the innermost bank (0.1ha) (Figure 1B). Leslie Alcock, who excavated the site in the 1950s, initially dated banks 1, 3, and 4 to the eleventh century AD. However, following comprehensive re-analysis of the finds and stratigraphy in combination with targeted radiocarbon dating, all the banks can now be confidently assigned to the fifth and seventh centuries AD (Alcock, 1963; Campbell, 1991; Seaman, 2013). Alcock's excavations revealed extensive evidence for fifth to seventh century occupation, including at least five hearths, drainage gullies associated with two buildings, and rich animal bone assemblages in midden contexts. The artefact assemblage is the largest of its type in Wales and includes fragments of over 70 rare pottery and glass vessels imported from production centres in the eastern Mediterranean and southern France. There were also 20 fragments of composite bone combs, and a range of iron objects, such as spear ferrules, knives, and tools. Metalworking debris including crucible fragments, a brooch die, and metal slag attest to on-site manufacture of fine jewellery in cooper-alloy, silver, and gold (Alcock, 1963). The site is interpreted as the residence of a local ruler, a status that is illustrated by fragments of a rare blue glass squat beaker of a type also known from 'princely' Anglo-Saxon burials such as Sutton Hoo Mound 2 and Prittlewell (Campbell, 1989).

Dinas Powys has been argued to lie within a small 'petty kingdom' focused on the eastern Vale of Glamorgan and Cardiff basin (Campbell, 1991: 225; Seaman, 2013: 13, fig. 5). This territory is likely to have formed after the collapse of the Romano-British administration in the fifth century and was subsumed into the larger kingdom of Glywysing around the time that Dinas Powys was abandoned in the later seventh century (Davies, 1978: 97; 1990: 37). While we can reconstruct some of the site's political background, less is

known about its landscape context, the significance of its location, and its role within systems of governance and territorial control.

Dinas Powys is the only well-excavated post-Roman settlement in the region, but it shares many characteristics with an unexcavated bivallate promontory fort near Llanvithyn (see Figure 1C), which will be considered for further investigation.

GIS AND LANDSCAPE ANALYSIS: METHODS AND THEORIES

The ability of GIS to model and integrate complex datasets means we can use it as a 'bridging concept' for interpretive frameworks that seek to understand the construction and articulation of social space (Hu, 2011; Llobera, 2012). In this study, 3D visualisation, least-cost paths (LCPs), and viewshed analysis are employed to examine how the landscape of Dinas Powys was reflected in the exercise of elite power. The analyses undertaken are comparatively simple 'off the shelf' forms of cartesian analysis that have long been applied in landscape archaeology (Conolly & Lake, 2006), but we have adopted an integrated approach that moves beyond 'typecast' analysis focused on identifying intervisibility between sites (Lock et al., 2014; Gillings, 2017). There is a wide literature on the application of GIS in landscape archaeology (for a recent overview see Howey and Brouwer Burg, 2017), and critiques of the tools employed in this study focus on the reductive nature of movement modelling and the primacy given to visual perception over other forms of sensory engagement (Frieman and Gillings, 2007; Supernant, 2017). It is necessary, therefore, that we consider how our approach differs and why it is appropriate for exploring socio-political aspects of hillfort siting and development.

As is well established, some hillforts were sited tactically in relation to topography, and monumentality and visual prominence could be exploited to exert control over a landscape and/or define hillforts as 'special' places (Bowden & McOmish, 1989; Hamilton & Manley, 2001: 31; Harding, 2012: 15; O'Driscoll, 2017; Driver, 2018). Conspicuous sites could reinforce ideological statements, as projected for example by hillfort 'defences' (Seaman, 2013: 10–12; 2016: 41), and act as permanent visual reminders of elite power (Jones et al., 2004: 117–18). Such aspects of a hillfort's siting are difficult to assess on the ground, especially where recent woodland regeneration and limited public access constrain fieldwork. We can, however, use 3D visualisation and visibility methods to investigate relevant topographic positioning, theoretical zones of visibility, and visual prominence (Lock et al., 2014; O'Driscoll, 2017). Spatial analysis of hillfort locations can also illuminate adjacency and oversight of routeways and strategic nodes such as river crossings through the

modelling of patterns of movement by LCPs. This makes it possible to conduct a robust debate about how social control was implemented through the monitoring of strategic nodes within the landscape and maximizing elite movement between centres. Patterns of visibility, as reconstructed through cumulative and total viewsheds, can be used together with modelled patterns of movement from derived LCPs to examine how social control was generated through surveillance and visual domination. Foucault (1977: 195–230), for instance, argued that power over individuals could be achieved through the creation of panoptic surveillance mechanisms. Such ideas of surveillance existed in the nineteenth century, as extolled in Jeremy Bentham's panopticon, a prison designed to 'induce in the inmate a state of conscious and permanent visibility that assures the automatic functioning of power" (Foucault, 1977: 201; for archaeological applications of these ideas, see Carlson & Jordan, 2014; Pierce & Matisziw, 2018). We do not contend that landscapes could be organized in such a way that they operated precisely like a panopticon but assert that visual domination can operate as a method of social control (Giddens, 1985: 14–15). The importance attributed to the 'elite gaze' in the early medieval world is exemplified through the literary motif of the *sentinel warrior*: a leader buried on the boundary of his kingdom overlooking enemy territory to protect his people against that enemy (O'Brien, 2008). On a more practical level we see it manifest in the built environment, Ray and Bapty (2016), for example, argue that the design of Offa's Dyke facilitated surveillance of strategic nodes on the frontier between Merica and Powys, inferring that the earthwork operated as a tool of Mercian political domination.

Since the significant research potential afforded by GIS-enabled analysis is tempered by the difficulty of defining meaningful parameters and appropriate datasets from which to work, the first step in this project was the creation of topographic datasets that are broadly applicable to the post-Roman period. Our methodology for achieving this was rooted in 'retrogressive landscape analysis'. This is a key principle of landscape archaeology that involves applying the rules of horizontal and vertical stratigraphy to identify and remove successive layers of landscape alteration and, thus, achieve an understanding of a historic landscape (e.g. Williamson, 1987; Rippon, 2004).

CREATING A DIGITAL TERRAIN MODEL

Our area of interest was initially defined as the entire Dinas Powys proto-kingdom, as reconstructed in Seaman (2013: fig. 5). However, it became clear that recent urban and industrial development in and around the city of Cardiff was too extensive to warrant inclusion, and so the boundary of the study was shifted west, from the River Rhymney to the

River Taff (Figure 2). The basis for the Digital Terrain Model (DTM; all analyses were undertaken in Ersi ArcGIS 10.5) used in this project was the 2m-resolution LiDAR data freely available from Natural Resources Wales (http://lle.gov.wales/Catalogue/Item/LidarCompositeDataset/?lang=en). This provided coverage of most of the study area. Several gaps in the data were filled using the Ordnance Survey 5m-resolution terrain data provided by Edina Digimap (https://digimap.edina.ac.uk/). These datasets had previously been processed to remove most of the surface features such as buildings and trees, thus introducing a level of abstraction. In addition, the cell resolution within the 5m data was re-gridded (with no value change) to match that of the 2 m LiDAR. This process will have introduced an additional level of abstraction, but the resulting composite DTM provides a representative picture of the modern topography and is of sufficient resolution for the generation of a cost-surface analysis (Verhagen et al., 2019).

This DTM was processed to remove above-ground structures but was still heavily influenced by extensive post-medieval landscape alterations associated with the construction of railway lines, major roads, and quarries. These features, largely represented by substantial linear cuttings, have dramatically altered patterns of visibility and the natural 'cost' of moving across the terrain and, hence, also had to be removed for our analysis to be meaningful. The next step was, therefore, to regress the DTM to a pre-modern state, achieved through retrogressive analysis using contemporary and historic Ordnance Survey maps. Polygon shapefiles were created around all post-medieval features that cut into the natural topography. Once all features judged to have significantly altered the topography had been identified, they were merged into a single shapefile that was used as a clip template for the raster DTM. The resulting holes were then 'patched over' by using Triangulated Irregular Network (TIN) models, to draw the true surface values across the gaps and form a cohesive surface. This created a DTM devoid of intrusive post-medieval earthworks, although the interpolation process will have introduced a further degree of abstraction. It was not possible to reintroduce lost topographical features, but analysis of historic mapping suggests that no major features have been removed. A series of test LCPs were run across this surface (see below). These showed that the patched features were not unduly influencing the route of the least-cost paths. This contrasted with LCPs derived from the unaltered DTM, which tended to run along roads and rivers or follow unreasonable diversions along contours rather than enter modern cuttings. At this stage, the coastline and river courses were adjusted to their earliest recorded positions and the DTM clipped accordingly. This process provided us with a DTM that could be used as the basis for 3D visualisation and visibility analysis. However, further

steps were required before we could create a cost-surface for use in a meaningful LCP analysis.

DERIVING AN ACCUMULATED COST-SURFACE

The relationship between power centres and contemporary routeways through the landscape is potentially informative. However, the origins of the earliest recorded network of footpaths surrounding Dinas Powys is poorly understood and appears to have developed over an extended period, whilst the modern road network is largely a creation of the post-medieval period. Our methodology, therefore, focused on creating a network of LCPs that would accurately reflect natural patterns of movement through the landscape (White, 2015). The LCPs were defined in relation to the speed of travel between defined nodes (considered below) across an accumulated cost-surface. The cost-surface was created by combining three environmental factors thought to influence the speed of pedestrian travel: slope, ruggedness, and land-cover (Herzog, 2014). Naismith's rule (a calculation of the time taken for a hill walk) was adopted for determining the speed of travel across different slope increments (Carver & Müller, 2014: 23). Relative Topographic Position (RTP) was used as the ruggedness metric, acting as a proxy for the physical challenge posed when traversing an area (Riley et al., 1999), and was considered suitable because the terrain of the study area does not have extensive elevation or slope diversity. Land-use was defined in relation to four broad categories: 'open ground' (for which there is no impediment to travel), followed by 'woodland', 'moorland', and 'marsh/mudflat' representing an increasing scale of impairment. These land-use units were identified through a Historic Landscape Characterisation exercise that included a comprehensive analysis of fieldnames and land-use data recorded in nineteenth-century tithe surveys, in addition to a limited programme of geoarchaeological survey (Rippon, 2004; Seaman, 2017; Davies et al., forthcoming a). Once the metrics for slope, ruggedness, and land-use had been defined (see Table 1), they were united using a mean operator and represented in the resulting accumulated cost-surface as seconds per (2 m) cell (s/c) × 1000.

The final step was to account for the impact of the rivers and streams that cross the study area. Except for historic crossing points, identified through the analysis of place-names (for example *ffordd* 'road, ford' or *pont* 'bridge') and historic maps such as Yates's 1799 map of Glamorgan (Walters & James, 1984), rivers were considered a total barrier to lateral movement unless they were deemed readily passable on foot. These crossings were defined as the point where footpaths marked on the first-edition Ordnance Survey map did not deviate

from their course to cross rivers or streams. This is obviously an approximation, but it was considered more appropriate than simply removing rivers from the cost-surface. Movement along rivers was not considered, since none within the study area is likely to have been navigable during this period (Oksanen, 2019).

DEFINING NODES FOR LCPS

Once the cost-surface had been created, the next stage was to identify start and end points for a network of LCPs that would provide a fair approximation of long-term movement patterns within and across the study area. This was achieved by using the principal points of entry/exit around the edge of the study area (Figure 3). In the south, nodes were determined at the historic landing places on the Bristol Channel coast. The location of landing places in this region was restricted by tides and the nature of the coastline, and nineteenth-century evidence suggests that different locations were chosen to suit certain conditions (Bedford, 1872), for example, it is likely that pilots used a network of landing places in the region as opposed to a single point of entry. We can be confident that these would have been transhipment points for a range of commodities during the post-Roman period, including prestigious imported pottery and glass (Campbell, 2007). Landing places were identified by examining entries in sixteenth-century port books, nineteenth-century navigational texts, and published archaeological surveys (Bedford, 1872; Lewis, 1927; Dunning & Howell, 2005). In the east and west of the study area, entry/exit points were defined as historic crossing points on the rivers Taff and Thaw. Entry/exit points in the north were defined as the early ridgeway tracks leading north into the Glamorgan uplands, some of which are associated with early medieval stone monuments and linear earthworks. These are thought to have been transhumance tracks associated with the movement of people and livestock between the northern uplands and the fertile lowlands of the Vale of Glamorgan (RCAHMW, 1976b: 2–5). It is important to emphasize that Dinas Powys was not an active node within the network, since our intention is to understand how the site was imposed upon pre-existing patterns of movement.

Once nodes were identified, *Cost Back Link* and *Cost Distance* surfaces were created, and LCPs calculated between all nodes in both directions. Supplementary paths were also created between the nodes and the Gloucester to Carmarthen Roman road that bisects the study area from east to west, since this is likely to have been a major routeway in post-Roman centuries (Burnham & Davies, 2010: 93–96). The resulting network was then edited to remove redundant or nonsensical paths (Figure 3). We do not claim that the final network of linear polylines represents a map of post-Roman routeways. We must expect that there was a

degree of 'fuzziness', that rough and un-made tracks would have become 'braided' over time and that some of the routes may not have been used at all. The network nevertheless provides a reasonable approximation of natural movement corridors through this landscape. Indeed, there are some correlations between the network and footpaths recorded in early maps. Some validation of the network is provided by considering it in light of the distribution of later medieval castles and moated sites, many of which are thought to have been located next to important routeways (Creighton, 2002: 35–65; Liddiard, 2005: 24). Of the 24 castles, mottes, ringworks, and moats within the study area, 17 (71 per cent) were located within 300 m of one or more of the LCPs. This figure rises to 21 (87 per cent) with an increased threshold of 500 m.

DISCUSSION

The analysis of the least-cost paths suggests that Dinas Powys was close to the course and junction of two of the sets of natural routeways derived from the LCPs, one heading west from Cogan Pill and the other heading north from Sully. Viewsheds created from Dinas Powys suggest that at least 15 km of the relevant LCPs were observable from the site (Figure 3). Much of the field of observation lies well within the limit for visual recognition of the human form, which Ogburn calculates as being 6880 m under perfect conditions (Ogburn, 2006). These viewsheds do not account for tree cover, but an ongoing programme of pollen analysis suggests that the landscape was largely open with limited patches of woodland (Davies et al, forthcoming b). Moreover, the impact of tree cover on patterns of visual structuration is complex and trees do not necessarily entirely inhibit observation (Cummings and Whittle 2003). A cumulative viewshed (with a 2 m observer offset applied to each cell point to mimic a person attempting to maximize their visual field) calculated from points every 20 m along these natural routeways shows that Dinas Powys would have been a conspicuous landmark (Figure 4). Thus, we can reasonably infer that it would have been difficult to move from the coastal landing places at Sully and Cogan Pill into the centre of the region without being seen from Dinas Powys. Indeed, it is likely that anyone moving along these natural routeways would have been aware that they could be observed and may have behaved accordingly. The relationship elucidated in the GIS analysis would have facilitated elite control over the landscape, such as the efficient payment of render in the form of food and materials from outlying estates, several of which are documented in early medieval sources (Davies, 1978). It would also have facilitated movement of the elite household between Dinas Powys and other power centres in the region (and potentially also on the south

side of the Bristol Channel), known to have been a key facet of early medieval governance (Charles-Edwards, 1989).

The LCP starting at the landing place at Cogan Pill on the lower River Ely (Figure 3) passes immediately next to the important post-Roman cemetery and monastic site at Llandough (location on Figure 1). This monastery is attested in historical sources from the mid seventh century, and excavations outside the churchyard revealed an extensive cemetery with evidence for activity extending back to the fifth or sixth centuries (Holbrook & Thomas, 2005). The monastic buildings have not yet been discovered, but are thought to lie under the present church and churchyard, within which stands an impressive tenth- or eleventh-century cross shaft (Redknap & Lewis, 2007: 570–72). It has been argued that Dinas Powys and Llandough were mutually interdependent secular and ecclesiastical centres (Knight, 2005). Llandough is not usually seen as a coastal site in the literature, but its close association with Cogan Pill places it alongside other early monastic sites with coastal or riverine locations with easy access to the sea, including Merthyr Mawr, St Dogmaels, and Bangor. This relationship should be seen within the context of the international connections fostered by early monastic communities and the importance of monasteries as nuclei of trade, exchange, production, and pilgrimage (Brown, 2013; Carver, 2015). The sherds of fifth- or sixth-century imported amphorae and glass recovered during excavation of the cemetery are thought to have reached Llandough via Dinas Powys, considered a primary import centre; but our analysis suggests that direct contact with traders cannot be ruled out (Knight, 2005: 100). Furthermore, isotopic analysis of skeletons within the cemetery suggest that an adult male and adult female were of Mediterranean origin (Hemer et al., 2013).

The distribution of post-Roman hillforts in northern and western Britain has a strong coastal bias and sites are often located next to natural landing places or harbours (Alcock & Alcock, 1990: 120). It is often these hillforts that have the largest assemblages of imported wares and it has been argued that international trade and insular redistribution of this material was orchestrated from these sites (Campbell & Lane, 1993: 68; Campbell, 2007). Our analysis suggests that the desire to control coastal trading places was not the only factor influencing the siting of these sites. Despite being identified as a potential primary import centre, that is a place to which international trade was directed (Campbell, 2007: 123), Dinas Powys is not located directly on the coast or on the banks of a navigable river (albeit it is only 4.1 km from the sea and 2.1km from the nearest riverine landing place). The site's close association with Llandough may compensate for this to some extent. A topographic review of the DTM, on the other hand, demonstrates that Dinas Powys was located on the first readily

defensible and strategically viable position next to the coast. There are no coastal locations that are as readily defensible in terms of their topographic position and the labour required to construct defences; and, whilst there are inland locations close to Dinas Powys, which may have greater defensive attributes, these are remote from the routeways crossing the lower-lying ground. The same is true in terms of visual prominence. Views to and from Dinas Powys are now entirely obscured by woodland; but examination of a total viewshed (constructed from *c.* 228,000 cell points at 10m-resolution from a 3km radius around the site) suggests that, despite its small area, the tip of the promontory on which the fort was constructed was a distinct and visually prominent landmark. This may have been accentuated by the ramparts, revetted in light-coloured stone; which would have stood out against the wooded cliffs to the west (Figure 5). Again, there are more visually prominent locations within the vicinity, but none as easily defensible or with as favourable strategic advantages in terms of natural routeways. Together, these elements suggest that the siting of Dinas Powys represented a considered balance of factors between the need for defence, visual prominence, and proximity to coastal landing places and overland routeways. We assert, therefore, that Dinas Powys was a 'gatekeeper' settlement, a defended and demarcated locus of elite activity associated with overseeing and monitoring movement from landing places on the coast.

As Figure 3 shows, Dinas Powys could, however, only have controlled routes leading from two of the five coastal landing places that gave access to the region. Unless the site was associated with a far smaller territory than previously suggested, we may conclude that it must have formed part of a wider network of hitherto undiscovered elite centres within the petty kingdom (*contra* Seaman, 2013: 13, but see Longley, 1997 for a consideration of a network of post-Roman power centres in north Wales). Not only would this network of sites have facilitated control over the landscape through strategic siting, but it also provided a circuit of well-connected settlements around which the elite household could move. This allowed rulers to maintain personal relations with their clients and rivals and also meant that they could consume render dues close to the point of production (Charles-Edwards, 1989: 28–29).

Before we consider the possible location of another site within the network, we should note that, although Dinas Powys appears to have been sited with local factors in mind, lines–of-sight derived from the 5 m Ordnance Survey DTM suggest that the promontory fort was intervisible with comparable sites in the wider region, including the hillforts at Cadbury Congressbury, Brent Knoll, and Cannington in Somerset (Burrow, 1981). We do not know if this would have been recognized or meaningful at the time, but the existence of a trans-

estuarine polity encompassing parts of Glamorgan and Somerset is plausible and it is possible that communication was facilitated through a system of beacons. In this respect, it may be significant that there is a distinct cluster in the distribution of imported pottery and glass centred on the eastern Vale of Glamorgan and north-eastern Somerset (Campbell, 2007: fig. 2).

LLANVITHYN: A POST-ROMAN PROMONTORY FORT?

We believe the siting of Dinas Powys, which is currently the only secular settlement within the petty kingdom with firm excavated evidence for post-Roman occupation (but see Davis & Sharples, 2016: 48 and below for possible post-Roman activity at Caerau), makes most sense if it formed part of a wider network of elite residences. There is, however, a strong case for suggesting that an unexcavated bivallate promontory fort near Llanvithyn (ST054718) may have performed a role similar to that of Dinas Powys. Llanvithyn occupies the eastern tip of a spur protruding into the valley of the Nant Llancarfan (Figure 1A). Its ramparts are much denuded by ploughing, but appear to have enclosed an area of around 0.1–0.2ha (Figure 1C). The site has not been excavated, but was classified as a 'small fort with close-set multiple defences' by the Royal Commission (RCAHMW, 1976a: 50). Dinas Powys was included in this group of sites but, despite their similarity, Llanvithyn has been ascribed an Iron Age date (RCAHMW, 1976a: 14; Davis, 2017). Nevertheless, Dark (1993: 20–21) has made the case that these small, inland promontory forts were a post-Roman type-site, and the parallels with Dinas Powys run deeper than morphology. First, Llanvithyn is close to Llancarfan (1.6 km to the south), which, like Llandough, is known to be an important monastic centre from at least the seventh century and possesses a fragment of early medieval stone sculpture (Davies, 1978; Redknap & Lewis, 2007: 565–67). Second, Llanvithyn lies immediately next to the junction of natural routeways leading to/from coastal landing places at Barry and Aberthaw, and historic river crossings near Cowbridge and Llan-fair. Indeed, viewshed analysis suggests that at least 10 km of routeways were easily observable from the site (Figures 3). Third, Llanvithyn also seems to reflect the same compromise between defence, visual prominence, and proximity to routeways that we have observed at Dinas Powys (Figures 3 and 4). Until the site is excavated, we cannot be certain of its date, and the setting could apply just as much to the Iron Age as to the post-Roman period. The similarities with Dinas Powys are, nevertheless, striking and we may hypothesize that the sites were contemporary and operated within the same network of elite sites.

The Iron Age hillfort at Caerau (ST134750) (Figure 3) is another site worthy of consideration. This large (5ha) site is also located next to the confluence of natural routeways, has commanding views across a large area to the east and north, and would have dominated routeways leading from historic crossing points on the rivers Taff and Ely. Interestingly, the site has more limited views to the south, where Dinas Powys is located, and it would not have been able to oversee the natural routes leading north from the coast. Thus, in terms of visual surveillance, Dinas Powys and Caerau are complementary. The directors of an ongoing excavation campaign at Caerau have suggested there may be evidence for a post-Roman phase of fortification there (Davis & Sharples, 2016: 48). This could date to the fifth to seventh centuries, but no post-Roman material has been recovered so far. A later phase of refortification associated with a Norman ringwork on the eastern promontory of the hill is perhaps more likely. The area enclosed by the Iron Age ramparts would have been difficult to defend with a small warband and would place Caerau amongst the largest post-Roman hillforts in Britain; occupation centred on the site of the later ringwork is nevertheless plausible and has previously been suggested (Dark, 1993: 132).

CONCLUSIONS

Theoretically informed GIS analysis has much to contribute to the study of post-Roman hillforts in Europe, especially when combined with principles drawn from 'traditional' landscape archaeology. The methodology developed in this study allowed us to reconstruct the topographic context of a lowland hillfort and construct LCPs and viewsheds that are free of the effects of modern landscape changes. This approach has significantly enhanced our understanding of the landscape context and function of Dinas Powys. This site has been described as a 'squalid and inconvenient eyrie' and 'nest of robbers' (Gresham, 1965: 127–28), but our analysis suggests it was a locus of elite activity, strategically positioned to serve as a 'gatekeeper' settlement controlling movement along natural routeways leading from landing places on the coast.

We also argue that Dinas Powys formed part of a network of sites and that Llanvithyn may have had a comparable function. Thus, we may propose that hillforts were an apparatus of governance in the nascent kingdoms of fifth- to seventh-century western and northern Britain. These hypotheses have wider implications for our understanding of patterns of power during this period. The post-Roman social hierarchy was structured around concepts of kinship, with political power deriving from personal relationships between rulers and clients rather than bureaucratic structures operating through territorialized administrative systems

(see Smith, 2005; Wickham, 2005). In Wales, the landed warrior aristocracy exercized considerable control over its immediate dependents; but this provided a limited powerbase, and maintenance of a wider network of clients depended on more transient strategies (Davies, 1990: 21–30; Jones, 1999). Such strategies included gift-exchange and feasting for forging, developing and preserving relationships between rulers and clients, with the maintenance of power negotiated through marriage alliances, violence, and intimidation (Davies, 1990: 17–18; Charles-Edwards, 2013: 298). Our study helps contextualize the role of hillforts as theatres of power, showing how the manipulation of space facilitated surveillance and control of movement through the landscape. Moreover, the monumentality and permanence of Dinas Powys, its visual prominence, and strategic positioning would have reinforced the political ideologies it represented and potentially engendered self-regulation through the panoptic effect of intervisibility. What we see is power being exercised in ways that transcended short-term personal interactions. We suggest, therefore, that Dinas Powys and other sites within the petty kingdom formed part of what political geographers describe as a 'landscape of power' (Jones et al., 2004: 116). This was a landscape that operated as a political device, serving to enhance and cement power, independent of the persons who exercised it. Here, we have focused on a single site within one small polity, but the methodology we have developed has wider applications and could be expanded to other datasets, which we hope will be applied on a larger scale in other regions.

ACKNOWLEDGEMENTS

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BIOGRAPHICAL NOTES

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Les sites de hauteur fortifiés et le pouvoir à l'époque post-romaine dans l'ouest de la Grande-Bretagne : analyse SIG de Dinas Powys

L'occupation (ou réoccupation) de sites de hauteur fortifiés est un trait caractéristique de l'Europe post-romaine, entre le Ve et le VIIe siècle apr. J.-C. Dans l'ouest et le nord de la Grande-Bretagne, on interprète les sites de hauteur fortifiés comme représentant des centres de pouvoir associés à des élites militarisées, mais le paysage dans lequel ils s'inscrivent est moins bien connu. Nous sommes donc mal informés sur les facteurs qui ont influencé leur implantation et comment leur position topographique a facilité l'exercice du pouvoir des élites. Les systèmes d'information géographique (SIG) nous permettent d'étudier le paysage mais sont limités par les données de base et par les difficultés de définir des paramètres d'analyse adéquats. Les auteurs de cet article présentent une nouvelle approche méthodologique qui combine le traitement des données et les fonctions analytiques des SIG avec les techniques et principes de l'analyse « traditionnelle » du paysage en archéologie. Un cas d'étude, Dinas Powys au Pays de Galles, démontre que la position de ce site de hauteur fortifié lui permettait de contrôler le paysage environnant et ceci a des répercutions plus profondes sur notre aptitude à déchiffrer l'organisation du pouvoir en Grande-Bretagne à l'époque post-romaine.
Translation by Madeleine Hummler

Mots-clés : sites de hauteur fortifiés, pouvoir, Grande-Bretagne post-romaine, SIG, cônes visuels, analyse distance-coût

Befestigte Höhensiedlungen und Macht in nachrömischer Zeit im Westen Großbritanniens: eine GIS-Analyse von Dinas Powys

Die (Wieder-) Besiedlung von befestigten Höhensiedlungen war ein Kennzeichen der nachrömischen Zeit in Europa, im 5. bis 7. Jahrhundert n. Chr. Im britischen Westen und Norden werden die befestigten Höhensiedlungen als Machtzentren einer militarisierten Elite gedeutet, aber der landschaftliche Rahmen dieser Höhensiedlungen ist weniger gut erforscht. Deswegen sind die Umstände, welche die Standortwahl beeinflusst haben und die Machtausübung der Elite gefördert haben, nur wenig bekannt. Die Methoden der GIS-Analyse ermöglichen es, die Landschaft zu untersuchen, aber die Analyse ist durch die Beschränkungen der Datenquellen und Schwierigkeiten in der Bestimmung von geeigneten Parametern behindert. In diesem Artikel wird eine neue methodologische Vorgehensweise vorgestellt: Diese kombiniert die Datenverarbeitungsleistungen und analytischen Funktionen des GIS mit den Methoden und Grundsätzen der „traditionellen" Landschaftsarchäologie. Eine Fallstudie, Dinas Powys in Wales, zeigt, dass die strategische Lage der befestigten Höhensiedlung die Überwachung der umgebenden Landschaft erleichterte. Dies hat weitreichende Folgen für unser Verständnis der Ausübung der Macht in nachrömischer Zeit in Großbritannien. Translation by Madeleine Hummler

Stichworte: befestigte Höhensiedlungen, Macht, nachrömische Zeit in Großbritannien, GIS, Sichtbereiche, Minimalkostenpfade

Figures and table

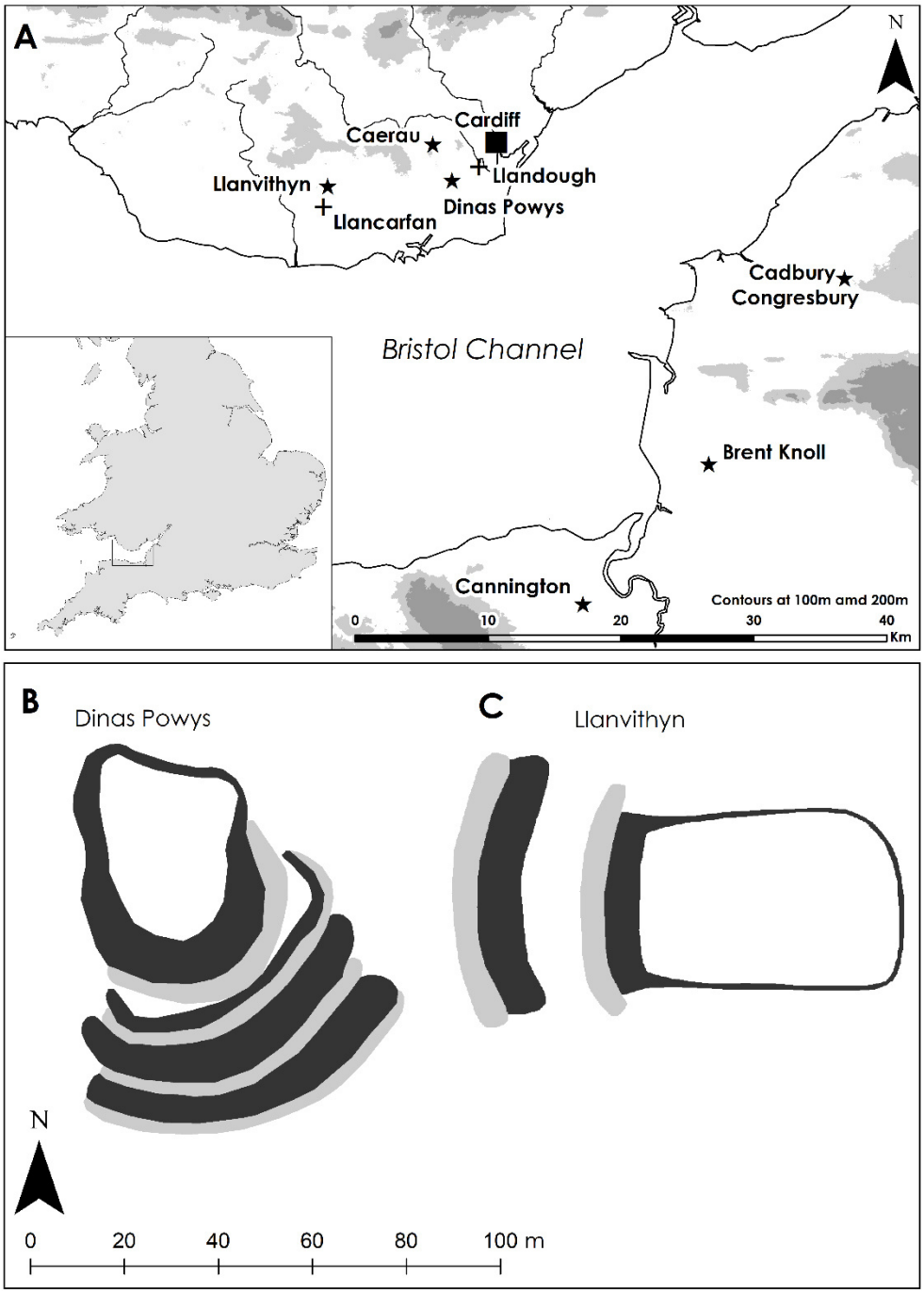

Figure 1. *Location map and site plans. B: Dinas Powys: after Alcock, 1963, based on survey by RCAHMW, with additions. C: Llanvithyn. Banks in dark grey, ditches in light grey.*

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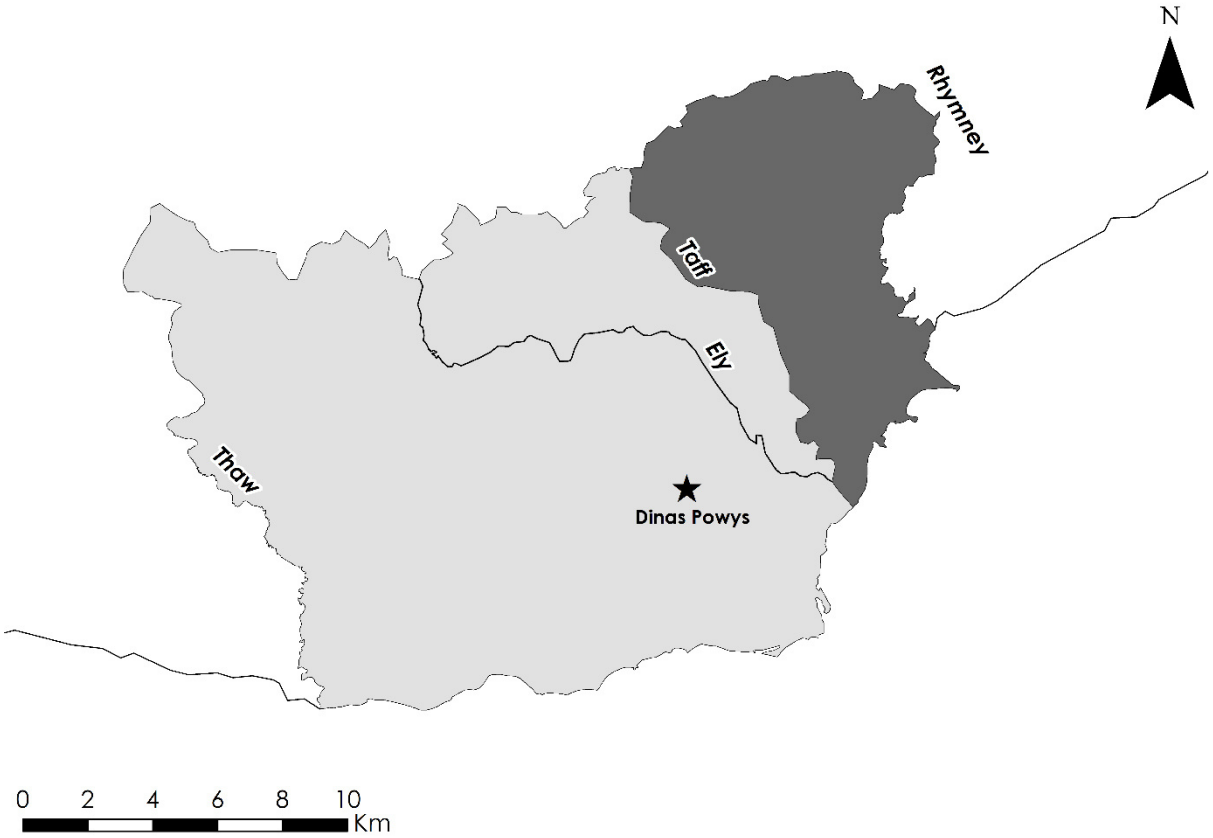

Figure 2. *The Dinas Powys proto-kingdom as defined in Seaman (2013). The area between the Rhymney and Taff, which includes Cardiff and its suburbs, was excluded from the study.*

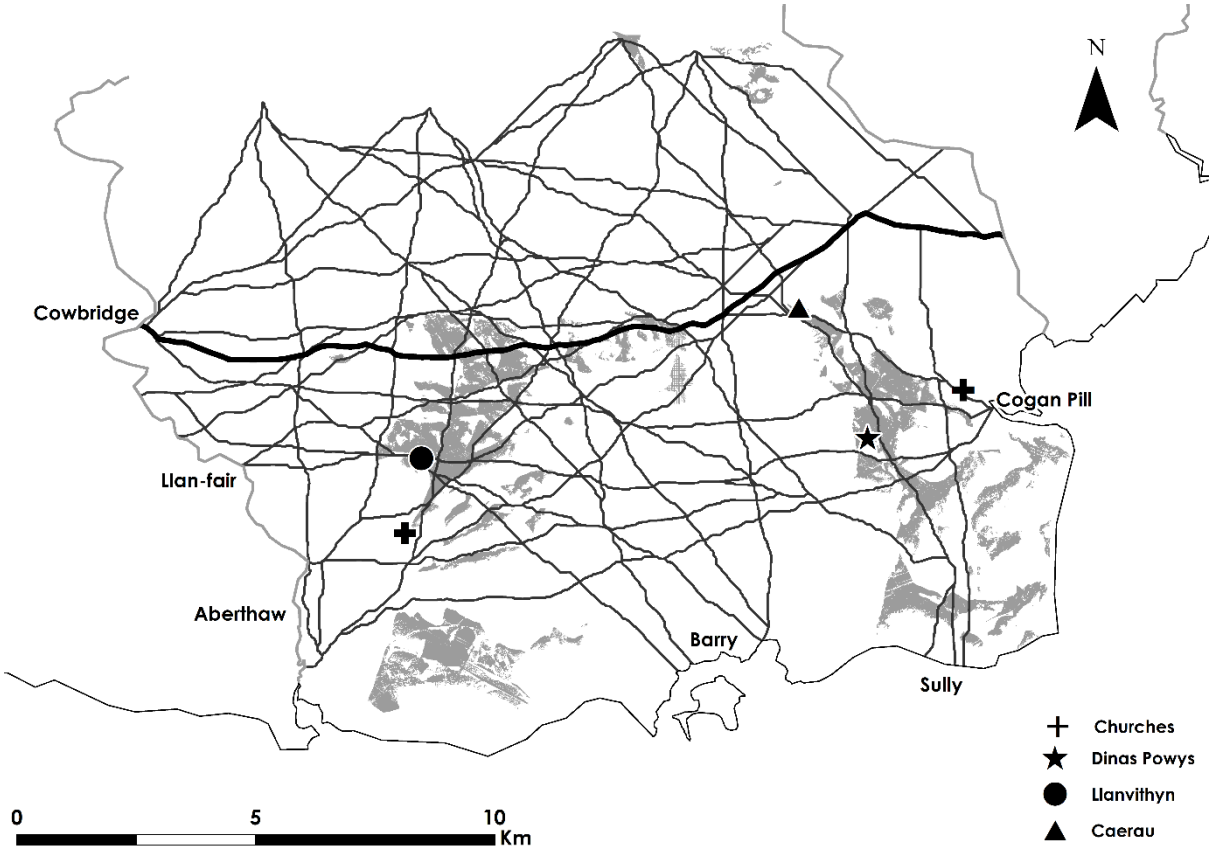

Figure 3. *The network of LCPs with viewsheds from Dinas Powys and Llanvithyn (in grey). Entry/exit nodes referred to in the text are labelled. The Roman road is highlighted.*

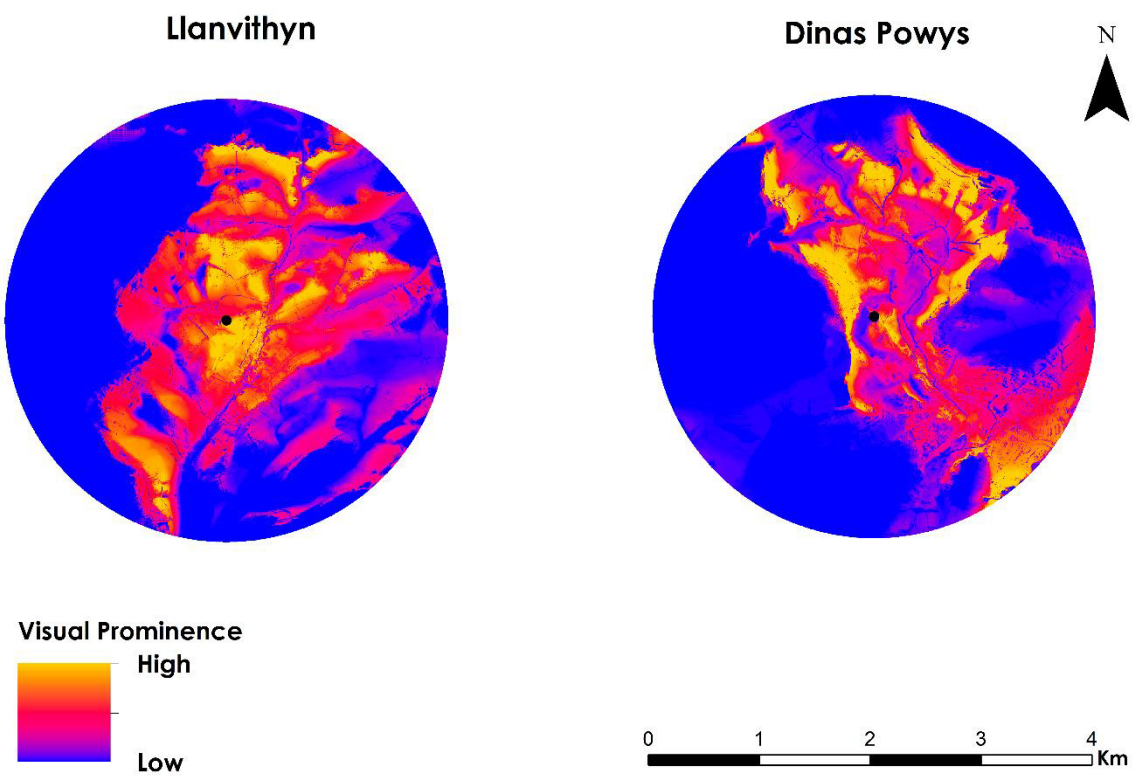

Figure 4. *Cumulative viewsheds calculated from Dinas Powys and Llanvithyn, showing that it was possible to observe movement along routeways passing through their environs from both sites.*

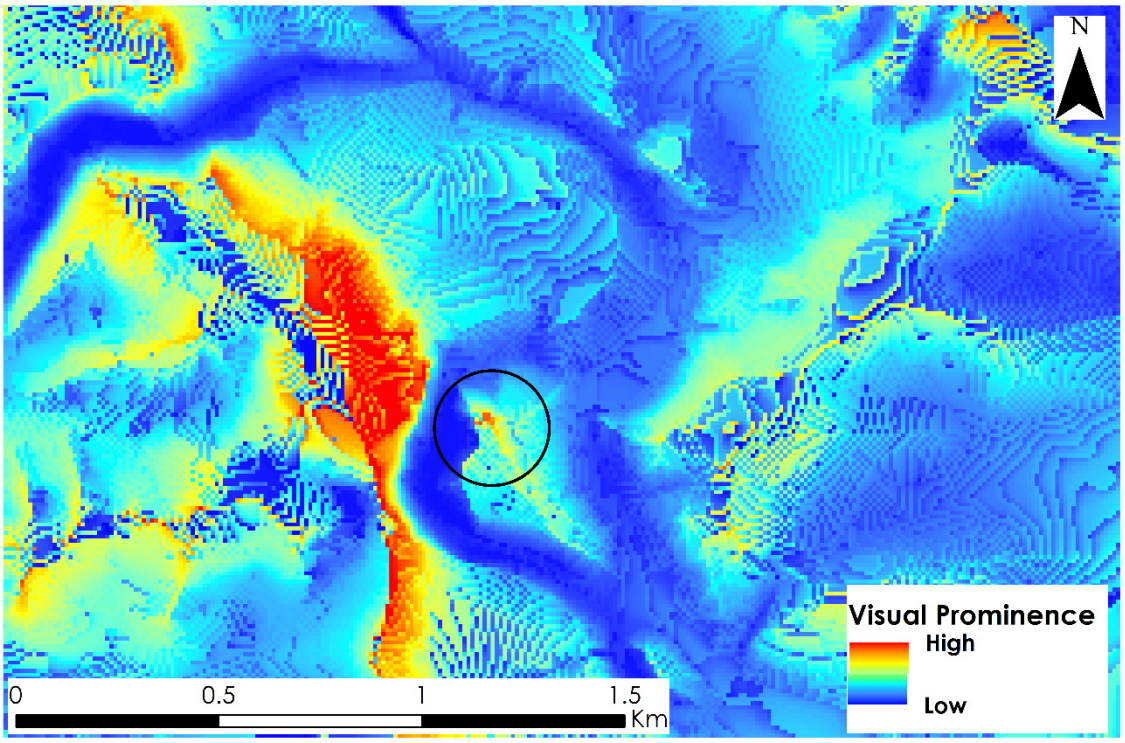

Figure 5. *Total viewshed derived from a 10m-resolution DTM. The cliffs to the west of Dinas Powys are visually prominent but not readily defensible and are difficult to access from natural routeways crossing lower ground. Dinas Powys is located within the centre of the black circle.*

Table 1. *Metrics used in the calculation of the accumulated cost-surface.*

Slope (°)	0–5°	5–10°	10–20°	20–30°	30–40°	40°+
Speed (kph)	5	4	2.022	1.241	0.859	0.626
Ruggedness (RTP)	0–0.55	0.55–0.65	0.65+			
Speed (kph)	5	3.5	2			
Land-use	Open ground	Woodland	Moorland	Marsh/mudflat	Sea/river	
Speed (kph)	5	4	2.5	0.5	0	