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“New Takes on Old Bricks: Using Geographical Information Systems to Investigate Archaeological Hypothesis”
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List of Abbreviations

CRM – Cultural Resource Management
CSV – Comma Separated Values
DEM – Digital Elevation Model
GIS – Geographical Information Systems
GPR – Ground Penetrating Radar
IDE – Integrated Development Environment
KS Test – Kolmogorov-Smirnov Test
LiDAR – Light Detection and Ranging
NNI – Nearest Neighbour Index
PPA – Point Pattern Analysis
Acknowledgements

I would like to acknowledge, first and foremost, my supervisor for guiding me through this process and ensuring I was on the right track. I would like to thank him for dealing with my convoluted questions, my sheer confusion, and my minor epiphanies in the middle of our meetings. I would also like to acknowledge my family and friends for their endless support, through the good times and the bad.
Introduction

Archaeology, much like any discipline that aims to reconstruct the invisible, is an innately visual discipline. In many ways similar to mathematic statistics and the everyday media alike, archaeology relies on the visual understanding of concepts and theoretical frameworks to ensure the equal understanding of the public and academic community, and to showcase the world of prehistory now lost to us. A variety of modern technological-based techniques have been adopted for use in the archaeological context; for example, Light Detection and Ranging (LIDAR) Technology and Ground Penetrating Radar (GPR) revolutionised archaeological survey by enabling the production of three-dimensional maps of the landscape (both above and below ground) in a fraction of the time that a manual survey would take. Essentially, modern-day fieldwork in archaeology is not limited to expensive and lengthy excavations and the same applies to the analysis techniques following the collection of the data of archaeological sites. Computer analysis of data is a cross-discipline field emerging in archaeology, and is one of the most useful ways of integrating and analysing the masses of data produced from a site. Due to the almost unique capability of computer software to integrate and manipulate large amounts of information, it can be used to visually reconstruct formations and distributions of any interesting category relevant to the archaeological research. It is a key tool in the compilation and understanding of mass datasets collected from archaeological excavations both current and in the past.

This paper will focus on Geographical Information Systems (GIS), a computer software tool used for the integration and visualisation of databases. GIS is used within archaeology for a variety of reasons – from the creation of maps to more complex database analysis. Throughout this paper, the author will demonstrate how the different facets of GIS can be used as an effective research tool in investigating a specific set of theoretical hypotheses in archaeology. The focus will be on the comparative distribution of Iron Age broch structures across Northern Britain, and use GIS analysis techniques to investigate two hypotheses:

Hypotheses 1: The distribution of brochs is dictated primarily by natural influences (i.e geography)
Hypotheses 2: The distribution of brochs is dictated primarily by conflict influences (i.e. the invasion of the Roman Empire, internal conflict).

Specifically, 5 specifically-chosen spatial analyses will be used throughout this paper with key focus on identifying why the brochs were distributed in different ways: 1) geographical analysis; 2) Kolmogorov-Smirnov Test; 3) Nearest Neighbour Index; 4) Ripley’s K-Function; 5) distance matrix. For the purposes of this study, Scotland will be divided into two sections which shall be henceforth referred to as ‘north’ and ‘south’, or some variation of this (Figure 1). These areas are loosely determined by geographical boundaries, and the mountainous areas of what is now the Cairngorms National Park and Loch Lomand & Trossachs National Park will be treated as a border between the two areas.

![Figure 1: Distribution of brochs across Scotland and research-based split of the territory (created by author)](image)

A combination of modern computer-based analysis and literature review will provide both an interesting investigation into what impacted the distributions of brochs across Northern Britain and a compelling argument for the use of GIS in archaeological contexts.
Chapter 1: Literature Review

Northern Britain in Larger Academic Context

The Iron Age in the British Isles dates from c. 800BC to the Roman invasion around 43 AD (Richards, 2011). The time period is defined by the gradual introduction of iron working and metallurgy into Britain, and increased sedentary communities. In prehistory, in both academia and the public view, the Iron Age is shrouded in mystery. This is due to a mix of the introduction of specific ritualised spaces and the poor preservation of materials from the period, leaving us with half of the story and allowing for a huge range of possible interpretations of life during this period. As such, there are many different ways that life has been reconstructed during the Iron Age. Earlier studies of the Iron Age in Britain focused on a framework revolving around the Roman invasion being the key catalyst in societal changes (Richards, 2011; Harding, 2004). However, more modern archaeological studies disregard this theory due to insufficient evidence and has switched towards indigenous economic or societal factors dominating changes in Iron Age Britain.

Research into Iron Age Britain, and Scotland specifically, did not truly become a priority until Gordon Childe’s 1935 publication The Prehistory of Scotland. The following generation of archaeologists, such as Stuart Piggott, began re-analysing the Scottish Iron Age under new theoretical frameworks (Harding, 2004). Diffusionism reigned as the main framework in understanding the movements of peoples and things into prehistoric British territory (Harding, 2004). This was a theory backed by Stuart Piggott, which is largely shown in his initial 1966 sketches of a regionalised Scotland (Figure 4). Similarly, R.B.K Stevenson’s (1966) model of Scottish finds links directly to the theory of diffusionism. However, the theory of diffusionism lost popularity for many reasons. Primarily, the diffusionism view skewed the researchers view of prehistoric Britain: it is based on the idea that all culture originates in the Mediterranean and Middle East, therefore placing Britain at the periphery of cultural development (Harding, 2004). Conversely, independent development is regarded as the more likely explanation for cultural and social patterns in Iron Age Britain. It is key to note that this does not mean that Britain was an isolated territory, rather that it means that it should not be assumed that Britain only developed as part of other external forces (Harding, 2004).
Figure 2: The traditional regionalisation of Northern Britain, as developed by Piggott (1966) and overlaid with Cunliffe’s (1983) principle distributions of regionally-distinctive settlement types. A: Atlantic; NE: North East; SC: Solway Clyde; TF: Tyne-Forth. (Taken from: Armit & Ralston, 1997)

Figure 3: Stevenson’s (1966) visualisation of diffusionism in Northern Britain
As a result of earlier research, Iron Age Scotland has been traditionally researched based on Stuart Piggott’s model from 1966, which was further developed by Cunliffe (1983) (Figure 4). Regionalism was the baseline for the majority post-war archaeological research of the Scottish Iron Age (Armit & Ralston, 1997). In a way, this has skewed the following studies in that it has drawn regional boundaries where none in fact exist. Primarily, there have been few attempts to integrate research from supposedly contradictory regions and as such there is no clear picture of Scotland during the Iron Age. Furthermore, there has been preferential treatment given to certain areas over others. For example, Harding (1982) summarised the burst of archaeological interest in the South-East of Scotland around 1980 – but the majority of work of this time remains unpublished (Harding, 1982; Armit & Ralston, 1997). Research into Atlantic Scotland remained a more constant field of interest with a series of in-depth excavations taking place between 1970s-1980s to support ongoing research. In comparison, the south-western areas of Scotland received almost no academic interest, with limited data collection occurring (Ralston, 1996; Armit & Ralston, 1997).

Essentially, it is easy to argue that we must study an archaeological landscape without predisposed political boundaries. Harding (2004) argues that any parameters drawn - whether chronologically or spatially – are essentially useless outside of research usage, as any boundaries we draw would be arbitrary or unprovable in the archaeological record. Nonetheless, for research purposes, it is important to understand how the research being conducted fits into the wider archaeological community, no matter how useless those agreed upon chronologies.
The arrival of the Romans, as has been mentioned, has been assumed to have been integral to many societal changes in prehistory. The Roman Empire have been widely considered an imperialist state prepared to attack any presumed threat to their strength. Initially, the plan would be to attempt to persuade the opponent to submit peacefully and if that failed, military action would be implemented (Breeze, 1996: 30). There is evidence of Roman presence in Northern Britain from AD71, but generally there are considered to be four main invasions into Atlantic Scotland by the Roman Imperial Army with the supposed aim of colonisation and control (Breeze, 1996). The first invasion took place between AD79-83 to AD80-84 led by Agricola. Many Roman forts and roads were built during this time – Figure 7 shows the Roman Forts of Scotland.
Academic’s knowledge of Agricola’s campaign comes from his son-in-law, the historian Tacitus. This has provided in-depth detail of the Roman empires movements within Britain (Keppie, 1998: 7). It has been suggested that during the time of the first invasion an arrangement of temporary camps on the lowlands was created to put a frontier along the eastern and south-eastern fringes of the Highlands (MacKie, 2016: 4). Around the time that Agricola invaded Scotland, an attack plan had been developed for Roman Britain. The general idea was to maintain control behind the frontier using legions, moving forward with every ‘tribe’ defeated (Breeze, 1996: 53). Forts tended to be situated about 22km (or a days march) apart, with larger forts in river valleys. Agricola arrived in Britain as a governor around AD 77-78 and secured Roman control over what is now Northern England by the end of AD 78. The movement further north began in AD 79 (Keppie, 1998: 7). Agricola’s invasion made as far north as the river Tay, theoretically subduing the Lowland ‘tribes’ of and securing the land with road networks (Ritchie and Ritchie, 1981:121). The large number of Roman forts in the Lowland area of Scotland is thought to support the lack of hostility from any natives of the area, and Tacitus does not note any resistance in his accounts (Keppie, 1998: 8). In the period of AD79-80, Agricola established forts between the Forth and the Clyde while consolidating Roman control over the land already seized through a series of garrisons across the Lowland area. Archaeological evidence suggests that by AD 83, Agricola had moved north past the Grampian mountains to the valley of the Spey river (Keppie, 1998: 9). However, with the battle of Mons Graupius (a hill whose location remains a mystery), Agricola’s military reign was drawn to an end. The following period saw the building of forts and roads in Scotland as far north as Strathmore, with forts placed at the mouth of glens and entrances to the highlands (Keppie, 1998: 11).

The second invasion occurred between AD138-42 to AD160 as led by Emperor Antoninus Pius, who followed Hadrian (Keppie, 1998: 14). The largest piece of archaeological evidence remaining from this period is Antonine’s Wall, built between AD142-43. This could be considered a result of the failure of the earlier Hadrian’s Wall to hold Roman control, but it’s more suggested that the construction of the Antonine Wall was an attempt to assert military prestige (Keppie, 1998: 14). The wall was 60km long, reaching between Bo’ness on the River Forth and Old Kilpatrick on the River Clyde, and was lined with additional fortlets and forts.
Additionally, forts were built along many communication lines in the Lowland area, with a few forts closing off the peninsula of modern Fife (Keppie, 1998: 14). The third and fourth invasions were much briefer and more like raids than colonisation attempts and led by Septimius Serverus between AD208-211 and Constantius Chlorus around AD305 respectively. Severus enabled a military push to the northern edge of Scotland, arranging a treaty with native tribes, and Severus named himself Britannicus or ‘conqueror of Britain’ (Keppie, 1998: 16). However, the following year there is evidence of a revolt by the northern natives, which was suppressed but was likely the beginning of the end for Roman occupation of Scotland. Chlorus, by comparison, launched a campaign to quell the so-called Pictish natives beyond the Antonine Wall in AD306, which was a success (Keppie, 1998: 18). However, there is no clear archaeological evidence of this. The Picts are given the most credit for the dispersal of Roman control, and by the 7th century AD it is assumed that the Roman impact on Scotland would have become memory rather than reality (Keppie, 1998: 19).
**Brochs in Iron Age Scotland**

The Iron Age landscape in Scotland is made of a compilation of many different types of cultures, and as a result many different types of structure evolved across the landscape. MacKie (2008) used revised radiocarbon dates of a variety of sites from the Scottish Iron Age to consolidate the table shown in Figure 8, which shows the relative emergences and dissolutions of different cultures across 4 different areas of Northern Britain. It depicts the broch cultures as being broadly adopted across the West and Northern Atlantic Island areas by c. 100BC, with some appearing later in the North Atlantic Mainland and North-Eastern territories at a much lower frequency.

<table>
<thead>
<tr>
<th>Period</th>
<th>Environment</th>
<th>The Western Islands (including N. Cumbria)</th>
<th>North-west mainland area (N. Cumbria)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Late Iron Age</td>
<td>coastal/peninsular</td>
<td>Stone and earth banks and hilltops</td>
<td>Stone and earth banks and hilltops</td>
</tr>
<tr>
<td>Early Iron Age</td>
<td>coastal/peninsular</td>
<td>Stone and earth banks and hilltops</td>
<td>Stone and earth banks and hilltops</td>
</tr>
<tr>
<td>Middle Iron Age</td>
<td>coastal/peninsular</td>
<td>Stone and earth banks and hilltops</td>
<td>Stone and earth banks and hilltops</td>
</tr>
<tr>
<td>Late Iron Age</td>
<td>coastal/peninsular</td>
<td>Stone and earth banks and hilltops</td>
<td>Stone and earth banks and hilltops</td>
</tr>
</tbody>
</table>

**Figure 5:** MacKie’s (2008) reconstruction of the composition of regional population groups in Northern Britain during the millennium from 700BC.
Nonetheless, one of the most prevalent and the most researched structures of the Scottish Iron Age are brochs. Broch towers are characterised as structures which combine architectural components of Atlantic roundhouses into a taller, more visually impressive form. There is a continuing debate surrounding the terminology used to discuss the Iron Age roundhouses of Scotland. However, for the sake of this study, broch shall be defined using the canmore.org.uk definition: "An Iron Age roundhouse, found mainly in the north and west of Scotland" (origin of the data used). This will be supported by Euan MacKie’s 1965 definition of a broch – a hollow-walled building defined by specific structural aspects (MacKie, 1965; Armit, 1990).

There is no one specific agreed upon definition for a broch, largely due to the sheer number of drystone roundhouses across Scotland (Armit, 2003: 15).

The term ‘Atlantic roundhouse’ covers a broad range of architectural structures, often described as brochs, galleried duns, dun houses, etc. The term was developed as a way of categorising similar structures of western and northern Scotland, with outliers in other areas of the territory (Armit, 2002; Armit, 1990).

Armit’s terminology uses the term Atlantic Roundhouse to encompass all roundhouse structures of Atlantic Scotland. Complex Roundhouses are roundhouses that contain features that are considered more complex, such as intramural cells or lintels – but this is not limited to tower-like structures. Brochs are a further subset of Complex Roundhouses, which combines tower-like structures with those that include more complex features. Figure 4 shows a simplified Venn-diagram of the classification (Armit, 2003).

![Diagram showing the sub-division of Atlantic Roundhouses as defined by Armit (2003).](image-url)
Initially, derivatives of the term ‘broch’ used to describe a wide range of man-made stone built towers of Iron Age Scotland (Armit, 2003: 13). Throughout research, the classification of architectural towers of Atlantic Scotland have been made more precise. Ian Armit’s classification of Atlantic roundhouses, although contested, tends to be the adopted framework for discussing structures of Iron Age Scotland (Armit, 1990).

There are several over-arching issues with terminology that have discouraged any standardised classification. Traditionally, archaeological theories have considered Atlantic roundhouses to be a homogenous group of architectural structures with a generally uniform function. These theoretical frameworks are likely to be a result of views that the majority of changes in Iron Age Scotland and Britain alike were a direct result of invasion by the Roman empire or by immigrants from outside the territory (Harding, 2004; Armit, 2002). Due to the reliance on this framework, there has been comparatively little study of broch adoption and use across different regional contexts (Armit, 2002). Furthermore, there is rarely analysis across regions – for example studies of Atlantic Scotland were rarely combined with studies of the Tyne-Forth province (Armit & Ralston, 1997).

Another issue with former categorisation and recording or brochs is the changing theoretical frameworks over time. An example of this is Angus Graham’s 1948 compendium of over 500 sites that he categorised as brochs based on the popular academic literature of the time (Graham, 1948; Armit, 2003). Graham’s work, although still hugely useful as a site recording device, is likely to include many sites that are no longer considered ‘brochs’ under more modern popular theoretical frameworks.

Brochs can be recognised by their dry-stone wall façade, about 3m-6m thick, which architectural analysis has shown could possibly have supported tall structures (Romankiewicz, 2009). Only 5 brochs in the entirety of Scotland are considered to be preserved near their original height: Dun Carloway in Lewis at 9.2 meters, Mousa in Shetland at 13.3 meters, Dun Trodden and Dun Telve on the mainland facing Skye at 7.6 meters and 10 meters, and Dun Dornaigil on Sutherland at 6.7 meters (Armit, 2003: 55).

Typically, the dry-stone wall was built with an incorporated intramural space between the inner and outer walls, with theories made that this intramural space was designed to support
a staircase or fortification. A commonly used example of a stereotypical broch is Dun Carloway, Isle of Lewis (Figure 5).

The structure is fairly circular, measuring 14.3 meters in external diameter and 7.4 meters in internal diameter. The walls vary in thickness across the broch – from 3.8 meters on the northern side to 2.9 meters on the south-eastern side (Tabraham, 1976). Dun Carloway possesses the specific architectural aspects that define a broch. It has two parallel concentric walls with intra-mural cells, galleries and lintels (Armit, 1990). It has been suggested that the projecting ledges at the upper levels of the walls were used for multi-floor support or roofing.

Figure 7: Dun Carloway, Lewis (picture sourced from: https://www.visitouterhebrides.co.uk/see-and-do/dun-carloway-broch-dun-charlabhaigh-p524091)

Figure 8: Plan of Dun Carloway broch taken from Tabraham (1976).
Interest in these stone towers is likely because of their renowned evocative nature (Armit, 2003: 13). They are often found across the Highlands and Islands of Scotland on inaccessible islands or on cliff outcrops. Furthermore, both the defensibility and the elaborate design of brochs stands out among Iron Age and earlier architecture, where semi-subterranean or cellular structures tended to reign (Hedges, 1987: 34; Armit, 1990).

Despite the overwhelming majority of broch structures being found in the northern and western areas of Atlantic Scotland, similar architectural forms have been found in the southern and eastern territories (Armit, 2003: 119). Due to extensive land use in the southern areas, few of these broch-like structures are preserved to an identification level, even fewer to broch level. Several of the surviving structures show evidence of intra-mural cells or similar elements, none except Torwood in Stirlingshire exist tall enough to see presence of a scarcement ledge (Armit, 2003: 119). As such, it is almost impossible to clarify whether Southern Brochs survived to similar heights as the northern. The existence of brochs in the south of Scotland has continued to be a mystery in the archaeological field. The clear separation from the main northern concentration of brochs in Scotland has encouraged discussions about why exactly these outliers exist (see Figure 9 for broch distribution and Figure 10 for concentrations across Scotland).
Early approaches to outlying brochs assumed they were a product of intruders either from the northern territories or from the Roman invasion (Armit, 2003: 119). For example, Stuart Piggott’s 1950 excavations at Torwood broch near Stirling produced a model in which he explained the southern broch phenomenon as a direct reaction to the Roman invasion and the Roman invasion alone (Piggott, 1951; Keppie, 1998: 13). His argument was that northern-based ‘broch lords’ migrated south to fill the power vacuum left by the Roman retreat. Euan MacKie also attempted to relate southern brochs to the Roman frontier. His theory, converse to Piggott’s, saw the southern broch-dwellers as allies to Rome who moved to the south to help suppress native uprising (Armit, 2002: 130). This theory was supported by the quantity of Roman material found on broch sites, which MacKie argues could only have resulted from direct trade. These arguments are directly influenced by early dependence on the theory of diffusionism.

Modern research, however, has tended to challenge these initial ideas for a number of reasons. Firstly, there is very little concrete evidence for northern brochs directly influencing the architecture of southern brochs (Armit, 2003: 131). For example, there is very little similarity between the material cultures found at southern brochs compared to northern brochs – the lack of fine decorated native pottery at southern brochs that is so abundant at northern brochs supports this (Armit, 2003). Furthermore, there are some architectural discrepancies. Although not many southern brochs are preserved to a point where height can be reconstructed, some like Edin’s Hall near Abbey St Bathans are considered too large to have supported a whole roof, which is contrary to assumptions made about northern brochs.
being roofed (Armit, 2003: 131). The second main issue is that many of the interpretations about southern brochs have attempted to directly link any construction or destruction layers of the brochs to limited histories of the Roman invasion. The issue with this is that due to the fragmented nature of literary sources are treated as full accounts of any development in Scotland, and it also considers all southern brochs to have been constructed in the same close period of time (Armit, 2003). Although brochs like Leckie and Buchlyvie have yielded some Roman material, it remains hard to pinpoint exact construction or destruction phases. Moreover, sites like Edin’s Hall have provided no Roman material at all (Armit, 2003: 132). It could be considered dangerous to base an entire theory around either sporadic evidence or around a lack of evidence, and as such the presence of Roman material on sites proves little other than that there was some kind of Roman activity or trade on the site. Essentially, it is not conclusive of a Roman influence on broch construction.
Chapter 2: Methodology

What is GIS?

As has been discussed, much of archaeology is about visualisation, whether reconstituting an excavated site or trying to analyse an invisible past. Since its 19th century appearance, modern archaeological theory has been based on the understanding of space, landscape and the human use of such (Lock, 2010: 2). It is for this reason that Geographical Information Systems (GIS) are especially invaluable in the use of creating, analysing and visualising databases. They are spatially referenced and allow for the management of data information in a way that makes it more easily approachable (Green, 1990: 3). There are two main parts of GIS: 1) a standard relational database and 2) a graphic and mapping database, which when combined can be utilised to analyse space, time and form in archaeological data (Green, 1990: 5).

Primarily, the system was used for cultural resource management (CRM) and landscape archaeology, and limited to categorising archaeological sites. GIS was largely unrecognised as a useful tool in archaeology until the 1980’s, when more scientific theories began to dominate the field and the usefulness of computerized data became more apparent (Khoumeri & Santucci, 2006).

GIS can be used in a variety of ways, but most useful to archaeology is that it can be used to integrate a variety of data sources (i.e written information, map data and images, ect.) to allow for a more complete analysis (Lock, 2010: 3). The capability of the system to manipulate large amounts of data, overlay varying types of vector and raster layers, and analyse first or second order spatial dynamics that makes it an appealing system in the archaeological discipline.

It is, however, key to note that GIS is a tool for research or analysis, rather than the answer to all archaeological questions. It should be used as a single step in an investigation.

Why use GIS?

There is a wealth of research available that showcases the successful use of GIS in archaeology. Patricia Murrieta-Flores used specifically developed GIS methodology to examine human movement through the landscape in western Sierra Morena, Spain (Murrieta-Flores, 2012). Oubina et al (1998) utilised GIS to reconstruct a sequence of
archaeological landscapes in Galicia, north-west Spain between the 4th millennium BC and the Middle Ages, with the main aim of analysing the social usage and shaping of landscape and sacred space. Graeme Erskine of the University of Edinburgh applied least-cost path analysis to Scotland’s Roman road in order to identify any localised factors that affected road placement (Erskine, 2012). GIS is used as a research tool to aid the investigation of a hypothesis in all of these studies, allowing for a more in-depth statistical analysis of the evidence.

In the case of this specific study, GIS has been chosen as the key methodology as the aim is to study differential factors affecting distribution. GIS allows for the analysis of landscape factors and social factors simultaneously, while encouraging interpretation in a more visual way.

*How will this study use GIS?*

The set of spatial analyses that will be used in this paper are tailored specifically to the study, and will also showcase the usefulness of GIS in the field of archaeology. The main programme that has been used is QGIS, as it is an opensource programme with easy access and have a wide variety of usages that can be adapted to the needs of the study. The system is ideal for visualising archaeological data, using vector layers to represent point data and raster layers to represent pixelized data. Together, these can be combined in QGIS for both visualisation and analysis. Prior to any analyses taking place, however, a database must first be created of the data points relevant to the study. In this case, the information has been gathered independently by the author from canmore.org.uk. Canmore is the National Record of the Historic Environment, which is an ongoing production as part of Historic Environment Scotland. It is essentially an opensource online catalogue of the archaeology, architecture and marine heritage of Scotland, which can be added to by both official archaeological institutions and the public alike. Using the Thesaurus section of the website, it is possible to specify a type of monument, site or building and view all Canmore recorded sites of that type, which can be further separated by area of Scotland or by form. Furthermore, and most relevant to this study, an author can download a CSV (Comma-Separated Values) File. This CSV file can be adapted into QGIS as a vector file and display the relative placement of each site across Scotland. Multiple CSV files can be loaded into the same QGIS file, allowing for the
comparison and analysis of multiple elements at the same time. In this case, the broch data was downloaded a county at a time as a ‘Delimited Text Layer’, and then combined into ‘north’ and ‘south’ regions (Table 1).

<table>
<thead>
<tr>
<th>South</th>
<th>North</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angus</td>
<td>Argyll</td>
</tr>
<tr>
<td>Ayrshire</td>
<td>Caithness</td>
</tr>
<tr>
<td>Berwickshire</td>
<td>Fife</td>
</tr>
<tr>
<td>Lanarkshire</td>
<td>Inverness-shire</td>
</tr>
<tr>
<td>Midlothian</td>
<td>Orkney</td>
</tr>
<tr>
<td>Perthshire</td>
<td>Ross &amp; Cromarty</td>
</tr>
<tr>
<td>Selkirkshire</td>
<td>Shetland</td>
</tr>
<tr>
<td>Stirlingshire</td>
<td>Sutherland</td>
</tr>
<tr>
<td>Wigtonshire</td>
<td></td>
</tr>
</tbody>
</table>

| Total Brochs | 23           | 708          |

*Table 1: Canmore-defined counties included in each territory*

Each individual county data file (and the brochs included within those layers) is merged with the others of the defined territory within QGIS. In this way, it is possible to create two defined territories designed specifically for this study (Figures 11 and 12).

The main elements that have been utilised in this study are brochs of the Northern territory; brochs of the Southern territory; Roman forts; and Roman roads. Each of these elements
were retrieved from Canmore and converted into CSV files onto QGIS, and a fifth vector layer was created by merging Roman Roads and Forts into one file used to represent permanent Roman activity. These four layers create the baseline for the research conducted in this study. Further than this, another essential element of the QGIS analysis is a Digital Elevation Model (or DEM) which contains elevation-related geographic information for the territory in question. The DEM allows for geographical analysis.

The second piece of software that will be used in this study is R, which is an environment for statistical computing and analysis. The flexibility and power of R has made it an attractive piece of software for many scientific fields, from biomedicine to archaeology. R will be accessed using Rstudio. Both of these are open-source, and can be easily downloaded from online. Rstudio is an R Integrated Development Environment (IDE) which makes the processes of R more easily accessible for the user. R and Rstudio will be used as a medium to produce more understandable visualisations of the statistics.

**Analyses**

A specific set of spatial analyses have been developed to tackle the two hypotheses of this paper:

**Hypotheses 1:** *The distribution of brochs is dictated primarily by natural influences (i.e geography)*

**Hypotheses 2:** *The distribution of brochs is dictated primarily by conflict influences (i.e the invasion of the Roman Empire, internal conflict).*

**Hypothesis 1** will be tested using geographical analysis, investigating whether elevation and slope have a consistent impact in the placement of brochs across Scotland. To do this, terrain analysis must be completed on the DEM to extract information on the slope. Then, a point sampling tool can be used to separate data for elevation and slope for either territory, and using the analysis tool for *basic statistics for numeric fields* the relative summary statistics can found. Comparison of the two areas (north and south) will allow for interpretation as to the importance of elevation or slope to the entirety of Northern Britain. Working on the theoretical framework that similarity is equal to commonality, if the values tend to be similar in both the southern and northern areas of the territory then elevation/slope are a defining
factor in the placement of brochs. Conversely, if the values are specifically divergent, then elevation/slope are not defining of broch placement.

In order to further test the validity of the geographical statistics, the Kolmogorov-Smirnov test (KS Test) will be employed. This test is designed to compare the results of a specific sample to the results of a randomised test, to ascertain whether the pattern of the original sample could be randomly generated. If a similar pattern could be generated randomly, it suggests that the pattern seen in the data could simply be a coincidence rather than a defining factor. For this, the two regions will be specified on QGIS using polygons and creation of random points within each territory (Figure 13).

![Figure 13: Example of the KS Test (created by author)](image)

It was the choice of the author to focus the KS Test on the mainland areas of each territory, exempting the Orkney Islands. This is to avoid any chance of the data being in any way impacted by random points occupying water.

**Hypothesis 2** will be testing in two ways – first with a focus on internal conflict and second on Roman conflict. Internal conflict will be investigated using clustering analysis, using both the Nearest Neighbour Index (NNI) function and Ripley’s K-Function in RStudio. NNI is the simpler of the two analyses, working purely on a statistical scale as a Point Pattern Analysis (PPA). The main function of NNI is to compute the average distance between chosen points, which will simply identify a clustered or dispersed pattern. Ripley’s K-Function is a more advanced method of identifying distribution factors, taking uncertainty of archaeological data into
account. Furthermore, Ripley’s K-Function calculates the results that would be created if the distribution was random (or equal to the Poisson Process), and this allows testing for the validity of the pattern. Combines, the two analyses will determine whether each territory shows a dispersed or clustered pattern of brochs and whether these patterns are randomly generated or intentional. Theoretically, if a pattern is shown to be dispersed, it can be interpreted as a direct attempt of the builders to avoid other structures, which in turn could be interpreted as evidence of internal conflict.

Roman conflict as a factor will be investigated by analysing the average distances between brochs and roman materials. If the brochs in either area are generally close to Roman evidence, it can be theorised that the brochs were not specifically avoiding the Romans. Conversely, if the brochs are generally far from Roman materials, it can be theorised that the broch distribution is generally influenced by avoidance of the Roman material. The results from this analysis will be used as a stepping stone in the full analysis of broch distribution.

The first step in this analysis is to merge the two roman data layers (roman forts and roman roads) into a single layer on QGIS. From here, it is possible to compute the distance between two vector layers. Firstly, the author must convert the vector layer of roman material into a raster (pixelized) layer. As the Roman material covers a smaller portion of the full territory than the brochs, the raster that would be created would only cover a fraction of the area and therefore not provide useful information for every broch. To combat this, redundant vector points are added to the Roman material vector layer, purposefully placed in the outlying ocean area of the map. Once this vector layer is rasterised and the full territory suitably covered, the redundant points can be removed. The next step is to create a proximity raster layer using the newly created raster layer. By enabling the values parameter during the proximity raster creation, the algorithm computes the distance to cells with a value of 1 – the Roman material. The new proximity raster layer will hold the information for distances from any part of Scotland to the closest Roman material. The final step, before result compilation, is to sample the new proximity raster. Point sampling analysis must be first completed on the vector layers of Northern and Southern brochs, in relation to the proximity layer of Roman finds. Finally, vector analysis of basic numeric fields can be completed on the point sampled vector layers to retrieve the desired results.
Chapter 3: Results

The following section will detail the results of the methodology outlined in Chapter 2. It will be separated by hypothesis: natural or conflict. The results will be explained and discussed later in Chapter 4.

Natural

The tables below (2 and 3) show the results of the slope and elevation analyses of the two territories.

<table>
<thead>
<tr>
<th>ELEVATION</th>
<th>North</th>
<th>South</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Maximum</td>
<td>667</td>
<td>315</td>
</tr>
<tr>
<td>Mean</td>
<td>119.48</td>
<td>49.61</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>52.59</td>
<td>87.3</td>
</tr>
</tbody>
</table>

Table 2: Elevation Data

<table>
<thead>
<tr>
<th>SLOPE</th>
<th>North</th>
<th>South</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>0</td>
<td>0.82</td>
</tr>
<tr>
<td>Maximum</td>
<td>29.49</td>
<td>12.47</td>
</tr>
<tr>
<td>Mean</td>
<td>4.29</td>
<td>5.42</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>4.38</td>
<td>2.61</td>
</tr>
</tbody>
</table>

Table 3: Slope Data

In the northern territory, the minimum elevation is 0 meters and the maximum elevation is 667 meters, with an average elevation of 119.48 meters across the area. Comparatively, in the southern territory, the minimum elevation is 6 meters and the maximum elevation is 315, with an average elevation of 49.61 meters. The northern brochs have a lower standard deviation (52.59) which means the results of the data lie close to the mean and therefore are not widely dispersed – the results across the territory are similar. Conversely, the southern brochs exhibit a larger standard deviation of 87.3 which suggests that there is a wider variance of elevations across the southern area.

In the north, the minimum slope is 0 meters and the maximum slope is 29.49 meters. In the southern area, the minimum slope is 0.82 meters and the maximum slope is 12.47 meters. The north has a marginally higher standard deviation than the south, meaning both areas results are relatively clustered but the south more so.
The brochs in the northern area of the territory tend to be situated on higher elevations, whereas southern brochs are found on lower areas. Regarding slope, there is not a remarkable variance in slope, but the northern brochs tend to be on steeper slopes compared to southern brochs. Figures 14 and 15 show the differences between the two areas.

![Figure 14: Elevation Bar Graph](image1)
![Figure 15: Slope Bar Graph](image2)

Each chart holds information for both regions relative to each other, for both elevation and slope. It can be seen that there is a clear difference between the regions in both slope and elevation, with the northern region being higher in slope and elevation.

The KS Test has been completed on the two regions to test the results of the prior analysis. The theory is that if similar results can be produced from a random number of points across a landscape as are produced from an analysis, then the results can be considered null.

Figures 16 and 17 show the KS Test results for elevation and slope per region.

![Figure 16: Results of KS Test for Elevation](image3)
![Figure 17: Results of KS Test for Slope](image4)
In the northern areas of the territory, minimum elevation is -3 meters while the maximum elevation is 1037 meters. It is important to note that the result of -3 meters is plausibly due to the inclusion of some areas of water. The southern area shows a minimum elevation of 0 and a maximum elevation of 35.5 meters. The northern mean elevation is 242.3 meters, and the southern is 194.1 meters. The standard deviations are similar for the two regions, the northern being 193.2 and the southern being 137.4, but both results describe a pattern that is distributed across the landscape. Concerning slope, the minimum in the north is 0 meters and the maximum is 53.3 meters, whereas in the south the minimum is 0 meters and the maximum is 35.5 meters. The northern mean is 242.3 meters and the southern is 5.2 meters. The northern territory is significantly more distributed in terms of standard deviation with a result of 193.2, compared to the south’s more clustered result of 5.4. These results are different enough compared to the actual geographical analysis to conclude that the actual results are neither coincidental or random.

**Conflict**

Figures 18 and 19 display the comparative observed and expected results of the NNI.

<table>
<thead>
<tr>
<th>NNI</th>
<th>North</th>
<th>South</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observed</td>
<td>2559.83</td>
<td>13259.45</td>
</tr>
<tr>
<td>Expected</td>
<td>8961.87</td>
<td>19339.01</td>
</tr>
<tr>
<td>NNI</td>
<td>0.28</td>
<td>0.69</td>
</tr>
<tr>
<td>Z Score</td>
<td>36.36</td>
<td>2.88</td>
</tr>
</tbody>
</table>

*Table 4: Results of NNI Analysis for both regions.*

The ‘Observed Mean Distance’ is the literal mean distance calculated between each of the brochs and its closest neighbour in meters. The ‘Expected Mean Distance’ is the mean distance that would be observed for a Poisson Process (a statistical process to express the probability of a distribution being random). The Nearest Neighbour Index (or NNI) refers to the ratio between the Observed and Expected mean distances. If the NNI is 1, the pattern observed is completely random. The Z-Score is the suggested statistical significance of the NNI – the number of standard deviations that the Observed mean is distant from the Expected mean. The larger the Z-Score is, the more significant the result is.
If the Observed Mean Distance is lower than the Expected Mean Distance, it can be plausibly argued that the dataset is clustered in its distribution. If the opposite is true, it can be reasonably argued that the dataset is dispersed in its distribution. Figures 18 and 19 show the North and South territories respectively, with their comparative Observed Mean Distance and Expected Mean Distance.

The results of NNI from either region show that both regions could be interpreted as clustered in their distribution, as both Observed Mean distances are lower than the Expected Mean distances. The Northern brochs have a difference of 6402.04, and the Southern brochs have a difference of 6079.56. Although there is little actual difference between the two values, statistically this shows that the Northern brochs are slightly more clustered than the Southern brochs.

The second part of clustering analysis is using Ripley’s K-Function in RStudio. Figures 20 and 21 display the results of Ripley’s K-Function on either territory.
The blue line visible on either graph represents the result that would be received if the distribution pattern was purely random, the result of the Poisson process. The other three lines present on the graph represent the results for the observed broch point patterns while additionally accounting for a diversity of corrections concerning edge effects and other possible spatial dynamics that could impact the distribution of the brochs. The further the observed results are from the hypothetical results for a Poisson Process, the stronger an argument can be made for the distribution patterns being deliberate.

In this case, even including any possible spatial dynamics that may impact the distribution, both sets of results from either territory are reasonably far from the results of a Poisson Process, which suggests the distribution patterns identified are deliberate rather than coincidental.

The second part of the Conflict hypothesis is investigating possible relationships between broch placement and Roman materials. Tables 5 and 6 display the information about distances from brochs to Roman remains for the two territories in question.

<table>
<thead>
<tr>
<th>Distance in Miles</th>
<th>North</th>
<th>Distance in Miles</th>
<th>South</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>13.03</td>
<td>Minimum</td>
<td>0.56</td>
</tr>
<tr>
<td>Maximum</td>
<td>215.88</td>
<td>Maximum</td>
<td>17.05</td>
</tr>
<tr>
<td>Mean</td>
<td>104.12</td>
<td>Mean</td>
<td>4.15</td>
</tr>
<tr>
<td>Range</td>
<td>202.85</td>
<td>Range</td>
<td>16.50</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>51.28</td>
<td>Standard Deviation</td>
<td>4.18</td>
</tr>
</tbody>
</table>

Table 5: Minimum and Maximum distances to Roman material for the Northern territory

Table 6: Minimum and Maximum distances to Roman material for the Northern territory
The maximum and minimum values refer to the maximum and minimum distances from the northern/southern brochs to roman materials. The mean refers to the average distance to roman materials. The range and the standard deviation both refer to the variance within the analysis results. The southern brochs tend to be significantly closer to Roman materials, with the minimum distance being 0.56 miles and the maximum being 17.05 miles, and the average distance is 4.15 miles. Comparatively, the northern brochs are a minimum of 13.03 miles and a maximum distance of 215.88 miles from Roman remains. The northern brochs exhibit a much higher standard deviation than the southern brochs, 51.28 miles and 4.18 miles respectively.
Chapter 4: Discussion

The Impact of Geography

The first proposed primary impact on the distribution of brochs across Northern Britain is the geography of the landscape. Geographical analysis of brochs across Northern Britain within this paper have shown that, statistically, there is little connecting the two territories geographically. Locational siting of Northern and Island brochs has been greatly discussed, as it has been noted that these brochs tend to be found on defensive sites, at the coast or on clifftops, with some relation to farmland (Scott, 1947; Fojut, 1982; Pearson et al, 1996). This relates to the results of the geographical analysis: on average the Northern brochs are found on high elevations with low slopes. It could be well argued that the brochs were placed in these areas for the defensibility, or for the visual impact the placement of these towers would have imposed. However, even a brief glance at a distribution map of the entire territory (Figure 25) shows that there is a clear difference between placement of brochs in the Northern area compared to the brochs in the Southern area – another point supported by the results of the geographical analysis. The Southern brochs, on average, are found on land about a third of the elevation of Northern brochs but on slightly steeper slopes.

![Figure 22: Broch distribution for the full territory (created by author)](image)
Does this mean that geography is not a key influence? This author would argue that geography could be considered an influence, but instead of being a full territory-wide impact the similarities are confined to either North or South territory. Despite the differences when comparing the geographical statistics of either territory, there is very little actual variance within the territories themselves. It is plausible that in the Northern broch communities the visibility of the broch and therefore the elevation of land on which it is situated was one of the key influences in the decision of where the broch would be constructed, and that the general coastal preference for placement is a reflection of the need to be seen. It is additionally plausible that in the South there was a preference for lower elevations and steeper slopes, possibly meaning that there was another factor outside of visibility that was influencing the placements of brochs.

It is the argument of this paper that the two areas are separated by the mountainous region of modern Cairngorms National Park and Loch Lomond & The Trossachs National Park, and therefore have developed separately concerning geography both due to separation from the other territory and additionally due to the general difference in the landscape of either area (the South being well known as the ‘Lowlands’ in modern terms, and the North as the ‘Highlands’).

**Friends or Enemies?**

The second proposed impact on broch distribution is internal conflict within the broch culture dictating their construction. Although a social system can not and should not be considered frozen in time and unchanging, it is possible to draw connections between relationships between groups and individuals and the organisation of settlement and wider regional distribution (Barrett, 1921: 214). According to the Nearest Neighbour Index analysis, both areas (North and South) are statistically clustered. The clustered distribution pattern is supported by the results of the KS Test, which considers any multiscale influences that could impact the distributions of the brochs. Furthermore, the results are not heavily weighted in the direction of clustered, therefore meaning the clustering factor is not necessarily the most important fact but rather the fact they are not distributed is the key note. If we are working within the theoretical framework that conflict between brochs or broch clans would be a
manifested in a distributed pattern, then we would draw the conclusion that those building the brochs were not actively avoiding each other.

The issue is that traditional interpretations of brochs is that they were the prehistoric versions of fortified castles and were used primarily as residences of the elite (Childe, 1935, 193-206). Some of the most persistent arguments for the height of brochs is that there was underlying social conflict that encouraged competition between architects to build the structures taller than their rivals (Barrett, 1981:214; Sharples, 2007: 181). Romankiewicz (2007) contests this argument with architectural evidence showing that soft sandstone was the dominantly used material in broch construction when a different rock (such as gneiss) would allow for much taller construction but was not used. Furthermore, brochs like Dun An Ruigh Ruadh demonstrate a reduction in construction (labour and materials alike) in order to maintain the height similarities seen across broch culture (Romankiewicz, 2007).

The data analysis results produced within this paper would further contest the argument for competition between the broch occupants. However, similarly, there is not enough statistical evidence from the analysis that brochs occupants were purposefully settling near each other. This information raises a question: if the broch occupants were not avoiding each other and they were not specifically aiming to settle together, was there any actual relationship between each broch?

The archaeological record seems to lean towards yes. Romankiewicz’s (2007) aforementioned argument for consistency of height regardless of building materials is simply one piece of evidence. In 1989, Foster analysed the spatial relationships both within and out with the brochs, suggesting that there was an introduction of hierarchal societal use of space displayed through the relative relationships between the broch structures themselves and other outbuildings, which would suggest there was some overarching community that included both the brochs and other outhouses. One of the more accepted arguments for broch usage is that they were a combination of homesteads, refuges and possibly sanctuaries due to the discovery of occupation refuse found at many of the brochs (Fairhurts, 1984: 179; Pearson et al, 1996: 61). If the brochs, did indeed function at homesteads (rather than elite homes or as defensive towers), then this would explain the sheer amount of them (115 found in the Orkney Islands alone) while also explaining the slightly clustered distribution. Despite the tall architecture and the thick (perhaps impractical) walls, very few of the brochs actually
display any evidence of conflict (in the form of weaponry or burning), therefore the archaeological record would suggest that conflict was not a direct part of the daily life of a broch. The one exception to this would be Leckie broch in the Southern territory, which displays a curious mix of Romano-British artefacts within the destruction layer of the broch (MacKie, 1982: 62). Leckie broch, being the only one of its kind, can be treated as the exception rather than the rule when dealing with conflict within broch culture. It is the argument of this paper that, based both on the statistical analysis completed within this study and the archaeological record interpretations that have been completed by past scholars, Northern British-wide broch distribution is not tied to the defensive or conflictual nature of broch culture.

*Here come the Romans!*

The third proposed primary impact on the broch distribution is the arrival of the Romans, specifically when discussing the difference seen in the Southern area compared to the Northern areas. The difference in distributions between the Northern and Southern areas of Northern Britain have been discussed within this paper. Southern brochs appear to be dictated not by the geography of the landscape, or by the proximity of other brochs in the area. On closer inspection of the Southern broch distribution (Figure 26), there is an intriguing mix of coastal and inland distributions that do not seem to follow the same rules as Northern brochs.

Figure 23: Closer look at Southern Distribution (created by author)
The question still stands: why exactly do the Southern brochs display such a different distribution?

The first proposed answer is that the Southern brochs were directly influenced by the arrival of the Romans. While completing the analysis of this paper, an interesting pattern appeared concerning a possible relationship between Southern brochs and Roman fort or road placement (Figure 24 – red representing brochs, blue representing Roman material).

The brochs appear to be situated in the same patterns as the Roman materials, with several of them existing either at the end of Roman road transport routes, at crossroads of Roman transport routes, or along the same paths (as is the case with the brochs in Stirlingshire and north). The one exception to this is Edin’s Hall on the east coast, which is especially interesting in itself as it is one of the Southern brochs that produces no Roman material. If we use this pattern to assume that there is a relationship between the arrival of the Roman Empire and the distribution of brochs in the Southern areas, then how can we discern which
came first? Did the Romans build the transport routes relative to the placement of brochs or were brochs distributed in the South specifically following the Roman routes?

Although all brochs can broadly be dated to within the first centuries BC and AD, dating methods (such as radiocarbon dating) have suggested that brochs in the South of the territory were constructed much later than the Northern brochs (MacKie, 2010). For example, the remains of Bu Broch in Stromness have been dated as early as 800BC, whereas the beginning of occupation at Buchlyvie Broch in Stirlingshire has been dated to c.400BC (MacKie, 2002a:216; MacKie, 2002b:1307). Further investigation into Southern broch chronology tends to show that the structures in this region were constructed prior to the arrival of Romans, and existed through to the late first century AD (MacKie, 2010:92). However, due to the generally poor preservation of brochs in the Southern area, radiocarbon dating is not necessarily enough to determine whether the occupants coexisted with Romans, and so to answer this question we turn to the archaeological record. A second way to investigate the relationships between broch occupants and the Roman invaders is to look at the presence of Roman material culture in broch contexts. Roman artefacts are found in abundance in Bucklyvie Broch and Leckie Broch, both found in Stirlingshire along the main frontier of what would become the Antonine Wall in AD142. Both Buchlyvie and Leckie would have been present during Agricola’s first invasion into Northern Britain, which involved the construction of a transport route towards what is now Aberdeenshire on the east coast. Both broch communities would have been close to the Romans and as such it is plausible to theorise that the archaeological evidence on these sites would be revealing of relationships between broch communities and Romans in the Southern area.

Buchlyvie occupation began in 400BC and continued until 550AD, concluding with destruction by fire (Main, 1998:310). 156 sherds of Roman pottery were found during the excavation of Buchlyvie, most of which belong to the third phase of occupation at the broch with a few sherds present during the earlier second phase of occupation. 31 sherds can be identified as Samian ware, which can be dated to the late first-century AD, and is known to have been present in Roman military sites in the region (Main, 1998:321). Leckie broch has an assemblage of a similar size to Buchlyvie, consisting of a number of fragments of Roman pot and glass vessels (MacKie, 2016:8). 34 fragments of Roman glass were uncovered at the
site, many of which are from high quality or rare Roman glass bottles or vessels. The rest of the assemblage is created from Roman iron tools, a single Roman bronze mirror, Roman pottery sherds and a large quantity of lead (MacKie, 2016: 12). The artefacts can be dated to both the Flavian and Antonine periods, meaning that the broch was in use during AD69 – AD193. An interesting thing about Leckie broch is that there appears to be a stark difference the Flavian occupation and the Antonine occupation. There is no evidence of conflict during the Flavian period compared to the seemingly violent destruction of the broch by fire in the Antonine period. Interestingly, the presence of two Antonine pottery sherds found in the stratigraphy of the destruction layer mean the destruction could not have occurred before AD140, and suggests that the destruction was unlikely to have been at the hands of the Romans (MacKie, 2016: 15).

The QGIS analysis of distance the distances from broch sites to archaeological remains completed within this paper confirmed that Southern brochs, on average, were closer to Roman remains than the Northern brochs. Evidence from Leckie and Buchlyvie shows that there was contact between the broch occupants and the Romans, but to what extent is still unclear. The archaeological record shows that the southern brochs that can be dates were constructed prior to the presence of Romans in the area, therefore it could be theorised that to some extent the Roman roads were created with the aim of reaching the brochs further from the centralised area. This would explain the apparent relationship between the distributions of brochs and Roman materials.

However, it would be foolish to assume that only Southern brochs were in anyway in contact with the Romans. It is well documented that brochs on the Western Islands and the Orkney Islands also provided some interesting Roman finds. For example, Roman pottery fragments were uncovered at Gurness Broch on Orkney which were determined to have been from an amphora and dated to around AD43 (MacKie, 2002:232). On the island of Tiree on the west coast, Roman artefacts such as a glass bowl were found at Dun Mor Vaul. The difference between these brochs and the Southern brochs is that these more northern brochs have been dated to have existed before the Roman invasion, and as such their distribution is unlikely to have been directly impacted by the Romans. The question of how these artefacts were brought to the brochs is the subject for extended subject.
Archaeological Issues

Due to the evasive nature of prehistory it is almost impossible to be certain of anything in archaeology, especially in a period of time such as the Iron Age where preservation is variable. Development can be a key issue with levels of preservation, which is especially visible when considering the Southern areas of Northern Britain. Compared to the reasonably well-preserved brochs of the North, Southern brochs are rarely stand preserved above a couple of meters and as such there is an air of mystery surrounding how similar they were to the Northern variations. Furthermore, it can be difficult to retrieve an accurate or useful date for many broch sites due to their age and due to the lack of datable material. Archaeologists often find themselves relying on stratigraphic context to date sites, which can provide a myriad of issues if there are no relative artefacts to date the site phases with or simply if prior excavations did not adequately store or record the materials uncovered. Additionally, on the topic of excavations, many of the broch sites were excavated in the times of antiquarians. These initial excavations did not necessarily execute the same strict processes as we do today, leading to the loss of a large amount of valuable information. For example, Main (1998) admits that the results of the Buchlyvie broch assemblage could have been directly influenced by the choices made by the excavators. They note that the placement of trenches during the excavations could have led to over-representation of Roman pottery sherds compared to native Iron Age pottery sherds. Moreover, the initial analyses of the broch sites could be said to have been tainted by prepositions about life in prehistory – with assumptions of what they were looking for and where to find it possibly clouding the full archaeological picture. Nonetheless, if a paper understands and accounts for these possible variances in the archaeological record, it is possible to still create meaningful conclusions from the research.

Doomed from the start?

One of the biggest issues with using a statistical system like GIS as the primary tool for researching an archaeological hypothesis is that it is a system based in mathematics and statistics, and human beings are rarely logic. The arguments that have been constructed within this paper are a direct result of the choices of analysis made by the author. The choice of the five analyses to investigate the distribution of brochs has fundamentally shaped the
interpretations made, and this is one of the main downfalls when studying the invisible past. The archaeologist only has the work of prior archaeologists and jigsaw pieces of evidence to reconstruct the landscape of our past, which can often lead interpretations led by assumptions based on past research.

This paper began with the assumption that the answer to why brochs are distributed in the way that they are was either geography or conflict. However, as has been mentioned, humans rarely conform to one path or the other.

The discipline of archaeology has had something of an identity crisis, which makes the combination of scientific statistics and human agency somewhat of a massive task. In the 1960s processual archaeology emerged, which was largely focused on developing the field away from its historical roots and towards a more scientific base (Krieger, 2017). However, the late 1970s brought the post-processual movement, which critiqued the processual movement for being overly objective and not understanding the variability of human agency in prehistory. The new movement wanted to move the archaeological focus back onto the individual. In modern archaeology, however, we find ourselves at a crossroads where both tools of research and interpretation must coexist somewhat harmoniously during research. In all complete and blunt honesty, it is entirely possible that some brochs were placed at the top of cliffs simply because the occupants liked the view.

Further Study

The analyses that have been completed throughout this dissertation process are one small stepping stone in the bigger archaeological picture, while displaying the usages. It could be reasonably argued that no analysis and interpretation of any database could be considered either fully accurate or complete without every piece of information analysed, which for archaeology is a remarkably difficult goal to achieve. However, as Campbell (2000) recognised in his own database analysis, while the patterns recognised in a database analysis may be inaccurate, these first steps are necessary to inform the fuller conversation on the subject.

The study of broch distribution would be benefited by a number of further studies. Ideally, each broch would be re-excavated in the light of a more open archaeological mind, in order to challenge and perhaps change the prior conceptions of broch culture development as a
direct result of other influences. Furthermore, there would be more of a cross-theoretical approach to the subject, with a mix of processual and post-processual theoretical frameworks. This would allow for a better mix of interpretations, and possibly overall a fairer evaluation of the prehistoric past.
Conclusion

Although these initial analyses have investigated only a small part of broch distribution, they contribute to the larger discussion of the broch culture. Furthermore, this dissertation has showcased the multiple ways in which a GIS system can be used as a research tool to analyse a set of specific archaeological hypotheses, while also discussing the possible downfalls of relying solely on a processual computational technique in a world where the fullest discussion would include multiple investigations from the different facets of archaeology. The research has proposed and tested 3 main influences on the distribution of broch: 1) geographical impacts; 2) internal conflictual impacts; 3) Roman arrival impacts. It has shown the ways in which the analysis competed within the investigation could be used in turn to support the three different arguments.

It is the conclusions of this paper that it is likely that the broch distribution across Northern Britain was influenced in varying ways by multiple different forces and impacts. It is unlikely that one single occurrence impacted the entirety of the broch culture, due to the sheer amount of time that brochs existed and the vast areas of land. Of course, it is almost impossible to be absolutely sure of any conclusions drawn about prehistory, without actually transporting back in time. This is one of the main curses of the discipline of archaeology. Nonetheless, each piece of research and investigation aids in the overall understanding of our past and development, and it is to that end that we continue our discoveries.
Bibliography


