An Assessment for the Case of Shared Traditions in the North Channel Region

Site morphology and settlement distribution during the 1st Millennium BC to 1st Millennium AD

Thesis submitted for the degree of Doctor of Philosophy

Institute of Geography

School of GeoSciences

University of Edinburgh

Shelly D. Werner MPhil

2007

Supervisors: Dr. William A. Mackaness

Prof. Ian Ralston

Contents

Declaration

I declare that this thesis is the result of my own work and has not, whether in the same or a different form, been presented to this or any other university in support of an application for any other degree than that for which I am now a candidate.

Date…………………………… Signature…………………………………………..

Abstract

The seaways appear to have been a prevalent means of travel in the past as observed in the evidence of contact and trade between regions. The Irish Sea between Britain and Ireland was part of a maritime network traditionally termed the Atlantic Seaways that linked these islands and the Continent. Communication across the North Channel between Western Scotland and northern part of Ireland may have been demonstrably easier during the later prehistoric period than movement looking eastwards across the Central Highlands of Scotland. Thus, these areas possibly developed into a 'North Channel' region as opposed to the sea creating a cultural divide.

This idea is explored through a series of comparisons between sites either side of the North Channel. Three specific areas are targeted for the overall research, Argyll, the coastline of Northern Ireland and Co. Donegal. Both the individual architectural features and site distributions in relation to their locations within the landscape are investigated through an integrated approach. Firstly, a fine scale examination of the morphology of settlement sites using a common classification scheme explores the degree of structural comparability between these areas. The second approach is at a broader scale that statistically tests the distribution of site types with regards to specific landscape variables, including elevation, slope and aspect to identify spatial patterns. The third approach statistically tests the location of sites with regards to visibility to determine whether or not the locations of sites have particular visibility features and the comparability between the three study areas. This technique uses the Viewshed tool available in GIS software.

It is argued that broad comparisons exist between Scotland and Ireland in site classifications, their distributions and vistas, which illustrate the degree of communication occurring between the study areas. Sites dating to the 1st millennium BC in Argyll and Co. Donegal exemplify similar distributions with regards to vistas and to a lesser extent the environmental variables. A few general structural features are similar between sites in Northern Ireland and Co. Donegal during this period; however, interpretations on the former also indicate that possible influences are also coming from outside the study region. Around the turn of the millennium to the beginning of the 1st millennium AD, communication links between Co. Donegal and Argyll appear to dwindle and the number of sites in Northern Ireland begins to increase. Around mid 1st millennium AD, sites in Co. Donegal illustrate features and distributions comparable to both Argyll and Northern Ireland, suggesting communication links are re-established during this period.

Acknowledgements

Numerous people have provided help and support in many different ways during the course of this research. I would like to thank my supervisors, Dr. William Mackaness and Prof. Ian Ralston for their guidance, support and encouragement. I am also indebted to those who have provided me with the means to do this research. I would like to thank Peter McKeague and Dr. Rebecca Jones from the RCAHMS for data and support. My colleagues Sarah-Jane Haston, Dr. Cath Flitcroft, Vasiliki Koutrafouri and Erin Osborne-Martin provided much needed assistance in the field, and I am grateful to all for their enthusiasm. I would also like to thank Dr. Graeme Cavers, Dr Simon Gilmour, Dr. Mel Johnson, Amy Judd, Phil Karsgaard, Dr. Arlene Kray, Dr. Sorina Spanou, Dr. Jenny Thoms and Dr. Lucy Verrill for useful discussions and much needed encouragement to complete this thesis. Special thanks goes to Ross Murray for his patience and expertise on several of the illustrations in this thesis.

I am grateful for the grants given for fieldwork by the Abercromby Fund and the Moray Endowment Fund.

I would also like to thank my parents, my sister Cheryl and my family for their many years of support, encouragement and understanding, without which I never would have finished this work.

Standard Convention

'Raw' radiocarbon dates are given with their lab codes at two sigma variation of the date range produced, unless otherwise specified. Dates have been calibrated on OxCal version 3.10 by C. Bronk Ramsey (2005) using the Stuiver and Kra calibration curve.

The use of the terms of Early Historic (for Scotland) and Early Christian (for Ireland) are used interchangeably, but roughly cover the same time period.

All DEM maps of Argyll are of Crown Copyright/database right 2005. An Ordnance Survey/(Datacentre) supplied service.

All DEM maps of Northern Ireland and Co. Donegal are available from the U.S. Geological Survey, EROS Data Center, Sioux Falls, SD

Licence Agreement

Ordnance Survey cartographic data downloads were available obtained for this project from EDINA Digimap; all cartographic data of Argyll remain copyright of Digimap. Site location data for Argyll was also downloaded from the NMRS and remains a copyright of the RCAHMS. The topographic data of Ireland and Northern Ireland were downloaded from the Seamless Data Distribution System, provided by the U.S. Geological Survey and EROS Data Center. Site location data for Northern Ireland and Co. Donegal were downloaded from Northern Ireland Sites and Monuments Record available through the Archaeological Data Service, ArchSearch and the Sites and Monument Record from the Department of Environment, Heritage and Local Government, Republic of Ireland, respectively.

List of Tables

List of Illustrations

List of Appendices

Chapter 1: Introduction

1.1 Overall Aim

The aim of this research is to devise a methodology for investigating settlement patterns using a GIS-based approach. The foundation of this methodology focuses on the later prehistoric and Early Historic settlements in Argyll in western Scotland, Northern Ireland and Co. Donegal in Ireland in order to assess the level of shared traditions between these areas. Principal investigations undertake issues with site classifications and settlement local influences. This research attempts to address three key issues including the level of comparability of architecture, the distribution of comparable sites in similar environmental settings and the distribution of comparable sites with regards to visibility throughout the three study areas.

Several hypotheses are formulated on the basis of these key investigations. Firstly, the architecture of domestic structures is examined to determine the level of comparability between the three areas. Similar architectural constructions may indicate connections between the study areas. Next, an integrated GIS and statistical based approach is developed to test several hypotheses. Both cultural and environmental attributes are investigated with regards to site distribution to identify settlement patterns within the landscape. An examination of site distribution with regards to the environment tests whether there are particular ranges in altitude, slope incline and hillside aspect that are preferred for habitation and if different site types reflect varying locational patterns. Three hypotheses are formulated to analyse the distribution of sites in the physical landscape. GIS techniques are used to extract environmental data, including altitude, slope inclination and slope aspect, for each site. The null hypothesis that site distribution is roughly equal to the distribution of the environmental attribute data is tested using statistical techniques. These analyses will determine whether or not there is a difference between the distributions of archaeological sites and the background environment. If the analyses demonstrate locational influences by the environment, then comparisons with equivalent sites throughout the region may illustrate similar patterns suggesting shared traditions in settlement organisation between the study areas.

A cultural perspective is also investigated to examine whether the locations of particular sites types were influenced by the visibility attributes at those locations. Four primary analyses are employed in the investigation of site location with regards to visibility. These investigate whether sites prefer locations with large views across the entire landscape, locations with large views across the seascape, locations that have large seascapes, but little visibility over the surrounding land and locations that have views towards particular areas in the land- or seascape which are observed by multiple sites. Hypotheses formulated around visibility analyses examine the amount of area visible from the site locations with comparisons to the amount of visible area from non-site locations in similar landscape settings. The four null hypotheses that are tested are as follows: there is no difference in visibility overall, visibility of the sea, ratio visibility of sea to land and shared views between the location of archaeological sites and non-site locations in the landscape. Some site types may illustrate preferences for locations with expansive views across the entire landscape while other site types may be located in areas that focus on the sea to observe water routes. Again, comparable sites between the study areas may demonstrate similar visibility results, suggesting settlement connections between the areas.

1.2 Background

British invasion theories have dictated archaeological thought prior to the 1960s and shrouded the achievements of prehistoric indigenous populations. As a response material evidence was then put into question and critically 're-analysed', which in turn deconstructed most hypotheses concerning population-movements of European 'Celts' into Britain and Ireland (Clark 1966; Waddell 1978). Nowadays, the British invasion theory is used as an example to demonstrate how careful analysis of the evidence can completely alter an entire school of thought. However, where historical written word is concerned, the invasion theory still exists for western Scotland, but it is the by whom and when that causes argument.

The origin of the Scottish Dál Riata in western Scotland has been a long-term debate between archaeologists and historians without satisfactory results. Historical texts suggest a picture of invasions and mass migration by the Irish Dál Riata into Argyll (i.e. ***Míniugud Senchus fher nAlban***; Annals of Tigernach). However, these accounts were written centuries after the supposed immigration took place and are contradictory with each other, which bring reservations to the accuracy of these texts. For example, Bede's work written in the early 8th Century recorded the migration during the 3rd Century AD, whereas 'The Annals of Tigernach' written in the 14th Century chronicled the invasion at AD 500. To further complicate matters, the Irish annals illustrated evidence of revision in order to establish claims of Kinship of Tara (Kelleher 1963), where similar claims of sovereignty were likely to have extended into Scotland. Several archaeologists, however, have concluded that there is no evidence in the record to support the view of a sudden migration of a diverse culture (Alcock 1970, 1972; Ritchie 1997a; Campbell 1999). Regardless of the lack of archaeological evidence and uncertainty of the historical chronicles, archaeological and historical books for the popular audience tend to support this conviction of a mass migration from Ireland into western Scotland (c.f. Duncan 1992; Laing 2006; Macdonald 1950; Marshall 1998; Ó Cróinín 1995; Paterson 2001).

In truth, this region of Western Scotland and northern Ireland is a component of a larger maritime network known as the Atlantic or Western Seaways, which also encompasses Northern Scotland, Wales, Cornwall, Southeast England and Brittany (Bowen 1972; 1977). Travel along these sea routes may have been just as frequent as landward travel, where contact and trade between these regions would have been expected. Evidence of contact is represented through the presence of 'exotic' artefacts and particular architectural features. Migration or invasion would depict a drastic change in the form of settlement organization, structural construction and in the local artefact types. In each region along the Atlantic Seaways, distinct site-based classification schemes have been adopted to manage and organise the respective archaeology. Individual classification designs have been applied to the structures, thus making cross comparisons between regions difficult.

This thesis comprises the results of redressing the classification schemes and analyses the data using Geographical Information System (GIS) techniques. The focus of this research is on the later prehistoric and Early Historic period, covering the time range just before and during the fabled Dalriadic migration movement. The aim is to investigate the architecture and settlement organisation throughout the 'North Channel' area, both on an individual site level and in the broader context of the landscape. The primary concern of this research is with GIS, considering the potential of specific techniques to explain archaeological questions on settlement organisation and development and to identify patterns of site location within the landscape.

There are three objectives for this research:

- A fine-scale examination of the morphology of archaeological monuments in each study area to determine the level of structural comparability between areas.
- A broad-scale examination of the spatial distribution of structural site types with regards to the landscape to determine whether distinct distributions influenced by particular environmental variables within each area can be detected.
- A broad-scale examination of the distribution of site types with regards to the visual land- and seascape to determine whether site locations influenced by the amount of visibility and/or views of specific areas can be detected.

The archaeological monuments indicative of this time period include a range of curvilinear and rectilinear structures. Visible sites in Western Scotland are characteristically of drystone construction and have been classified as forts, duns or brochs (Maxwell 1969; RCAHMS 1971, 1975, 1980, 1984, 1988). In northern Ireland, settlement sites dating to the turn of the millennia (c.500 BC-AD 500) have proven difficult to identify (Raftery 1994; O'Sullivan 1998; Waddell 1998), however it has been suggested that a number of hilltop enclosures classified as hillforts may demonstrate evidence of activity dating to this period (Raftery 1994; Mallory 1995; Mallory and Hartwell 1997; O'Sullivan 1998). Other site classes generally considered Early Historic or Early Christian (post c.AD 500) include ringforts and crannogs, however, the construction dates for these monuments is currently under debate (Lynn 1983; Stout 2000)(argument for earlier constructions: Limbert 1996).

Spatial analyses exploring site location to deduce settlement patterns have been a focus for archaeological investigations. These include descriptive statistics on site locations within the landscape and more complex statistics analysing site location in reference to other sites such as Thiessen polygons, nearest neighbour, proximity analysis and cluster analysis. The amount of archaeological and digital environmental data available today has grown significantly, in which GIS with its ability to handle large amounts of spatial data can replace the tedious process of manual calculations and lessen the degree of human-error. Digital Terrain Models (DTM) and thematic maps are widely available in a variety of resolutions that can calculate a number of environmental variables to correlate with site locations. From these maps, variables such as elevation, slope, slope aspect, soils and watercourses can be linked to site locations. Statistics applied to the data may demonstrate specific environmental situations that may be important to particular settlement locations, however the interpretation of why these results signify certain settings over others must still be addressed.

Relatively recent research has utilised GIS techniques and specific statistical tests to confirm whether correlations existed between the location of archaeological sites and particular geomorphological settings (see Morgan 2000; Evans 1999; Kvamme 1990a). There have been numerous debates on the environmentally deterministic bias with the use of these environmental attributes and whether or not these types of analyses are appropriate in the interpretation of settlement distribution (c.f. Gaffney and van Leusen 1995; Harris and Lock 1995). New developments for acquiring digital cultural data and creating a cultural landscape model in a GIS are becoming the emphasis.

Culture influences in site locations can be investigated using specific GIS techniques to analyse site attributes such as visibility and proximity. The Viewshed analysis functionality determines the visibility from site locations providing a quantifiable measure of visible area and indicating site intervisibility. Certain assumptions are involved with the use of this technique, particularly vegetation cover and the accuracy of the source data. However, previous research has successfully demonstrated intervisibility as an influencing factor of archaeological site location with the application of Viewshed analysis in conjunction with statistical testing (Ruggles *et al*. 1993; Lock and Harris 1996; Fisher *et al.* 1997; Woodman 2000a).

It is argued in this thesis that sites in the Argyll region of Western Scotland should not be studied within the confines of the modern borders. Influences or contact from across the waters must have occurred. As discussed above, separate classification schemes have been developed for each region (i.e. Scotland, Northern Ireland and Ireland) making comparisons across the 'North Channel' impossible. Conclusions from prior investigations have focused on a region-based development of settlement and architecture, without a comprehensive consideration of possible influences from across the water (see Raftery 1972; Nieke 1984; Stout 1997). The focus of this project is on the distribution of drystone and earthen built structures and hilltop enclosures within the larger landscape region of Argyll in Scotland, the coastlines along Northern Ireland and Co. Donegal in Ireland. A single typology is developed for the purpose of providing a method for site comparison between all the areas. Site data is then correlated against environmental variables and applied to descriptive and analytical statistics. Results are further investigated to determine whether these settlement locations are demonstrating regional patterns through specific environmental settings and visibility.

1.3 Structure of thesis

The following chapters aim to contextualise the settlement archaeology in all three areas, with Chapter Two reviewing the scene for cross-channel contact and influence and the primary issue of the thesis. Chapter Three discusses the geographical and environmental setting of the entire study region. Agricultural and resource exploitation practices of the time period in question are also briefly discussed. Chapter Four considers previous typological classification on domestic sites within Western Scotland and northern Ireland and discusses the merits and methodology of the classification strategy devised for this research. Excavation and dating evidence is then reviewed in reference to the new classification scheme. Lastly Chapter 4 ends with a review of the geographical distribution of sites under the new scheme. Chapter Five sets the theoretical perspective and methodological framework. Results of the distribution of site types against the environmental variables are discussed under Chapter Six. Chapter Seven discusses the results of visibility from site and non-site locations, with reference to sea routes, areas of contact and landscape markers in the landscape in each study area. Chapter Eight considers the evidence of sea routes and areas of contact referring the settlement record and the wider implications of the analyses discussed above.

Chapter 2: The Migration Theory and the Maritime Highway

2.1 Introduction

This chapter reviews the evidence of the Scots migration into Argyll and general Atlantic sea routes through the northern sector of the Irish Sea. Section 2.2 reassesses the evidence from the historical texts that trace the migration. Possible prehistoric Western sea routes discussed in previous research, with a concentration on the study region, are discussed in Section 2.3. Section 2.4 reviews the primary issue of the thesis.

Since the 1960s, migration theories concerning European populations settling in Britain and Ireland were largely discredited because the archaeological evidence fails to support this conjecture (further discussed under Section 2.3) (e.g. Champion 1982; Clark 1966; Cunliffe 2001). The most probable explanation for the occurrence of pre-Roman import objects, 'cultural packages' or structural techniques in Britain lies with the exchange of ideas and material goods brought by seafaring trade along the maritime highways. However, the migration theory suggested by the historical texts of the Scots from Northern Ireland is still debated from both historical and archaeological perspectives (Alcock 1970; Campbell 2001; Ritchie 1997a; *contra* Bannerman 1974; Laing 2006). The focus of this research is on the northern Irish Sea around the North Channel (Figure 2.1). This area is part of the wider maritime network traditionally termed the Atlantic Seaways that connect all landmasses associated with the Atlantic Ocean (Cunliffe 2001) (Figure 2.2). For the North Channel region, I will investigate the degree to which individual societies influenced each other and the networks of possible communication. Architecture may reflect shared or localised patterns indicating connections between different localities. Distribution of particular site types along the coastline may indicate important places of contact and trade centres. The purpose of this research is to investigate the settlement evidence from both an environmental and cultural perspective in order to examine the similarities between areas on either side of the North Channel and by extension to enlighten the 'problem of the Scots'.

2.2 Review of the Written Evidence

Classical texts are the earliest surviving documentation about the study region and the native populations. Later indigenous texts were written and often recopied and revised by monks at major religious centres after the Early Historic period. The historical texts generally are the primary evidence for supporting the Irish ancestry of the Dalriadic kingdom in Argyll. Detailed information about the genealogies and migrations of people is documented; however, the recorded entries remain vague and contradictory. Most discussions about the textual evidence focus on the two origin-legends of the Dál Riata.

The earliest written accounts concerning the study region were observations made by the Romans (Table 2.1). Tacitus recorded the Agricolan campaigns in his work, *De vita et moribus Iulii Agricolae,* at the end of the 1st Century AD. He describes the lands of Northern Britain ruled by petty chieftains that failed to unite under the pressure of invasion and therefore were easily conquered by the Romans. This account may represent the Roman bias against the native population, but the underlying social hierarchy of chiefdoms may be inferred (Nieke 1984). Tacitus's only mention of Ireland documented Agricola's desire to invade the island with the aid of an exiled Irish petty king/chieftain (Freeman 2001). Information from Ptolemy's *Geography* was compiled during the mid 2nd Century AD and listed relative locations of tribal names in Scotland and Ireland. This work was presumably an expansion and revision on the lost work of Marinus of Tyre written decades earlier and entailed a list of place names and locations (Breeze 1982; Freeman 2001) (Figure 2.3). Around AD 200, Solinus produced his *Collectanea rerum memorabilium* ("Collection of Remarkable Facts"), largely borrowed from Pliny's *Naturalis Historia,* where he described Ireland as rich in agriculture and renowned for the savagery of its people (Freeman 2001). Solinus also referred to five Hebridean Islands under the rule of a single king, but failed to allude which specific islands (Nieke 1984). Although the references on the study region in the classical sources were vague in terms of chiefdom and ruler names and territorial boundaries, they have suggested some form of hierarchal structure was present in both Northern Britain and Ireland.

Ptolemy's map indicated numerous tribes inhabiting northern Britain and Ireland. Unfortunately, the location of names may be questionable for Scotland especially North of the Forth due to mathematical miscalculations (see Figure 2.3). There was no indication on whether these names were indigenous or Roman. Conversely, the locations and tribal groups in Ireland may have been reasonably based on Irish names due to the lack of Roman settlement (Breeze 1982). The major pre-Roman tribes that were thought to occupy western Scotland were the Epidii in Kintyre and the Creones, north of modern-day Argyll (Skene 1837:100). Rivet and Smith (1979) suggested the Epidii controlled not only the area of Kintyre, but also the whole of Argyll. The tribal name Robogdii was placed in modern day Co. Antrim and corresponded to that of the Irish Dál Riata. Comparisons between Ptolemy's map and more recent maps have demonstrated some similarities, but also some speculative associations between features and tribal names known in later literature (Orpen 1894; O'Rahilly 1946).

Post-Roman documentary sources appeared several centuries later in the form of king-lists, genealogies or annals. Other texts occurred as Irish legal tracts, secular sagas, poetry and tributes to the lives of saints. King-lists and genealogies were produced to emphasize claim to leadership (Dumville 1977). A genealogy tracing the ancestry of the Scottish Dál Riata was listed in the text of the *Míniugud Senchus fher nAlban*. The majority of the texts in the Book of Leinster, Book of Lecan and Book of Ballymote also consist of genealogical lists amongst the entries concerning Irish histories and sagas. Annals, such as the Annals of Ulster and the Annals of Tigernach, developed from the insertion of historical events in the blank spaces of the Easter tables (Anderson 1980). These were revised and rewritten with the inclusion of additional entries over a span of several centuries and eventually became highly decorated manuscripts.

Events prescribed to the time period under consideration in the current research were found to have been written centuries later. The earliest surviving indigenous texts were thought to have been scribed around the 10th Century AD. The original sources for these texts may have appeared as early as the 7th Century, but the evidence has yet to be validated (Dumville 2002). Bannerman (1974) argued that the *Míniugud Senchus fher nAlban* was originally compiled in the 7th Century and later modified in the 10th Century (Table 2.1). The surviving text was thought to be a compilation of overlapping sources, 'probably both incomplete and of different dates' (Dumville 2002:208) and was dated to the 10th Century by the mixture of Old- and Middle-Irish form of text (Bannerman 1974). Evidence supporting the later date was also observed in the use of the word *Alba,* which was not used before the 10th Century and unlikely to have been used by Irish scriptors (Bannerman 1974; Campbell 2001). Dumville (2002) further suggested that the evidence presented by Bannerman does not satisfactory place the text in the 10th Century and proposes that the modification of the *Míniugud Senchus fher nAlban* dates even later. Another text with an origin date of late 7th Century AD was Adomnan's *Vita S. Columbae Tripartita* (Table 2.1). The four surviving manuscripts are differing versions of the original source, in which the 8th Century AD version considered most similar to the original source can only be speculated (Anderson & Anderson 1991). In the early 8th Century, Bede briefly stated the migration of the Scots into Scotland in his "Ecclesiastical History of the English People"(*infra*). 'The Ulster Chronicle' was thought to have originated around AD 740 and to have been the original source for later texts, the 15th Century AD texts, 'Annals of Ulster' and 'Annals of Tigernach', and possibly the *Chronicum Scotorum* (Table 2.1)(O'Rahilly 1946). It is further suggested that entries concerning Scotland in the Ulster Chronicle were from an earlier source written in Iona around AD 670 to 740, referred to as the Iona Chronicle (Hughes 1972; Anderson 1980). Additions and revisions were thought to have occurred during the scripting of the later manuscripts in which the later texts exhibited parallel, conflicting and additional entries. Overall, the earliest surviving texts were positively dated to the 8th (*Vita S. Columbae Tripartita)* and 10th Centuries AD, in which their sources may have originated several centuries earlier, but the extent of additions and alterations remains enigmatic.

The origins of the historical sources are illusive, which later developed into the surviving texts. Prescribing dates to the original sources was also problematic. Investigations into the surviving texts indicated a long history of re-writing, revision and additions, in which these texts may be dramatically different from their original sources. The earliest dated text is ascribed to the 8th Century AD, which is three centuries after the alleged migration of the Scots. References of an Irish migration or the Irish ancestry of the Scottish Dál Riata in these texts should therefore be approached with caution due to their late dating and evidence of revision.

From the available sources, two differing origin-legends of the Dál Riata are apparent. One consists of the migration of a group of people led by a person titled Caipre Riata; and the other centres around an individual named Fergus Mór. Both Bannerman (1974) and Dumville (2002) have contemplated the identity of Coirpre and the various forms of his name, Caipre Riata(i) or Eochaid / Eochu Riata(i), but failed to confirm any tangible connections to the other texts. Vague references to both individuals and their offspring have been noted in several of the sources. Unfortunately, neither of these origin-legends demonstrated precedence over the other, nor has chronological priority been agreed upon (Dumville 2002).

The Caipre origin-legend began with the tribal group, the Érainn, located in the Munster province of southern Ireland (Figure 2.4). Old Irish prose texts describe the leader of this tribe as Conaire mac Eterscéla, the High King at Tara (Bryne 1973; Dumville 2002). The *De Shíl Chonairi Móil* ("Concerning the Descendents of Conaire Mór") and the *De maccaib Conaire* ("Concerning the Sons of Conaire") narrated that this leader had three sons, Cairbre Músc, Cairbre Baschaín and Cairbre Rigfhota, who were suggested to be the ancestors of Múscraige, Corcu Baiscind and Dál Riata respectively (Gwynn 1912a; 1912b). The tale narrates that during a time of famine the leader, Coirpre or Echoid, the son of Conaire, led his people to Northern Ireland and Britain (Anderson & Anderson 1991). This was the legend of how the Dál Riata acquired "a small territory entirely enclosed between the sea and the Cruithnian Kingdom of Dál-nAridi and the Eilne," (*ibid*.: 36) (Figure 2.4). In Ulster there were a total of five tribes. All were associated with the Cruithin except the Dál Riata who were known as Érainn (Marshall 1998). Unfortunately, the written text referring to this migration legend is vague, incomplete and perhaps reflecting conjecture by the documenter.

The two Irish prose texts, *De Shíl Chonairi Móil* and *De maccaib Conaire* are translations found in the Book of Leinster, Book of Lecan and Book of Ballymote. The *De Shíl Chonairi Móil* further discussed specific regions in Ireland that were controlled by three brothers. One of the brothers was named Caipre rigfhota, in which "[the people of Cairpre rigfhota] came into *Alba*," (Dumville 2002:187). The control over *Alba* was also recorded in a late medieval Irish manuscript, the *An Leabhar Breac*, in which both divisions of the Dál Riata, one in *Alba* and the other in Ireland, "were of the seed of Cairpre rigfhota son of Conaire son of Mug from Munster," (Dumville 2002:188). Bannerman (1974) has suggested that Bede also alluded to the Caipre version of the migration of the Irish into Scotland in his "Ecclesiastical History of the English People":

> As time went on, Britain received a third nation, that of the Irish; they migrated from Ireland under their chieftain Reuda and by a combination of force and treaty, obtained from the Picts the settlements that they still hold. From the name of this chieftain, they are still known as Dalreudians, for in their tongue *dal* means a division. (Bede 46, translated by Sherley-Price 1903).

Several of the Irish manuscripts describe the migration of an Irish tribe not only into Scotland, but also into Northern Ireland, however the available evidence was vague, in some cases contradictory and written much later than the actual occurrence (see Dumville 2002 for further discussion).

The second and well-known origin-legend included the genealogy of Fergus Mór. The main source of his lineage, wealth and region was recorded in the *Míniugud Senchus fher nAlban.* Fergus Mór, the son of Erc was one of twelve sons; six brothers remained in Ireland and six emigrated to Scotland. Bannerman (1974) proposed Fergus Mór's arrival in Scotland to have occurred around AD 500, using evidence from the Annals of Tigernach and The Synchronisms of Fland Mainistreck. Several of the sources documented his death shortly after his arrival in Scotland. An entry in the Annals of Tigernach referring to the year AD 501 stated (Stokes 1896:124):

> Fearg*us* Mor m*ac* Earca c*um* gente Dalriada part*em* Britaniæ tenuit, *et* ibi mort[u]*us est*.

> 'Fergus Mór son of Erc with the people/nation of the Dalriada occupied a part/region of Britain, and there he died.'

Allegedly, three of the six brothers controlled Western Scotland, which was divided into three territories as detailed by the *Míniugud Senchus fher nAlban*. The tribal groups were listed as Cenél nOengusa, Cenél Loairnd and Cenél nGabráin who controlled the areas of Islay, the northern region of modern-day Argyll including Lorn and possibly Tiree, Iona and Mull and the southern half of Argyll including Kintyre, Bute, Arran and possibly Jura respectively (Figure 2.5). Until his death Fergus Mór led the Cenél nGabráin and was then succeeded by his son, Domangart. The reign of the Cenél nGabráin was passed down to the two sons of Domangart, Comgall and Gabran. The *Míniugud Senchus fher nAlban* was the main source of this origin-legend and references to particular names mentioned in other manuscripts were typically one-line entries announcing obits or brief mentions.

Fragments of the two origin-legends appear throughout several of the historical texts. As mentioned above, the dating of either of these legends proves fallible. This is due to the assumption that the surviving texts were based on information from earlier source material that is no longer obtainable. Unfortunately, the dating of these earlier manuscripts can only be speculated. To complicate matters further, a few academic sources have attempted to combine the two legends into a single timeline, in which the historical texts would be referring to two separate migration events, the first by Caipre, followed several centuries later by Fergus Mór. Duncan (1992) suggests two of the tribes listed in the *Míniugud Senchus fher nAlban*, the Cenél nOengusa and Cenél Loairn, were kindred from an earlier migration and that the Cenél nOengusa were known in Ireland before the time of Fergus Mór. This may have occurred during the end of the 3rd Century AD when Caipre Riata, who was suggested to have lived ten generations earlier than Fergus Mór, colonised Western Scotland (Bannerman 1974; Laing and Laing 1990; Macdonald 1950; Paterson 2001). The emergence of Cenél Comgaill in the 8th Century AD was the kindred of Fergus Mór's grandsons and probably gained control of Cowal during the decline of power of the Cenél nGabráin (Duncan 1992). This version of the origin-legend does appear plausible owing to the early reference of 'Reuda' by Bede and the later tribal names of Cenél Comgaill and Cenél nGabráin referring to the offspring of Fergus Mór, if the written sources are to be taken at face value.

Text	Original Source Date	Written Date
De vita et moribus Iulii Agricolae, Tacitus	1st C AD	1st C AD
Collectanea rerum memorabilium, Solinus	AD 77	AD 200
Geography, Ptolemy	2nd C AD	Mid 2nd C AD
Iona Chronicle	c. AD 670-740	N/A
Ecclesiastical History of the English People, Bede	AD 731	AD 731
The Ulster Chronicle	c. AD 740	N/A
Vita S. Columbae Tripartita, Adomnan	Late 7th C AD	8th C AD
Míniugud Senchus fher nAlban	7th C AD	10th C AD
De maccaib Conaire, Book of Leinster	Unknown	2nd ½ of 12th C AD
The Synchronisms of Fland Mainistreck	11th C AD	14th/15th C AD
Annals of Ulster	8th C AD	15th C AD
Annals of Tigernach	8th C AD	15th C AD
De Shíl Chonairi Móil, Book of Lecan and Book of Ballymote	Unknown	15th C AD
An Leabhar Breac	Early 15th C AD	Early 15th C AD
Chronicum Scotorum	Unknown	17th C AD

Table 2.1: List of written sources, their presumed origin dates and the dates of the surviving texts.

Overall, evidence from the texts does not reflect accurate information or account of the events occurring at the beginning of the 1st millennium AD. The classical texts illustrate Roman bias and vague descriptions of the local inhabitants of Britain and Ireland during the early centuries of the millennium. The indigenous manuscripts are thought to have been copied from earlier texts no longer existing, but with modifications and additional notes. Evidence of the earlier texts originating prior to 7th Century AD remains vague. Kelleher (1963) has suggested that entries concerning events prior to AD 735 were written or revised during the 9th Century AD. Consequently, the earliest written information on the study region provides legends and lineages rewritten for claims of leadership, in which the Scots emigration into Argyll should not be regarded as historical fact.

2.3 The Western sea route networks and migration

2.3.1 Research on maritime travel and Scottish-Irish affiliations

Early approaches to Atlantic Britain and Ireland were from a physical geographic outlook, in which regions were construed as independent landmasses where 'the seas divide and the land unites' (Bowen 1970; 1977). Ireland was described as an island, disconnected from the rest of Western Europe by the Irish Sea. Mackinder's (1902) regional divisions of Atlantic

Britain based on physical geography did however suggest the potential axes of contact between the western coasts of Scotland and Ireland (Henderson 2000b) (Figure 2.6). A decade later, an important recognition of sea travel was demonstrated through the distribution of Irish Bronze Age gold lunulae in Britain (Crawford 1912). Crawford (1912:196-7) also suggested the utilisation of isthmus roads to transport goods possibly to bypass treacherous coastal promontories. The first attempt at reconstructing a map of the major sea routes along the Irish Sea was by Sir Cyril Fox (1932) (Figure 2.7). He illustrated the Irish Sea as a north-south corridor with several shorter routes across the Irish Sea between the eastern coast of Ireland to Galloway, the Isle of Man, Wales and Cornwall. Later Crawford (1936) introduced a variation of the western sea-routes with more details of connections between southern Britain and the Continent (Figure 2.8).

A closer look at the postulated sea routes through the North Channel region indicates that Fox's (1932) theory relied on continuous journeys through this area and up to the Western Isles of Scotland. He felt the distribution of archaeological sites on Skye and the Outer Hebridean islands may reflect the last ports of call to gather supplies before continuing across the North Sea (Bowen 1970), but does not consider insular trade and contact routes between Argyll and the northern coastline of Ireland. Interestingly enough Crawford (1936) varied the route through the North Channel, in which the North Channel section between Kintyre and Co. Antrim was bypassed and the route extended into Argyll along the Firth of Clyde and Loch Fyne and then on land through to Loch Crinan on the western coastline.

Davies' (1946) research analysed the megalith distribution around the Irish Sea basin in conjunction with physical aspects of the sea, such as currents and tidal movements. Figure 2.9 illustrates the tidal currents, their maximum speeds in knots and whirlpools and eddies along the North Channel compiled by Davies (1946) from Admiralty Pilots. She noted that the tidal circulation has not changed drastically from prehistoric times due to the fact that the coastline has only been slightly altered. Davies suggests that due to the fast tidal flows and hazardous whirlpools along the North Channel, much of the traffic was probably by land routes, which utilised the raised beaches, particularly for the Antrim coast (Figure 2.10). As Bowen (1970:13) has discussed the importance of distribution maps where archaeological evidence along the coastline can illustrate the "existence of important maritime highways in the seas off western Britain, involving not only the ocean itself, but the arms which it pushes into the land, and the connecting routes across the peninsulas which bound its bays. In this way we are able to build up a picture of the intense maritime activity that characterized these sea-lanes from remote antiquity."

Little evidence of Iron Age and Early Historic objects from Ireland has been recovered from sites in Argyll. There was evidence of trade between the two areas during earlier periods. Several porcellanite Neolithic axes identified in Argyll from the southern tip of Kintyre, Jura, Colonsay, Islay and Mull were petrologically linked to Tievebulliagh on the north-east coast of Co. Antrim and Rathlin Island (Clough & Cummins 1988; Sheridan *et al.* 1992). The majority of porcellanite objects were distributed throughout Northern Ireland, with a high concentration in Co. Antrim, and spread outward towards Co. Donegal and up the Inishowen peninsula (Sheridan 1986). A Late Bronze Age penannular armlet Variety 10 was found in Kintyre and a hoard of 36 gold armlets in Islay were of the Irish type found in Co. Donegal and throughout Ireland (Harding 2006). An Irish origination for these armlets was indicated due to the higher proportion of this object type in Ireland compared to Scotland (Coles 1962). Irish bag-shaped axes dating to the first half of the 1st millennium BC were recovered from Galloway and related versions of the Irish type were found on Islay and Lismore (*ibid.*). Comparable artefacts from the 1st millennium AD were relatively sparse. Only a single loop-headed spiral-ring dress pin was recovered in Argyll, but these objects were commonly distributed though Northern Ireland and to a lesser extent Co. Donegal (Campbell 1999; 2001). In the second half of the 1st millennium AD a Type G3 penannular brooch workshop was excavated on the 'Dalriadic Royal' site of Dunadd, in which the moulds had affinities to a workshop at Dooey on the west coast of Co. Donegal (Lane & Campbell 2000).

By the 8th Century AD, Bede noted five 'nations' or peoples of Britain, that each spoke a distinct language. These included English, the Britons, the Scots, the Picts and the Church (Alcock 1993). Ritchie (1997a:62) strongly suggests that the inhabitants of Argyll, prior to the Dál Riata, spoke P-Celtic Brittonic. Whereas the Q-Celtic Goedelic language spoken by the Dalriadic *Scotti* in north-eastern Ireland was brought to Argyll during the 'migration' around AD 500. Alcock (1970; 1993) suggested the scarcity of P-Celtic placenames in Argyll might indicate that the transition from Brittonic to Goedelic may have lasted over a period of centuries. This was also supported by the Goidelic origin of modern placenames in Argyll

(Nicolaisen 1976). Only two stones with Irish Ogham writing were detected in Argyll, one at the site of Dunadd and the other on the island of Gigha, but this might rather reflect the predominant southern Irish aspect of Ogham writing. Adomnan's text suggested that by the 8th Century AD the language spoken in Argyll was Gaelic. This is supported by reference to place names and personal names. References also suggested the languages spoken by Columba and the neighbouring Picts were too different and a translator was necessary for effective communication (Anderson & Anderson 1991). Campbell (2001) has suggested a slightly different viewpoint, in which the language spoken in Argyll was more related to the Irish speakers across the North Channel, rather than the Pictish ones on land prior to the Dalriadic migration. The Grampian Highlands, known by the early medieval commentators as *Druim Alban,* may have acted as a linguistic barrier. This area may have reflected the true border between the Q-Celtic and P-Celtic languages during the 1st millennium BC, where the mountains divided rather than the sea. The pre-Dalriadic tribal name for the inhabitants of Argyll was the Epidii, which is of P-Celtic origin. Ptolemy's source, however, may have been from the Central Lowlands, which may reflect the Brittonic tribal and placenames in western Scotland, rather than indicating the language of the inhabitants (Campbell 2001).

The evidence of Irish objects in Argyll indicates that communication did occur between the inhabitants of these two landmasses. During the later prehistoric and Early Historic time periods, travelling across the sea between the northern part of Ireland and Argyll may have been precarious in small boats. Several types of boat technology were developed by the 1st millennium BC. The famous wooden Dover Boat recovered from the south of England dated to the Bronze Age (c. 1300 BC) was of considerable size, suggesting cross-channel trade with the Continent during this period (Clark 2004). Log boats or dug-out canoes were a popular means of water transport during the prehistoric and later periods throughout the British Isles and Europe (McGrail 1990a). Numerous examples, though undated, were recovered from both western Scotland and Northern Ireland. This type of vessel was most likely created for inland travel along the rivers, however, the log boat could be sea worthy with modifications (McGrail 1978). Unfortunately, not enough evidence of modified log boats dating to pre-Roman periods has been recovered to indicate this was a prevalent means of sea travel. A second type of boat construction was the hide boat or currach, built by stretching a hide or leather waterproof covering over a light timber or woven wicker framework. This type of boat would have been sturdy enough for sea-faring travel (McGrail

1995). Unfortunately, the construction materials rarely survive in the archaeological record, although, the golden model boat recovered from Broighter on the margins of Lough Foyle, Co. Derry in 1895 is thought to be a representation of a currach (McGrail 1995). This model dates to 1st Century BC and would have held nine oarsmen on each side and was fitted with a square sail (Farrell & Penny 1975). Numerous passages in Adomnan's *Vita S. Columbae Tripartita* describe ships with sails and oars (Alcock 1993), similar to the Broighter model. Classical literary evidence also documents the use of currachs at sea around Britain during the beginning of the 1st millennium AD from Caesar (*De Bello Gallico* 1.54), Pliny (VII.206), Lucan (*Pharsalis* IV.130-8) and Solinus (*Polyhistor* II.3) (McGrail 1995). The Greek merchant and explorer, Pytheas, also documented his travels to north-west Europe, including the Irish Sea and northwards through the N Channel, Sound of Jura and Sound of Mull around 330 BC (Cunliffe 2001).

The model boat from Broighter suggest that wind sails combined with rowing would have provided the power needed to cross the sea. The people sailing along the North Channel and the Atlantic Ocean would have been aware of dangerous areas caused by tidal circulation and the underwater topography. Overfalls or turbulent waters, caused by strong currents setting over submerged ridges would have caused difficulties. Davies (1946) illustrates the more prominent dangers that exist within the area of the North Channel and along the west coast of Argyll (see Figures 2.9 and 2.10). She justifies the use of relatively modern Admiralty charts to highlight these areas due to the fact that tidal circulation in the Irish Sea Basin has not had any marked changes over the last 5000 years and the configuration of the coasts has only slightly altered. Areas that may have proved treacherous for prehistoric marine travel were around the southern tip of Kintyre, where sea currents are forced to divide and flow around the peninsula (Nieke 1984). Overflows are noted along the north-eastern point of northern Ireland around Rathlin Island and Torr Head (Admiralty Chart 1886; Davies 1946). Other areas were near the Inner Hebrides and included the south-western coast of Islay around the Rhinns and the northern most point on Jura, to the north-west of Crinan Loch. The northern coastline of Co. Donegal provided relatively calm waters, particular near Fanad and Horn Head, an area consisting of several inlets and sandy beaches.

2.3.2 Migration

The establishment of probable sea routes along the North Channel, however does not rule out the postulated migration theories between Ireland and Argyll and the origins of the Scottish Dalriadic kingdom. The emigration presumption is largely formed from the 'information' recorded in the historical texts, evidence of a common language and placenames (Bannerman 1974; Koch 1991; Nicolaisen 1976). If a migration occurred, the archaeological record should reflect a massive re-organisation resulting from a change to the social structure, as observed in Brittany during the Roman conquest (Gilmour 2000). Indications of migration are observed through changes in the style of personal jewellery such as brooches and pins, artistic design in metalwork or the settlement evidence (Alcock 1970; Campbell 2001). In the case of Argyll, the lack of Irish-type structures, such as the earthen raths or stone cashels, and the recovered artefact evidence does not appear to support a situation of mass migration (*ibid*.). Gilmour (2000:161) has suggested that the appearance of rectilinear- and irregular-shaped structures in Argyll may signify a change in the social structure caused by an influx of a population, however this statement is impossible to confirm without an analysis of the Irish sites under a common classification scheme. Crannog sites are apparent on both sides of the North Channel, however the Scottish examples traditionally date to Early Iron Age and Irish examples date 600 AD and later, possibly suggesting the transference of cultural traditions moving from Argyll to Ireland (Campbell 2001). Recent evidence suggests several Scottish sites showing similar constructional features to Irish ones (Crone 2000; Cavers 2005), but the evidence is too slight to support theories of migration. This lack of evidence led to the postulation of the transference of a single dynasty rather than an entire population (Alcock 1970; 2003; Foster 1996). However in this circumstance, archaeological evidence would also be expected, in terms of objects distinguishing the emigrated elite from the established leadership. Campbell (1999; 2001) noted that brooches and dress-pins typical in Northern Ireland were absent from the Argyll material evidence.

In essence, the evidence discussed above fails to indisputably answer the debate between wholesale colonization or the imposition of a small but powerful dynasty. Harding (2006:71) has suggested the establishment of cross channel connections between related kin groups over several centuries, in which "the documentary record would not necessarily be wrong, serving simply as a metaphor for a longer and more complex process of cross-channel integration." This would also support Dumville's (1977) theory of the use of textual heritage to support the claim for leadership. The societal disruption that would be expected given these scenarios would not necessarily occur and the architectural development and material evidence would reflect cultural continuity.

2.4 Problem statement – the North Channel: a cultural region or home of several localised traditions

There are a number of inconsistencies in accounts of the origins of the Scottish Dál Riata. Information on tribal groups in western Scotland in the classical texts, such as Tacitus and Ptolemy, was probably gathered from sources in central and eastern Scotland, where the majority of the Romans in Northern Britain were located. This indicates that tribal names and places were documented in the local tongue of the source rather than the one used in western Scotland. The indigenous historical texts were written much later, when the Scottish Dalriadic kingdom was already established. These provided two legends for the origins of the Scottish Dál Riata, though both document an invasion/migration from populations in Ireland. Linguistically, the migration of the Scots into Argyll during the 1st millennium AD was thought to be of the transition from Brittonic to Goedelic language. There is no diagnostic material assemblage or settlement type that identifies the Irish Dál Riata or suggests a migration of people, in which L. Alcock asks, 'Did the Scots come without baggage?'

Perhaps the evidence indicates that a single dynasty from the Irish Dál Riata took over leadership in Argyll and established the Scottish Dál Riata rather than a wholesale population movement, suggest by the lack of Irish-type structures or evidence for a transfer of an Irish 'cultural package' (Alcock 1993; Foster 1996). However, could the arrival of a single dynasty instigate the replacement of the local Brittonic language by an imported Goedelic language or was a single language used throughout the area because of trade and communication? The social affinities between the areas on either side of the North Channel are difficult to assess. No definitive material culture assemblage exists in Northern Ireland during the late 1st millennium BC and early 1st millennium AD and 'ethnic groups need not be distinguished by an exclusive material culture" (Harding 2006:17). Nieke (1984) has suggested a history of intermarriage between 'royalty' from Argyll and Northern Ireland prior to the establishment of the Scottish Dál Riata. This circumstance would not be reflected by the archaeological evidence and would explain the importance of Irish connections and ancestry in the Scottish Dál Riata and the use of 'revised' king-lists and genealogies to demonstrate the claims to leadership. Campbell's (2001) view on the Grampian Highlands acting as the language barrier, suggested that the Goedelic language was used in Argyll due to constant contact with the Irish neighbours. Kinship ties, evidence of prehistoric trading and the probability of a common language may indicate the landmasses bordering the North Channel developed as a region, rather than as separate cultural entities.

Three distinct areas are investigated in order to identify localised traditions and distribution patterns. These areas are Argyll in Scotland, the north and north-east coastlines of Northern Ireland and the whole of Co. Donegal in Ireland (refer to Figure 2.1). Results of the analyses in all three areas will indicate whether this region reflects a shared tradition or if particular localities demonstrate a mixture of local distinctiveness and overseas influences. Probable maritime networks during the 1st millennium BC and 1st millennium AD are identified through the examination of local architecture and settlement patterns. Recognisable similarities are taken to be the result of shared ideas, rather than independent invention. On the whole, the domestic structures between the three areas reflect dissimilarity more than comparable features. This is in terms of size, building material and morphological layout. This, however, could be the consequence of variations between very different classification schemes for settlement systems applied to each area.

Under a single classification scheme, the existence of shared architectural trends may come to light. Specific architectural features, such as intramural galleries, have been noted in sites on both sides of the North Channel (Gilmour 2000; Henderson 2000b) but there is not enough evidence to support a societal migration in either direction or to unite the region into a single cultural identity. Distribution analyses can then be compared systematically and similar patterns may be uncovered. Sites types are analysed by their distribution patterns with regards to particular environmental variables and the visibility from their locations. Examination of the results of these analyses may indicate areas of high contact through site distribution and visibility patterns. The central theme for this thesis depicts the sea as pivotal to human activity and as the main means of contact between smaller regions.

Chapter 3: Physical Landscape and Palaeoenvironment of the Study Region

3.1 Introduction

This chapter briefly summarizes the physical landscape, prehistoric climate and the paleoenvironmental evidence concerning subsistence for the study region. Section 3.2 is a detailed description of the study region and is subdivided into the study areas of Argyll, Northern Ireland and Co. Donegal. This section describes the underlying geology, the topography and significant landscape features for each study area. Section 3.3 provides a brief overview of probable climatic conditions occurring from the prehistoric through to the Early Historic periods. Environmental evidence is used to outline the climatic and agricultural history for Argyll and Ireland. Upland areas consist of land located above the limits of arable agriculture (Ratcliffe & Thompson 1988), where the probable maximum altitude for cereal crop cultivation is marked around the 200m contour and for animal grazing at 600m OD (Alcock 2003). Due to the lack of paleoenvironmental research in Co. Donegal, sites from both the whole of Ireland and Northern Ireland are discussed to represent the areas as a whole.

3.2 The Physical Landscape

As briefly discussed in Chapter 2, the study region covers the area surrounding the northern half of the North Channel (refer to Figure 2.1). The narrowest section of water separating the landmasses of Britain and Ireland is found between the top of Kintyre and the north-east coastline of Co. Antrim measuring as little as 12 miles. To the north-east of the channel in western Scotland lie the peninsulas and islands that make up Argyll. South-west of the

North Channel, the coastlines of Co. Antrim and Co. Londonderry in Northern Ireland and Co. Donegal in the Republic of Ireland form the most westerly part of the study region, where the North Channel runs into the Atlantic Ocean. The character of the landscape throughout the study region is a complex mixture of mountains, peninsulas, sea lochs, jagged coastlines and sandy bays.

3.2.1 Argyll

The limit of the study area includes the Argyll mainland and the Inner Hebridian islands (Figure 3.1). The central Highlands border on the east, which may have inhibited travel and communication between western and eastern Scotland. The islands of Islay and Jura create a sea corridor to the east leading up to Kilmartin, where the Dalriadic capital supposedly stood at Dunadd Fort. To the west of Islay and Jura are the small low-lying islands of Colonsay and Oronsay. Directly north-east of Colonsay is the mouth of the Firth of Lorn, which lies between Mid-Argyll and Mull, leading up to the start of the Great Glen. The small, elongated island of Lismore lies at the convergence of the Firth of Lorn and Loch Linnhe. Two small outlier islands, Coll and Tiree, lie at the northwest limit of the study area.

The Great Glen Fault runs south-west to north-east dividing the mainland and continues to the south-west beneath Loch Linnhe clipping the south-east edge of Mull (Stewart & Strachan 1999) (Figure 3.2). North of the fault zone, the mainland consists mainly of Moine metamorphic rock with intrusions of Caledonian granite masses (RCAHMS 1980). A narrow coastal fringe provides a limited amount of land suitable for settlement bordered by mountains and deeply incised valleys on the west coast. North of the fault line are the islands of Mull, Coll and Tiree. The geologically complex island of Mull can be divided into several parts. The northern area is formed from basalt lavas creating distinct fertile plateaus and steep cliffs (ERM 1996). Distinctive basalt columns are observed on the small island of Staffa lying off the west coast of Mull. To the south, the land is more rugged, but also consists of a coastal fringe suitable for settlement. The low-lying islands of Coll and Tiree consist of hard granitic gneisses underlying fertile, well-drained machair. Fertile machair soils cover large expanses of Tiree, whereas the more rugged terrain of Coll limits this soil cover (RCAHMS 1980).

On the mainland south of the Great Glen Fault, the underlying geology principally consists of Precambrian Dalradian metamorphic rock with narrow bands of limestone (Craig 1991). Much of the coastline is broken by small bays and inlets. To the east lie the steep mountain ranges of the Lower Grampians. These consist of bare rock, scree slopes and strongly ridged, steep-sided U-shaped valleys formed by glacial scouring (Bibby *et al*. 1982). Numerous freshwater lochs and bogs are found within the valleys. Much of the soil development in the upland region is greatly restricted due to shallow acidic and nutrient-poor fluvio-glacial deposits that overlie bedrock outcrops. Land to the immediate south and south-east, consists of low, rounded hills and open moorland. There are some areas of high quality soils to be found along the river valleys and coastlines in areas of fluvioglacial terraces of sands, clays and gravels, such as the outwash region of the River Add (near Dunadd on Figure 3.1).

To the south, lies the large peninsula, Kintyre, jutting out into the North Channel. Its northern end is cut by several sea lochs and consists of a series of tightly folded parallel ridges and valleys running in a south-east north-west alignment. Land generally rises steeply from the coastline, limiting settlements to a narrow coastal strip (RCAHMS 1988). Further south, along the peninsula are undulating plateaus dropping off in precipitous cliffs to the western shoreline (ERM 1996). A large, flat coastal plain lies near the southern tip of the peninsula rising to the uplands of the Mull of Kintyre. The islands in the eastern half of the study area, south of the Great Glen Fault are Jura, Islay, Colonsay and Oronsay. Jura is largely composed of quartzite, notably observed in the dominant natural features, the Paps of Jura (ERM 1996). Much of the island consists of infertile upland heather moorland and peat bogs, though the eastern side of the island consists of better-drained Dalradian limestone and more fertile soils. Islay, by contrast, mainly consists of Dalradian limestone, which is represented by the lush soils. Colonsay and Oronsay largely consist of marine sands giving rise to the formation of fragile but fertile calcareous machair grasslands.

3.2.2 Northern Ireland

The limit of the study area includes four of the six counties in Northern Ireland; Co. Londonderry, Co. Antrim, Co. Down and Co. Armagh. All four of these counties converge in the centre at Lough Neagh, (Figure 3.3) the largest body of freshwater in the British Isles at 388sq km. About 43% of the water in the catchment area of Northern Ireland flows into

Lough Neagh, which itself exits out through the River Bann (Carter 1993). The floodplain area makes up the Bann lowlands, a north-south corridor running between Lough Neagh and the coast. To the west of the Bann valley the study area is bordered by the River Foyle, which flows north-east into a large sea lough, Lough Foyle. The northern coastline is dotted with small coastal bays within a high plateau landscape. The most notable geological features along this coastline are the basaltic columns and stacks known collectively as the Giant's Causeway. To the east, the coastline is lined with high cliffs, which border a high plateau cut by nine deep glens that open to the sea. The drumlin belt lies in the southern section of the study area, consisting of tightly packed small hillocks. The Mourne Mountains, to the south-east of this drumlin belt, and border the southern boundary of the study area and includes some of the highest elevations in the study area.

The underlying geology consists mainly of basalt in the north and shale in the south (Figure 3.4). The north-west part of the study area contains a mixture of both sedimentary and metamorphic rocks. The north-eastern coastline, below the cliffs, is an ancient raised beach that leads inland through the basaltic plateau by the way of the small glens. These glens, however, do not penetrate further south-west through the hills, but rather end abruptly. The uplands create a barrier between the mainland and the narrow coastline (Haughton 2005). The chief summits of the plateau are Trostan (554m) and Slieveanorra (513m), which reach heights up to 554m OD and 513m OD respectively (Figure 3.5). Heather moorland, peat bogs and patches of conifer plantations presently cover the hills. This plateau gently slopes inland, downwards to the west. The basalt underlies the Bann lowlands and is deeply covered in drift deposits of sand and gravel (Haughton 2005). Immediately south-east of the hills lies the Main River valley that drains in into Lough Neagh and is covered with well-drained glacial sands and gravels on which soils, suitable for agriculture, are formed. This valley runs parallel to the Bann river valley but is separated by the Long Mountain Range. The Bann lowlands and Lough Neagh occupy an elongated depression in the basalts. These lowlands are a mixed landscape including peat bogs, drumlins and well-drained sands and gravels (ibid.). West of the River Bann the basalt plateau reappears as a ridge running north-south from the flat coastal plain at Magilligan to the Sperrin Mountains in the south. The highest points of the ridge are found in the south, at Mullaghmore (554m OD) and Slieve Gallion (527m OD). The hills are presently covered in a mixture of moorland and conifer plantations and drop sharply to the west in a series of cliff-like escarpments overlooking the

Roe valley. The River Roe runs through a broad valley that opens out to the southern shores of Lough Foyle. Arable agriculture occurs on the sandy soils of the glacial ridges above the low-lying and poorly drained parts of the floodplain. The western side of the valley is bordered by the rising moorlands of the Loughermore hills and to the south by the more agriculturally suited grassland of the Sperrin foothills.

The majority of the southern half of the study area consists of sedimentary rocks including slates, shale and grits. This area consists of low rolling hills covered by a thick layer of glacial drift forming the numerous drumlins characteristic to the area (Proudfoot & Boal 1960). Outcrops of granite occur near the southern border of the study area observed at Slieve Croob and the more recent formation of the Mourne Mountains (Haughton 2005). The basalt plateau of the north and the lowlands in the south are separated by a strip of sandstone running along the Lagan valley. This is a wide, flat-floored valley running south-west to north-east opening to the sea through Belfast Lough. The valley floor is well drained due to the occurrence of glacial sands and gravels.

3.2.3 Co. Donegal

The limit of the study area includes most of the modern boundary for the county, with the exception of the southern limit bordered by the River Erne. This study area also includes the small section of area just south of the Inishowen peninsula to the west of the River Foyle, which in modern times is bounded by the present day limits of Co. Londonderry (Figure 2.1 and 3.6). The north-east part of the study area consists of a large peninsula, known as Inishowen, bordered on the east and west by sea lochs and on the north by the Atlantic. To the west of Inishowen, the northern coastline is made up of smaller peninsulas and sea lochs intermittently lined by sandy beaches. Along the western Atlantic coastline the terrain becomes rugged with several small islands, the largest being Aran Island. The south-western coastline is dominated by Donegal Bay and large stretches of sandy beaches.

A considerable amount of the study area consists of land above 180m OD. These uplands are dominated by rough pasture and blanket bog, with only c. 33% of the land suitable for agriculture (Lacy 1983) (Figure 3.7). The characteristic north-east to south-west trend of the Caledonian granite mountain ranges cover most of the western half of the study area

(Pitcher & Berger 1972). Through the north-western part of the study area lies the Gweebarra fault line, which divides the granite intrusions of the Derryveagh and Glendowan mountains formed through glacial erosion (Lacy 1983) (Figure 3.6). Expanses of blanket bog and areas with little soil cover lie on the high plateaus to the west of this fault (ibid.). Rising from the plateau are great conical peaks of quartzite such as the Muckish and Errigal Mountains. To the north lie a spread of peninsulas and fjord-like sea loughs. Deep deposits of boulder clay in this area are suitable for agriculture (Comber 2006). Further south lies a second plateau known as the Blue Stack Mountains consisting of granite. On the western most point of land into the Atlantic the land is rugged and discontinuous where the mountains reach the shore. The western half of Co. Donegal as a whole consists of large expanses of upland heather moorland observed in two ranges, between 30m OD and 100m OD and at a higher elevation between 200m OD and 260m OD (Figure 3.8). Lowland areas lie to the south at Donegal Bay and to the eastern half of the study area. The presence of glacial moraines and outwash gravels make these areas prime locations for agricultural practices (Haughton 2005). The area around Donegal Bay is cut-off from the east by the Blue Stack Mountains except through the Barnesmore Gap, a pass through the mountains that is historically one of the main routes from the west to the north. The Donegal Bay landscape is dotted with drumlins, the western end of the drumlin belt observed in the Northern Ireland study area, and is rich in carboniferous limestone. The eastern lowlands consist of the broad drift-covered valleys of the Swilly and Foyle rivers and are well suited for agriculture. North of these lowlands lies the Inishowen peninsula. This peninsula has comparable characteristics to the granite ranges of the west, in which the highest point is of Dalradian quartzite at Slieve Snaght (615m OD).

3.3 Later prehistoric and Early Historic economy in a climatic marginal region

This study region is defined as a maritime environment by its relationship to the ocean. Typically, this climatic environment consists of high precipitation levels, low variation in seasonal air temperatures and strong wind speeds. A feature of this region is the warm North Atlantic Drift, a westerly wind that flows up from the warm waters of the Atlantic Ocean, bringing relatively mild winter conditions to the coastlines (Haughton 2005) and produces the characteristic mild and damp climate observed today. During the prehistoric period between c. 3200-800 BC, the climate was generally warm and dry with intermittent colder episodes. After c. 800 BC the climate shifted to a wetter and cooler phase. This climate fluctuation between a cool and wet to a slightly warmer and dryer environment would have affected the agricultural potential in certain areas, particularly the uplands (Askew *et al*. 1985). With the additional influences of high winds and heavy rainfall, cultivation limits could become severely constrained. The evaporative power of the ocean climate may create habitats only suitable for particular vegetation species (Crawford 2000). Due to the oceanic currents in the region, some of the land was not marginal and therefore suitable for stable agricultural development (Parry 1978).

Climatic fluctuations between drier and wetter phases were traditionally thought to correlate with changes in the pollen records (Bridge *et al*. 1990). For example, the sudden reduction of pine evidence during the mid-Holocene (Birks 1975; Pears 1970) was possibly the response to a wetter climate phase, which was intense enough to affect the vegetation growth. Drier climatic phases would reflect an increase in pine pollen. Recent research has shown climatic wet and dry phases have been found to vary regionally across Scotland (Langdon & Barber 2005). A number of investigations have indicated changes in bog surface wetness that represents climatic fluctuations during the mid- to late Holocene (see Langdon & Barber 2005 for examples). In Scotland, the southern and coastal western examples indicated a higher sensitivity to climatic change than the central and eastern sites (Langdon & Barber 2005).

Forest clearance is often attributed to the intentional removal of vegetation typically for agricultural means, including both arable and pastoral. The decline of woodland species in paleoenvironmental data is not always an indication of forest clearance (Tipping 1994). The occurrence of ribwort plantain (*Plantago lanceolata*) in environmental samples indicates the clearance of woodland and is one of the first species to colonize cleared ground. The presence of both ribwort plantain (*Plantago lanceolata*) and cereal pollen and a decline in woodland species would probably indicate anthropogenic activity. However, research on Loch Bualaval Beag on Lewis demonstrated the presence of cereal-type pollen and ribwort plantain (*Plantago lanceolata*) occurring c. 6000 BC, prior to human agriculture activity (Fossit 1990). Woodland deterioration can be attributed to a combination of factors also including climatic fluctuations (Birks & Madsen 1979; Fossit 1990), machair formation (Ritchie 1979), natural soil acidification and blanket peat formation (Tipping 1994).

3.3.1 Overview of the evidence from Argyll

Palaeoenvironmental research on Argyll indicates several phases of woodland clearance and/or deterioration and the expansion of grassland throughout the prehistoric period. Possible anthropogenic influences were found on a number of sites, indicated by the presence of cereal pollen and ribwort plantain (*Plantago lanceolata*) (Walker & Lowe 1985). The decrease in woodland pollen could also be attributed to natural conditions such as expansion of mire and blanket bog. Episodes of decreased cereal-type pollen levels were also detected and were thought to coincide with periods of climatic deterioration (Macklin *et al.* 2000; Parry 1975). Parry's (1985) research on marginal agriculture in Northern Britain illustrated the span of cultivation was broadly limited up to 175m OD and 300m OD before significant crop failure. This limit roughly equates to the zone of skeletal mineral soils generally at 200m OD to 300m OD and higher (Askew *et al.* 1985).

Evidence of forest clearance for probable agricultural purposes during the early 1st millennium BC was indicated at Aros Moss near Campbeltown, Kintyre (Nichols 1967). By mid 1st millennium BC evidence of pastoral subsistence and birch scrub re-growth occurring on previously cultivated land was demonstrated on Oronsay and at Loch Cholla on Colonsay, respectively (Tipping 1994). During the second half of the 1st millennium BC, woodland regeneration and a decrease in agricultural evidence possibly reflected the environmental change to a cooler and wetter climate illustrated by pollen data from Gallanach Beg, Oban (Rhodes *et al*. 1992) and supported by evidence from Aros Moss (Nichols 1967). During this wetter episode, pastoralism possibly replaced arable subsistence in areas of marginal soils (Gilmour 2000). Evidence from the northern part of the study area on the mainland at Loch Shiel, Ardnamurchan, indicated a possible major clearance phase in the sediment record occurring after 300 BC (Tipping 1994). At the end of the prehistoric period, the woodlands of southern Scotland were possibly greatly diminished, primarily by anthropogenic means, but also with secondary influences of climate change, soil deterioration and blanket peat growth. The remaining woodland probably represented areas of re-growth from previous clearances (Tipping 1994:37). The next major woodland clearance was depicted during the mid 1st millennium AD at both Gallanach Beg (Rhodes *et al.* 1992) and at Aros Moss (Nichols 1967), possibly for the expansion of pastoral activity (Gilmour 2000).

3.3.2 Overview of the evidence from Ireland and Northern Ireland

The environmental data from both Ireland and Northern Ireland reflects a similar pattern to the one illustrated in the pollen evidence from Argyll. The first major woodland clearance phase is dated to around the end of the 2nd millennium BC. The expansion of agricultural activity is also attributed to a mixture of arable and pastoral based economies at Loughnashade in Co. Armagh (Weir 1994; 1995; 1997), Long Lough, Co. Down (Hall 1990), Weir's Lough in Co. Tyrone (Hirons 1984) and along the drumlin belt at Killymaddy Lough, Co. Tyrone (Hirons 1983). This was followed by a decrease in agricultural vegetation, possibly signifying climate deterioration throughout most of the 1st millennium BC. At this time, a regeneration of secondary woodland was identified at Cashelkeelty I in Co. Kerry (Smith 1999), Redbog in Co. Louth (Weir 1994; 1995) and Essexford Lough in Co. Louth (Weir 1995). Numerous Irish pollen diagrams illustrate that a severe regional episode of climate deterioration near the turn of the millennium, around 200-100BC suggesting a fall in population through the lack evidence for anthropogenic activity (see Baillie 1992; Barber 1982; Mitchell & Ryan 1998). Modest evidence for farming has been detected at a number of sites through the presence of ribwort plantain (*Plantago lanceolata*) and grass and some cereal-type pollen. These included locations in the north-east at Long Lough in Co. Down (Hall 1990), Loughnashade (Weir 1993), Whiterath Bog in Co. Louth (Weir 1995), Essexford Lough, Killymaddy Lough and Weir's Lough; in the west at Mooghaun Lough in Co. Clare (Molloy 1997) and Lough Sheeauns in Co. Galway (Molloy & O'Connell 1991) and in the south of Ireland at Cashelkeelty I. This was further supported by evidence from the south-west of Ireland at Dromatouk 1 in Co. Kerry, in which the inception of peat was followed by pastoralism activity (Lynch 1981). This evidence may suggest a picture of gradual climate deterioration with a severe episode causing the abandonment of areas of marginal soil quality and the switch from arable to pastoral subsistence in more sustainable soils.

Pollen evidence dating to the first few centuries of the 1st millennium AD depicts an increase in secondary woodland regeneration at Essexford Lough. Evidence from Mooghaun Lough illustrates a scene of open landscape and a decline in pastoral activity, suggesting woodland regeneration (Molloy 1997). After c. AD 250-300, this situation rapidly changes and a marked increase in secondary woodland clearances and intensive mixed farming activity is observed at Mooghaun Lough (Hall 2000; O'Connell 1980) and possibly initiated much earlier at Loughnashade (Edwards 2005; Weir 1997), Essexford Lough and Redbog. Several catalysts are attributed to the cause for the sudden change, which include improvements in climate, land management (Baillie 1995; Huntley *et al*. 2002; McDermott *et al*. 2001) and plough technology (Brady 1994; McCormick 1995). Environmental evidence throughout the whole of Ireland illustrated intensive farming of both arable and pastoral and continued clearance with a few intermittent phases of slight woodland regeneration for the remaining duration of the 1st millennium AD.

3.4 Conclusion

The retreating glaciation across the region has caused the south-west to north-east trend observable in the mountain ranges throughout Co. Donegal and northern Argyll. The highest points of the study region are located in Argyll and Co. Donegal where the proportion of uplands characterized by the heather moorlands is larger than in Northern Ireland. Both the former areas have large expanses of mountainous areas covered by peaty soils. Ancient volcanic activity has formed the distinct basaltic columns witnessed on both the northern coast of Northern Ireland and off the western side of Mull. The paleoclimate evidence appeared consistent between Ireland and Argyll. Pollen analyses suggested climate deterioration during the latter half of the 1st millennium BC indicated by the increase in woodland pollen and a decrease in agriculture indicator pollen. The inception of blanket peat growth occurred during this period. The next major clearance phase was detected around the mid 1st millennium AD, which suggested climatic improvement and an increase in anthropogenic activity.

Chapter 4: Site Morphology: from inherited descriptions to a common classification scheme, the archaeological evidence and the geographical distribution

4.1 Introduction

This chapter reconsiders the archaeological data and applies a common classification scheme to sites across the entire study region. Firstly, Section 4.2 reviews previous site descriptors and classification schemes utilised in each study area. This is followed by a justification and presentation of the classification scheme developed for the current research, which overcomes restrictive boundaries and misleading typological groupings apparent in earlier schemes. Sections 4.3 and 4.4 discuss the excavated evidence in reference to chronology and the current classification scheme. A comparative analysis on site typology and their geographical distributions in each study area is illustrated and discussed under Section 4.5.

4.2 Inherited evidence: the development of site classification schemes

Since the late 1700s, several terminologies and classification schemes have been developed, modified and applied to the upstanding domestic structures in each of the geographical areas in this research. Each scheme was developed with underlying stimulants that shape the typology contemporary to that particular time. Classifying the data gives order to the various structure types, which then can be applied to distribution analyses. Archaeological site data in the current research is uniquely maintained by three separate governmental bodies. These comprise the Royal Commission of Ancient and Historical Monuments, Scotland (RCAHMS) for Argyll the Environment and Heritage Service, DoE NI for Northern

Ireland and the Department of Environment, Heritage and Local Government for Co. Donegal in the Republic of Ireland.

4.2.1 Previously applied site terminology for Argyll

A variety of terms introduced over time have been applied to the drystone structures in Argyll. These include terms such as dun, broch, galleried dun, semi-broch and fort. Characteristic sites for Argyll are mostly of drystone construction and exhibit a wide range of sizes and architectural features. As early as 1792, the term 'dun' was applied to later prehistoric fortified structures by Colin McKenzie (Maxwell 1969). Several of the circular drystone sites demonstrated a collective group of architectural features constructed within the enclosing wall(s), in which the term 'broch' was utilised to distinguish this type of site. Early definitions for the 'broch' type site consisted of a massive, circular drystone structure of hollow-wall construction or two concentric walls connected by lintels, consequently creating galleries that circled around the entire structure (Anderson 1878). These sites typically stood up to 15m high and incorporating chambers and staircases within the wall(s). Thomas (1890) devised a classification scheme to differentiate the later prehistoric fortified sites as either a 'dun' or a 'broch tower' and subclassed the 'duns' according to topographic locality. The term 'fort' was also applied to fortified enclosures during this time (Christison 1889; 1904; RCAHMS 1928). Terminology differentiating 'forts' from 'duns' was roughly based on size, in which smaller examples were classified as 'duns', however delineation by size was ambiguous between the small 'forts' and large 'duns'. Additional definitions have been introduced to categorise 'dun' sites that encompassed broch style architectural features, but did not wholly adhere to the broch criteria. Examples included 'duns' encompassing intramural galleries, termed galleried duns, and structures with concentric wall with no evidence of an intramural stair or upper gallery, labelled as semi-brochs (Beveridge 1903; Feachem 1963; Young 1962). Up to the 1960s, only the 'broch' site had a rigid definition, whereas the terminology applied to the remaining drystone structures appeared less structured and was constantly modified.

In the late 1960s, Maxwell (1969) devised a scheme to systematically differentiate 'duns' from 'forts'. This scheme was incorporated by the RCAHMS and used during the archaeological surveys for the Inventory volumes on Argyll produced in the 1970s and 1980s (see RCAHMS 1971; 1975; 1980; 1984; 1988). The RCAHMS defined a rigid list of criteria for the 'broch' classification and all drystone sites not compliable to this 'broch' definition as either 'duns' or 'forts' depending on the internal size. Most 'forts' in Argyll, however, are relatively small, in which differentiating them from 'duns' was difficult (RCAHMS 1971). The definition of a 'fort' relied on size and needed to be large enough to accommodate a small community, whereas a dun was considered for a single-family unit. A cut-off point at 375m^2 was determined, in which sites measuring below this point were classed as 'duns' and larger sites as 'forts'. Occupation for these site types was roughly dated through a limited number of excavations. Several 'brochs' throughout the whole of Scotland were excavated and dated to around the turn of the millennia (RCAHMS 1971). 'Forts' were though to have been a 1st millennium BC phenomenon supported by excavations from sites, such as Duntroon (Christianson *et al* 1905). Very few 'duns' have been excavated, however, evidence from Dun Fhinn, Kildonan and Ardifuar have suggested occupation during the 1st millennium AD (Alcock & Alcock 1987; Nieke 1984). Also, the structural sequence of 'duns' overlying 'forts' observed at a few sites instigated the model that 'forts' dated earlier than 'duns' (Nieke 1984; RCAHMS 1971). The majority of fortified, later prehistoric drystone monuments were classed into the three major categories of 'fort', 'dun' and 'broch'. Unfortunately, the classification scheme applied by the RCAHMS conveyed overly strict definitions and a lack of consistency.

Succeeding research on the later prehistoric drystone sites of Argyll highlighted several issues with the RCAHMS classification scheme. For example, simple circular stone-walled structures, sites encompassing architectural features identical to those found in 'brochs' and irregular-shaped sites were all enveloped under the single heading of 'dun' (Figure 4.1). The RCAHMS classification system does not separate the complexity of structures under the 'dun' heading and analyses on settlement patterns using this scheme would not represent accurate interpretations by considering all 'dun' sites as the same. Alcock & Alcock (1987) highlighted inconsistencies with the diameter size break point between fort and duns, in which the internal area size of several duns measured over 375m^2 (Figure 4.2). As a response, the classification system was comprehensively questioned (Armit 1990b; Harding 1984; 1997; Hingley 1992; Nieke 1990) and re-evaluated (Gilmour 1994).

Harding (1984) investigated the dimension of sites within the dun classification and suggested the refinement of the class based on size. He sorted structures into two categories using a breakpoint of 15m internal diameter, thereby proposing to separate sites that could potentially be roofed and ones that were too large or irregular shaped. The roofing potential of a site might affect the possible function of the site as either a homestead for a single-family unit or a larger enclosure, which in turn would influence interpretations of settlement patterns. Considerable variation in the internal area was demonstrated between the 'dun' sites, in which inferences on social status may be concealed through use of a single term to define a diverse range of sites (Alcock & Alcock 1987). Basic statistical analyses undertaken by Alcock & Alcock (1987) determined that 66% of known duns fell within the criterion of a dun house, i.e. with a diameter of 15m or below. The re-evaluation of the 'dun' class highlighted a subset of smaller sized sites that may convey a different functionality from the larger sites under the same heading.

Armit (1991; 1992) introduced a new classification scheme for approaching the site data in the Outer Hebrides in a less subjective manner. Armit's scheme simplified the collection of categories that shared similar traits such as duns, galleried duns, broch and semi-brochs. His scheme allowed the comparison of curvilinear sites exhibiting similar architectural traits that were previously classified under separate headings. Harding's (1984) subdivision of dun structures by roofability was also incorporated into the typology. When this approach was linked with evidence produced from excavated sites, a greater depth of meaning could then be extracted from the overall database.

Gilmour (1994; 2000) adapted and modified Armit's scheme for drystone sites in Argyll. The classification step of roofability became one of the final steps in the method rather than an initial one. Roofability was a subjective decision, in which the functionality of the structure would be implied. The size of a site, therefore, should not be an initial typological criterion. Table 4.1 illustrates the number of sites classified in Gilmour's scheme for all of Argyll. Circular and oval sites demonstrated smaller diameters, whereas irregular and rectilinear sites were larger. When compared with excavated evidence, smaller circular sites suggested origins in the 1st millennium BC and the larger irregular and rectilinear sites demonstrated evidence of 1st millennium AD occupation. His chronological findings also suggested similarities with the paradigms of settlement evolution suggested for other areas of Atlantic

Scotland. This classification scheme ordered the site data into manageable and coherent groups, in which a greater depth of meaning could be extrapolated from the database.

Classification	Number of sites
Circular/Oval	188
Rectilinear	95
Irregular	154
Promontory	34
Cellular	10
Linear	3
Incomplete	15
Total	199

Table 4.1: Gilmour's classification of stone structures in Argyll (1994; 2000).

4.2.2 Previously applied site terminology for Northern Ireland and Co. Donegal

As early as the mid 1800s the terms fort, dún, lios, ráth and caiseal were used interchangeably to define the typical homestead enclosure throughout both Northern Ireland and the Republic of Ireland (Wakeman 1848). Such monuments were enclosed by one or more walls or banks and the earthen examples were further enclosed by outer ditches. These outworks were thought to have been more for penning purposes or protection from wild animals rather than defensive ones as observed on hillforts (Westropp 1901). More recently, the majority of these sites in Northern Ireland and Ireland have been classified as 'Ringforts'. Tens of thousands of these monuments are thought to be distributed throughout the whole of Ireland, and neither function nor chronology was assumed to be the same for all sites in this classification (Lacy 1983:119). Unfortunately, the categorising of enclosure sites appeared to have been inconsistent during various inventory compilations, thus creating varied classifications of comparable monuments throughout the counties of Ireland. Terms such as enclosure, earthwork and ringfort were used indistinguishably in some inventories, yet have distinctions in others (Limbert 1996).

Early classification schemes focused on the size, shape and number of enclosing circuits. Macalister's work (1928) stressed the differentiation between the number of ramparts enclosing the site, which in turn became a criterion for subsequent schemes (Figure 4.3). The majority of earthen ringforts in the whole of Ireland were univallate, whereas multivallate sites were less frequent (Figure 4.4). Fahy (1969) devised a scheme accounting for the variation of enclosing outworks, in which all ring-forts detected in the field could be appropriately classified. However this scheme proved to be too complex with the numerous subdivisions and included the number of enclosing ditches as a primary classification, which may not always be apparent in the field (Barrett 1980).

The surviving enclosures considered in the current research are found in a variety of construction types ranging from earthen banks to drystone walling. The term, rath, generally referred to ringforts consisting of earthen ramparts (Limbert 1996). Cashel was employed to distinguish sites constructed of drystone walling from the earthen rampart examples. Cahir and dún were also popularly used for drystone sites. Sites falling in-between these extremities of the continuum between earthen rampart and drystone walling have enclosing banks composed of both earth and stone in a variety of forms. Examples of these may consist of an earthen core with stone facing or a drystone wall completely concealed by a mixture of earth and stone bank resulting from modern ploughing. These differing bank compositions, however, can rarely be distinguished through field observation alone.

Field surveys have detected a correlation between local geology and the distribution of earthen ringforts and stone cashels (Cotter 1993); there is a high proportion of cashels in Donegal (Lacy 1983) and very few surviving in Co. Meath (Moore 1987) and Co. Louth (Buckley & Sweetman 1991). If geology is the underlying influence for building material, then distribution analyses utilising a classification scheme based on construction type may detect inaccurate patterns. The landscape in the west consists of carboniferous limestone outcrops and thin soils making drystone walling the simpler constructional technique. Less available stone for building and deeper soils occur in the lower lands along the eastern half of Ireland. Mountainous areas in the east also provide glacial eroded stone debris such as the lower slopes of the Mourne Mountains in Co. Down (Limbert 1996). Also, material finds recovered from excavations have not revealed significant differences between the two construction types (Barrett 1980).

Defining more rigid terminology has been attempted, however these were either used loosely in later surveys or ignored altogether. Warner (1981) introduced the term 'ring-work' to define ringforts that were too small for defensive purposes. This was to differentiate enclosure sites assumed to function as farmsteads with protective enclosing banks or walls from sites of military significance. Raftery (1972; 2005) attempted to classify the hillfort typology into three categories, based on the number of enclosing ramparts and typological location. Unfortunately, the one term that has continued use throughout time was 'Ringfort', which still pigeonholed most enclosure sites.

Prior to Raftery's (1972) work on classifying hillfort sites, the use of this term was sporadic and allusive. Studies on Irish prehistory either avoided attaching the classification to particular sites or made brief comparisons to equivalent sites in Europe (Henry 1965; Ó Ríordáin 1943; Radford 1966; Raftery, J. 1951). Raftery (1972) devised three main classes to define large hilltop enclosures. The first class included simple univallate sites with a rampart of earth or stone. Multivallate sites with widely-spaced ramparts on hilltops or clifftops were categorised as Class II. Class III sites encompassed all inland promontory forts.

The Western Stone Forts Project addressed the issue of dating drystone monumental sites, typically in prominent positions, along the western coastline of Ireland. This series of sites "are distinguished from the majority of cashels, promontory forts etc. by the massiveness of their enclosing wall or walls and by a number of other architectural characteristics," (Cotter 1993:2). Similarities within this particular group of sites have been noted since the 19th Century, which include features such as wall thickness, internal terraces, intramural cells and stairs (e.g. Graves 1859). Only one site in Co. Donegal, Grianán Ailech, is classed in this particular series. The site Dromboghill, near the western coastline of Co. Donegal, has comparable features such as intramural galleries and double staircases to those observed on the Western Stone Forts, but is located on a small low lying island rather than a hilltop or promontory cliff. Sites within this series are similar in wall construction and architectural features, but also are morphologically varied from triangular-shaped to circular and have a range of internal sizes.

Several attempts at classifying enclosure sites were discussed above, in which the results from survey work highlighted the problems that arise out using several terminologies for comparable sites. For example, survey work in Co. Down classified several hilltop enclosures as ringforts (ASNI 1966). However, comparable structures were identified as hillforts and promontory forts and were equivalent in size to the ringforts (Barrett 1980;

Limbert 1996; Warner 1981). Sites of varying morphological character were classed under the same heading (Buckley & Sweetman 1991). Conversely, there was no distinction between sites of earth and 'stone and earth' construction for raths/earth ringforts. Many of these problems echoed the issues concerning the RCAHMS classification scheme for Argyll (*supra*).

4.2.3 Classification justification and strategy for the current research

Due to the independently developed and broadly defined classification schemes employed by the governmental agencies/bodies that manage the archaeological databases of their respective areas, difficulties have arisen during architecture comparisons and site distribution analyses between Scotland and Ireland. Currently, a common classification scheme that incorporates sites from either side of the North Channel does not exist. Therefore, it is necessary to develop a typology that applies to the site types in the three geographic areas.

The classification scheme for the current research is based on the strategy originally devised by Armit (1991; 1992) and later modified by Gilmour (1994). Gilmour's application of a classification scheme based on morphology was able to recognize curvilinear from rectilinear and irregular-shaped sites that were previously classified under the same heading. His findings demonstrated that curvilinear sites typically had smaller internal areas than the rectilinear and irregular-shaped sites. He also detected a number of small circular drystone enclosures comparable to sites further north in the Western Isles that were previously concealed by the RCAHMS classification system. Excavation evidence from rectilinear and irregular-shaped sites suggested the appearance of these sites in the 1st millennium AD. Re-assessment of the dating evidence recovered from the smaller curvilinear-shaped sites previously dated to the 1st millennium AD was proposed to be from secondary occupation and the construction of the original curvilinear structure would be much earlier. Thus, Gilmour's research has demonstrated a more coherent distribution pattern of monuments in Argyll, in which curvilinear sites may have connections to those in neighbouring areas and the rectilinear and irregular-shaped sites date later than the curvilinear examples.

The scheme used in the current research was chosen on the basis of Gilmour's (1994) findings, in which he demonstrated comparable sites between the Western Isles and Argyll. The application of this scheme to sites in Northern Ireland and Co. Donegal may also illustrate comparable sites to Argyll through morphology and size. The first level of typology categorizes the morphological shape of the innermost enclosure. These include curvilinear, rectilinear, irregular and sites located on promontories (Figure 4.5). The irregular classification is further sub-classed into curvilinear, rectilinear and irregular variations. The irregular shapes of these sites are usually influenced by the topographic surface area they are located on. Sites classified as irregular-curvilinear sites are typically of pear- or egg-shape (Figure 4.6). Triangular and D-shaped structures fall under the irregular-rectilinear classification (Figure 4.7). Sites that did not correspond to either the irregular –curvilinear or –rectilinear categories are considered irregular-irregular and are typically elongated or asymmetrical (Figure 4.8). Sites with architectural features are also sub-classed by morphological shape. These features include intramural galleries and cells, cells built into the entrance passage, median wall-faces and staircases. Several of the sites had additional enclosing banks or walls, in which the number of enclosing circuits is noted (see Appendix 2).

As discussed in the previous section, sites in Northern Ireland and Ireland are generally of drystone construction, earthen banks or ramparts constructed of both earth and stone. The construction type of a site has been suggested to be a product of material availability, rather than an indication of functional distinction and their distribution is simply a reflection of the availability of raw materials (Barrett 1980; Gilmour 2000; Limbert 1996). However, Henderson (2000b) has noted the presence of earthen 'raths' in areas also populated by drystone 'cashels', but a lack of 'cashels' in areas with a high number of 'raths' in eastern Ireland. He suggested that this is possibly demonstrating sites from different time periods, rather than a reflection of the local geology. Therefore, sites are also sub-divided by construction material to investigate whether the site distribution is comparable within each of the morphological headings. These include drystone walling, earthen ramparts and stone and earthen ramparts. The latter classification includes sites with a stone-revetted or stony earthen bank and may not actually reflect a distinct site type, but rather differentiates ambiguous enclosures construction.

Finally, sites are then grouped by the internal size of the site, above or below 15m diameter ($180m^2$), which is the suggested breakpoint for roofability (Harding 1984). This is used to divide the sites between a single household unit from enclosing yards with internal domestic structures. Table 4.2 specifies the abbreviations for each classification type that will be applied from this point onward. Sites within each category may not all be contemporary, particularly the larger groups, but rather may have reflected the cultural continuity over a period of time.

Classification Heading	Abbrev
Curvilinear drystone sites with an internal area below 180m^2	CSB
Curvilinear drystone sites with an internal area above 180m^2	CSA
Curvilinear sites constructed of stone and earth with an internal area below 180m^2	CSAEB
Curvilinear sites constructed of stone and earth with an internal area above 180m^2	CSAEA
Curvilinear sites constructed of earth with an internal area below 180m^2	CEB
Curvilinear sites constructed of earth with an internal area above 180m^2	CEA
Rectilinear drystone sites with an internal area below 180m^2	RSB
Rectilinear drystone sites with an internal area above 180m^2	RSA
Rectilinear structures sites of stone and earth with an internal area below 180m^2	RSAEB
Rectilinear structures sites of stone and earth with an internal area above 180m^2	RSAEA
Rectilinear structures sites of earth with an internal area below 180m^2	REB
Rectilinear structures sites of earth with an internal area above 180m^2	REA
Irregular-curvilinear drystone sites with an internal area below 180m^2	ICSB
Irregular-curvilinear drystone sites with an internal area above 180m^2	ICSA
Irregular-curvilinear sites constructed of stone and earth with an internal area below 180m^2	ICSAEB
Irregular-curvilinear sites constructed of stone and earth with an internal area above 180m^2	ICSAEA
Irregular-curvilinear sites constructed of earth with an internal area below 180m^2	ICEB
Irregular-curvilinear sites constructed of earth with an internal area above 180m^2	ICEA
Irregular-rectilinear drystone sites with an internal area below 180m^2	IRSB
Irregular-rectilinear drystone sites with an internal area above 180m^2	IRSA
Irregular-rectilinear sites constructed of stone and earth with an internal area below 180m^2	IRSAEB
Irregular-rectilinear sites constructed of stone and earth with an internal area above 180m^2	IRSAEA
Irregular-rectilinear sites constructed of earth with an internal area below 180m^2	IREB
Irregular-rectilinear sites constructed of earth with an internal area above 180m^2	IREA
Irregular-irregular drystone sites with an internal area below 180m^2	IISB
Irregular-irregular drystone sites with an internal area above 180m^2	IISA
Irregular-irregular sites constructed of stone and earth with an internal area below 180m^2	IISAEB
Irregular-irregular sites constructed of stone and earth with an internal area above 180m^2	IISAEA
Irregular-irregular sites constructed of earth with an internal area below 180m^2	IIEB
Irregular-irregular sites constructed of earth with an internal area above 180m^2	IIEA
Promontory sites with an internal area below 180m^2	PB
Promontory sites with an internal area above 180m^2	PA
Curvilinear sites with an internal area below 180m^2 and encompassing architectural features	AFCB
Curvilinear sites with an internal area above 180m^2 and encompassing architectural features	AFCA
Irregular-curvilinear sites with an internal area below 180m^2 and encompassing architectural features	AFIC
Irregular-rectilinear sites with an internal area below 180m^2 and encompassing architectural features	AFIR

Table 4.2: Site classification headings and the associated abbreviations.

4.3 Excavated evidence and site descriptions from Argyll

This section discusses the excavated evidence chronologically by sites under the classification strategy for this research. As Gilmour (1994) detected in his research the majority of excavated sites indicated evidence of secondary occupation or re-use of the site. Unfortunately, material used to date the initial occupation of several sites was often found in secondary contexts. Gilmour's re-evaluation of the excavated evidence in Argyll demonstrated that multiple occupation layers were not recognised, particularly for the earlier excavations (e.g. Childe and Thorneycroft 1938; Christison 1891; 1904; 1905). A pattern was recognised through his analysis, in which smaller curvilinear sites dated earlier than the rectilinear and irregular sites.

4.3.1 Occupation evidence during the 1st millennium BC

Sites with construction phases that date to the 1st millennium BC include Rahoy (AR-149) and Dun Mor Vaul (AR-008). Both of these were of drystone construction, circular in shape and measured under 12m in internal diameter, but Rahoy is classed as a CSB site and Dun Mor Vaul a AFCB site due to the presence of intramural staircase and galleries (Figure 4.9a and b). The main occupation phase of the site, Rahoy was possibly dated to the latter half of the 1st millennium BC by artefact evidence (Gilmour 2000). These included a forged iron looped and socketed axe head that date to the pre-Roman Iron Age, fragments of a bronze fibula classed as a La Tène Ic that probably dates to the 4th Century BC and the presence of broken saddle querns (Childe & Thorneycroft 1938). The construction date of the AFCB site at Dùn Mór Vaul (AR-008) has been fiercely debated, however, the more favoured chronological sequence dates the construction of the roundhouse to c. 2nd Century BC (Armit 1991; Gilmour 2000). Radiocarbon dates from this site span from the 5th to 3rd Century AD, which indicated a lengthy occupation. MacKie (1974; 1997) insisted that the earliest occupation layer (Gak-1098 at 2395 ±90bp from a basal context (Eta-2)) represented pre-broch activity and firmly defended the construction of the walls with architectural features to the Middle Iron Age (100 BC to AD 300). A re-analyse of the stratigraphy and the pottery developmental sequence in comparison to similar sites further north illustrated the probability that primary occupation of the AFCB site was much earlier (Armit 1991; Lane 1987). This interpretation asserted that radiocarbon dates associated with occupation prior to the construction of the AFCB site may actually represent a primary roundhouse that later developed into a massive complex structure incorporating architectural features. Both Rahoy and Dun Mor Vaul were possibly constructed in the second half of the 1st millennium BC, however, both also illustrated evidence of multiple occupations and secondary activity spanning over several centuries.

The construction of the single enclosing drystone enclosure at Eilean an Duin (AR-894) was also set in the 1st millennium BC. This site was a large irregular-shaped drystone enclosure that measured 53m by 28m internally and classed as an ICSA (Figure 4.9c). Unfortunately, the constraints of the rescue excavation only permitted section cleaning and recording, in which internal structures or function of the site could not be determined. However, radiocarbon dating provided a *terminus post quem* date to the mid to late 1st millennium BC for the construction of the site (GU-1814 at 2290±65bp (540calBC to 170calBC) and GU-1815 at 2160±55bp (280calBC to 50calBC) (Figure 4.10), both dates from charcoal under the rampart) (Nieke 1985; Nieke & Boyd 1987).

Several of the larger multivallate enclosures also dated to the 1st millennium BC, including the irregular-shaped site at Balloch Hill (AR-854) classed as an ICSA and the curvilinear site at Duntroon (AR-700) classed as a CSA. Four phases of occupation were illustrated through radiocarbon dates and stratigraphy at Balloch Hill (AR-854) (Peltenburg 1982). The first two phases were a settlement and cremation burials. The settlement was dated to the 3rd millennium BC by artefact evidence and the cremations burials to the 2nd millennium BC (HAR-1902 3360±70bp (1880calBC to 1490calBC)). Evidence from Phase three indicated that all three ramparts, may in fact, have been constructed and maintained (Figure 4.9d). Material objects from this phase were ineffective for dating purposes, however radiocarbon dates and structural sequence for the ramparts suggested dates in the 1st millennium BC (HAR-1093 at 2320±80bp (550calBC to 50calBC), HAR-1904 at 2240±120bp (750calBC to calAD50); HAR-1906 at 2120±110bp (400calBC to 80calBC) (Figure 4.10))(*ibid*: 203, 208). Re-occupation of the site after Phase three was observed as an unenclosed settlement. Blue glass beads from one of the structures was similar to those recovered from other excavated sites in the area, such as Kildonan Bay (AR-073) (*infra*), suggesting occupation during the 1st millennium AD (*ibid.*).

Excavations in the interior of the CSA site at Duntroon (AR-700) produced no structural evidence, contexts or a stratigraphical sequence from the interior (Figure 4.9e). This was a reflection of the lack of structured recording that often occurred on sites excavated in the early 1900s. Material evidence was restricted to stone implements and 36 saddle querns (Christison *et al.* 1905). The occurrence of only saddle querns suggested an occupation date for this site prior to the quern transition, c. 2nd century BC (Armit 1991; Caulfield 1977).

4.3.2 Occupation evidence during the turn of the millennia

Dùn Cùl Bhuirg (AR-681) and Dùnan nan Nighean (AR-136) were two very different sites in shape and size, but rougly dated to the same time period at the turn of the millennium. The irregular-curvilinear site Dùn Cùl Bhuirg (AR-681), classed as an ICSA, consisted of a single line of drystone walling following the contours of a large rock outcrop (Figure 4.11a). Excavations uncovered a small stone hut in the interior of the enclosure. Dating of the site relied on debris, including pottery and beads, found in the rubble core of the wall, providing a *terminus post quem* for the wall construction (Ritchie & Lane 1981). The pottery evidence did have strong similarities with those recovered from Dùn Mór Vaul (AR-008) (*ibid.*:220), which placed activity on the site to c. 100 BC to AD 300. Evidence from the small-scale excavations on the RSB enclosure, Dùnan nan Nighean (AR-136) (Figure 4.11b), also suggested a date to the last century BC or early 1st millennium AD (Piggott 1951). Reports on this excavation were brief and the dating of this relied on undecorated dark brown ware sherds that were assumed to date to this period (*ibid.*:232).

4.3.3 Occupation evidence during the 1st millennium AD

Several of the curvilinear sites with evidence of occupation during the 1st millennium AD have been postulated to have earlier origins in the 1st millennium BC. The AFCA enclosure, Ardifuir 1 (Figure 4.12a), was loosely dated to the 1st millennium AD by the recovery of 2nd Century AD Samian sherds and 6th to 7th Centuries AD E-ware (Christison 1905). A secondary structure was found constructed of edge slabbing and drystone walling in the interior of the enclosure. The excavator noted the entrance passage as unusually wide and short with paving extending into the interior of the site and a guard cell built off the southern entrance passage wall (*ibid.*). Gilmour (1994) has argued for an earlier construction date for this site. He also considered the unusual guard-cell entrance placed above ground level and paving in the entrance as secondary. The evidence used to argue a 1st millennium BC construction date, however, was unconvincing. Dating evidence from the AFCB at Kildalloig (AR-778) (Figure 4.12b) was more substantial and placed activity at the site into two main phases, c. 2nd Century AD with intermittent occupation until the 8th Century AD (Bigwood 1964). However, discrepancies in the excavation reports on the location of an iron pin with a glass bead head placed this object in two contexts, once in the construction phase (RCAHMS 1971:88) and again in the "upper occupation layer" (Bigwood 1964:19). This inconsistency possibly indicated a stratigraphy that was more complex than the reported two phases of occupation (Gilmour 1994). The construction date of this site was also based on a Collingwood Group Q Roman fibula (Bigwood 1964) found at the base of a midden, outside the west wall of the dun, underneath flagstones which were assumed to have been placed at the onset of primary occupation (Gilmour 1994).

The site, Dùn Fhinn (AR-311), indicated occupation to the early 1st millennium AD. Dùn Fhinn (AR-311) was a simple rectangular drystone structure that enclosed the entire summit of a small rock stack and was classed as a RSB site (Figure 4.13a). This site was excavated to bedrock and evidence suggested two separate phases of activity. Material evidence dated the construction of the site to the 2nd Century AD with intermittent occupation lasting over five or six centuries (RCAHMS 1971). Recovered objects included fragments of Samian ware, two bronze penannular brooches, two spindle whorls and a possible blue glass dumb-bell shaped bead (Bigwood 1966).

Two other sites possibly dating to the 1st millennium AD include Dùn an Fheurain (AR-194) and An Dùn (AR-211), classed as ICSA and CSA sites respectively. The irregular-shaped site, Dùn an Fheurain (AR-194), was not excavated, however, this site was dated by the material recovered from a large midden deposit located at the base of the large rock stack on which the site was built on. Dating occupation of the actual site cannot be certain, however the evidence recovered from the midden would suggest activity in the general area, possibly relating to the site. Material from the midden suggested two phases of activity, indicating a lengthy occupation of the actual site, however the actual stratigraphy of the midden was not recorded (Ritchie 1974). Earlier finds date to the first few centuries AD and included a Samian sherd, a ring-headed pin and a spiral finger ring. Later finds included a fragment of a bone comb, globular headed pin and a potters stamp, all dating to mid 1st millennium AD and later (*ibid.*). The CSA enclosure at An Dùn (AR-211), measuring 21m by 29m internally, was imprecisely dated to the 1st millennium AD (Figure 4.13b). This site was excavated by the Lorn Archaeological Society in 1969 and dating conclusions were based on the recovery of two rotary querns built into the lowest course of the drystone wall (Betts 1969).

Excavated sites providing occupation dates to the mid 1st millennium AD include Kildonan Bay (AR-073) and Kildalloig (*supra*). The AFIR enclosure at Kildonan Bay (AR-073) was irregular-rectilinear in shape and first excavated in 1939 by H. Fairhurst (Figure 4.14a). His findings suggested at least four phases of occupation with the first and second phase lasting till abandonment of the site during the 8th or 9th Centuries AD (Fairhurst 1939). The dating of the primary occupation phase was based on the recovery of a penannular brooch, Roman and other material evidence. Radiocarbon assays were taken from an early hearth below Fairhurst's Hearth II2 during a later excavation and confirmed the late date in the 7th to 9th Centuries AD (GU-1457 at 1425±70bp (calAD650 to calAD960) and GU-1458 at 1210±60bp (calAD670 to calAD970))(Peltenburg 1982) (Figure 4.10). However, the dating evidence presented from both excavations only represented activity at the sites and not the construction of the walls. The earlier discussion on the site at Kildalloig, demonstrated at least two phases of occupation. Material from the later phase included a dumbbell shaped glass bead, decorated spindle-whorl, bone pins and a fragment of an antler weaving comb that dated activity at the site up to the 8th Century AD (RCAHMS 1971).

Material evidence recovered from two sites indicates occupation to the later half of the 1st millennium AD. The partially excavated RSA site at Ugadale Point (AR-074) (Figure 4.14b) produced material from its earliest phase, similar to that recovered from Kildonan Bay (Fairhurst 1956). These included part of a bronze needle and three glass beads. Fairhurst (1956) dated the first phase of occupation of this site to the 7th and 8th Centuries AD with the possibility of an earlier construction date. Amateur excavations by the owners of the IRSA site at Eilean Righ I (AR-230) (Figure 4.14c) recovered several artefacts that dated activity between the 7th and 9th Centuries AD. These included a tanged iron knife and a dark blue annular bead (Brown & Cowie 1987). No structural features were uncovered in the interior. Any evidence indicating occupation of the site prior to or later than the dating of the artefacts was unfortunately not evident due to the nature of the excavation.

Excavations of the fort complex at Dunadd (AR-849) indicated lengthy occupation from the Iron Age to the 13th Century AD (Lane & Campbell 2000). Early historians assigned this site as the capital of the Dàl Riata (Skene 1867; 1886) and later claimed that the presence of a rock cut footprint and circular basin were relics of the inauguration ceremonies of the kings (Thomas 1879). Small-scale excavations in 1980-1 targeted specific areas to further explain and date results from earlier excavations (Christison *et al.* 1905; Craw 1930; Lane & Campbell 2000). No definitive Iron Age enclosures or structures were detected; however, the remnants of a possible rubble wall lie underneath a later drystone wall on the uppermost enclosure, classed as a CSA site (Figure 4.15, Fort A). Results from radiocarbon dating indicated activity on the summit from c. 400 BC to the early centuries AD (GU-2464 at 2280±50 (410calBC to 200calBC; GU-2306 at 2000±50 (160calBC to calAD130); GU-2307 at 1980±50 (110calBC to calAD130)) (Figure 4.10). The next phase of activity on the summit was the construction of an oval-shaped drystone enclosure. This was later enlarged to enclose the entirety of the summit. A pit and hearth outside the enclosure wall was uncovered and indicated activity between calAD250 to calAD560 and calAD650 to calAD970 (GU-2308 at 1630±60bp and GU-2463 at 1240±80bp). A floor layer inside the enclosure yielded a date between to calAD430 and calAD660 (GU-2314 at 1470±50bp). The site was also expanding with the construction of the lower ramparts by the 7th Century, perhaps a reaction to its growing status observed in the abundance of rich material objects and production processes (Lane & Campbell 2000).

The two irregular-shaped sites at Dun Aorain (AR-259) and Ronachan Bay (AR-119) have no conclusive evidence for dating, but are comparable to the mid 1st millennium AD site at Kildonan Bay (AR-073) (Figure 4.16c). Dun Aorain is classed as an AFIR site and Ronachan Bay as an IRSB site (Figure 4.16a and b). Dun Aorain was partially excavated, in which an intramural stairway leading into a cell was uncovered (RCAHMS 1975). A dumbbell shaped glass bead, comparable to the examples recovered from Kildonan Bay and Dùn Fhinn (AR-311), was discovered from a molehill at Ronachan Bay (Gilmour 2000:126).

In summary, sites with activity dating to the 1st millennium BC included CSB and CSA sites, such as Rahoy (AR-149) and Duntroon (AR-700) respectively. Several of the curvilinear sites exhibiting complex architectural features that date to the 1st millennium AD may have had earlier origins dating to the 1st millennium BC, such as Dùn Mór Vaul (AFCB)(AR-008) and

Kildalloig (AFCB)(AR-778). Rectilinear and irregular shaped sites start emerging in the settlement evidence at the turn of the millennium, such as the ICSA with internal structures at Dun Cul Bhuirg (AR-681) and the RSB site at Dunan nan Nighuan (AR-136). However, there was evidence of ICSA sites possibly dating earlier to the 1st millennium BC (e.g. Eilean an Duin (AR-894) and Balloch Hill (AR-854)) and of CSA sites dating later to the 1st millennium AD (e.g. An Dùn (AR-211)). The rectilinear and irregular sites continued through to the mid 1st millennium AD as observed at Dun Fhinn (RSB)(AR-311) and Dun an Fheurain (ICSA)(AR-194). Irregular-rectilinear sites appeared to be more prevalent in the mid 1st millennium AD, with some examples also incorporating complex architectural features. These included Kildonan Bay (AR-073)(AFIR), Eilean Righ I (IRSA)(AR-230) and possibly Dun Aorain (AFIR)(AR-259) and Ronachan Bay (IRSB)(AR-119). Curvilinear sites illustrating activity to the later 1st millennium AD included the AFCA site at Ardifuir I (AR-401), the AFCB site at Kildalloig (AR-778) and the complex at Dunadd (AR-849). This chronological sequence demonstrated a gradual replacement of curvilinear sites by irregular and rectilinear shaped sites and the development of architectural features.

4.4 Excavated evidence and site descriptions from Northern Ireland and Ireland

Archaeological features dating to the Late Bronze Age and the Early Historic period have been recovered from a number of excavations, however, firm occupation evidence dating to the Iron Age, between 500 BC and AD 500, is scarce throughout Ireland and Northern Ireland. This issue may be a direct result of grouping a diverse range of sites into the classification of ringfort and a failure to confidently recognise settlements belonging to the turn of the millennium (Warner 1981). "Unfortunately, this has led to the untenable view that ringforts are a phenomena which belong exclusively to the Early Christian period" spanning the latter half of the 1st millennium AD (Henderson 2000b:127) (see Edwards 1990: 10-11; Hirons & Sheridan 1986; Lynn 1983; Mytum 1992; O'Sullivan 1998: 101; Stout 2000; Waddell 1998). A number of excavations have occurred in Northern Ireland, however most of these concerned circular earthen enclosures. Unfortunately, only a small number of other site types were excavated that have conclusive dating evidence significant to the current research. Only one of the excavated sites in Co. Donegal has been radiocarbon dated.

Therefore, excavated sites from other areas of Ireland that encompass comparable features to the sites in the study areas are also discussed.

Traditional interpretations of Bronze Age settlement evidence were perceived as curvilinear enclosures as small, homesteads scattered throughout the landscape (see Grogan & Eogan 1987; Kelly 1974; O'Kelly 1981; Raftery 1994). During the Early Historic period, the settlement evidence is observed in the (re)development of the curvilinear enclosures, represented by the large enclosing ringforts. While the archaeological evidence strongly suggested the majority of ringfort enclosures dated to the second half of the 1st millennium AD, not all curvilinear enclosures typified as ringforts must date to this period (Henderson 2000b). Iron Age dates for some of these sites have been rejected due to the nature of the evidence and arguments became circular rather than fact (i.e. Caulfield 1981; Lynn 1983; Proudfoot 1970; Raftery, B. 1976; Raftery, J. 1981). However, earlier activity dating to the later Prehistoric period recovered from several excavated sites cannot be dismissed (Caulfield 1981; Limbert 1996; Proudfoot 1970; Warner 1983).

4.4.1 Occupation evidence during the 1st millennium BC and earlier

Evidence from several of the large hilltop enclosures indicated long periods of activity originating in the Bronze Age. Two outer stone ramparts encircle a large curvilinear stone enclosure (i.e. CSA site) at Mooghaun South, Co. Clare. All three of the enclosing ramparts were of stone construction, with no apparent facing, and followed the contours of the hilltop. Two smaller circular drystone enclosures (i.e. CSB sites) overlay the middle and outer ramparts (Figure 4.17a). Bronze Age occupation was recovered from the site, which suggested an unenclosed habitation prior to the construction of the visible ramparts. The outer enclosure was dated by a sample recovered underneath the rampart, which provided a *terminus post quem* between 1260calBC and 930calBC (GrN-20290 2895±50bp) (Grogan 1996; Grogan & Conduit 1994). Material retrieved from the inner enclosure at the summit of the hill was suggested to represent Bronze Age occupation through bronze-working evidence and a bronze pin shank and later activity through rotary quern fragments (Grogan 1996). Others have argued that the dating of this material by the excavator appeared arbitrary and some of the assemblage may have actually represented Iron Age occupation (Gilmour 2000; Henderson 2000b). Rotary querns were the only datable finds, and indicate activity occurring after the 3rd Century BC. One of the smaller stone circular enclosures was partially excavated. There were no apparent internal features uncovered, however a few finds were recovered. These included three iron nails, animal bone fragments and charcoal (Bennet & Grogan 1993). Two smaller house structures were uncovered between the inner and middle ramparts, however no datable material was recovered. Evidence suggested occupation occurring across the site from the pre-rampart phase in the Bronze Age through to the 1st millennium AD.

Radiocarbon dates produced from Haughey's Fort (NI-1850) in Co. Armagh mainly produced Late Bronze Age dates for the site; however, two Iron Age dates suggested activity during this period. This site is classed as a CEA enclosure located on a hilltop, enclosed by three ditches and located 1000m west of Navan Fort (*infra*) (Figure 4.17b). Stratigraphy in the ditches indicated material slippage from upslope, suggesting the presence of internal banks (Waddell 1998). Excavations in the interior uncovered a double-ring structure measuring c. 25m in diameter with large post-pits. A second, slightly larger double-ring feature, also located in the interior of the site, was apparent in aerial photography (*ibid.*). A pit from the former structure yielded radiocarbon dates ranging from 1260calBC to 840calBC (UB-3049 2833±55bp and UB-3386 2877±60bp) (Mallory *et al.* 1996) (Figure 4.18). One pit produced Iron Age dates ranging from 400calBC to 200calBC (UB-3384 2253±26bp and UB-3385 2221±26bp) (*ibid.*). Though the evidence from this site indicates the majority of activity belonging to the Bronze Age period, radiocarbon dating has suggested use intermittently through to the second half of the 1st millennium BC.

Similar to Haughey's Fort, the multivallate hillfort at Rathgall, Co. Wicklow (i.e. CEA site) also produced evidence of activity possibly dating to the Iron Age (Figure 4.17c). Within the interior of a stone enclosure, a large circular roundhouse centrally located within an annular ditched enclosure was recovered through excavation. The stone-walled enclosure, thought to be no earlier than Medieval, partially overlaid the ditched enclosure. The ditch and timber roundhouse were considered contemporary and the radiocarbon dating of the ditch suggested a Bronze Age date (SI-1485 2930±75bp (1380calBC to 920calBC))[1] (Figure 4.18). Additional features at the site included a metalworking area and several cremated burials (Raftery 1971; 1973). Material evidence and radiocarbon dates from several of the large

[1] http://ads.ahds.ac.uk/catalogue

hearths suggested extensive occupation from the Bronze Age through to the Early Historic period.

The site Grianán Ailech, Co. Donegal (DG-018) consists of a massive circular drystone structure, measuring 23m internal diameter with three terraces accessible by a series of interconnecting double stairways and two intramural chambers (Figure 4.19). The structure is located on a prominent hilltop, enclosed by three earthen ramparts and was classed as an AFCA site. In the 1800s, the site was surveyed (Colby 1837) and later restored (Bernard 1870-9). A construction date for the earthen ramparts was suggested during the Late Bronze Age or Iron Age (Raftery 1972), whereas the AFCA site has been associated with the ancient seat of the northern Ui Neill during the Early Historic period (Lacy 1983). However, without archaeological evidence this declaration is unfounded, in which excavation of the site may reveal finds similar to those recovered from sites with comparable features, such as Dún Aonghasa (*infra*).

The large drystone enclosure at Dún Aonghasa on the edge of a clifftop on the Aran Islands, Co. Galway was excavated under the Western Stone Forts Project (Cotter 1993; 1994; 1995; 1996). This site comprised of three enclosing well-finished drystone walls. Other distinctive features included two terraces accessible by four flights of vertical steps, a sidelong staircase and a wall chamber in the innermost enclosure and a *chevaux de frise* surrounding the middle ramparts (Figure 4.20). Though, the morphology of the inner drystone enclosures at Dún Aonghasa and Grianán Ailech are different, the size and construction of the terracing and the sidelong staircase are comparable. Excavation evidence from the former site may indicate possible chronology for similar features in the latter site. The earliest structural features at Dún Aonghasa were several small circular houses with stone foundations. The occupation layer from the house sites dated to the first half of the 1st millennium BC (GrN-20226 2840±25bp (1120calBC to 910calBC) for Hut 1; GrN-20234 2470±35bp (770calBC to 410calBC for Hut 2) (Cotter 1995) (Figure 4.18). This layer ran underneath the refurbished interior face of the innermost drystone enclosure wall. A second section produced occupation material abutting and spreading under the foundations of the enclosure wall and dated to the first half of the 1st millennium BC (AA-10276 2635±60bp (930calBC to 550calBC); AA-10270 2585±60bp (900calBC to 510calBC)). This provided a *terminus ante quem* for the foundations and a *terminus post quem* for the construction of the wall. Iron Age deposits and material evidence were scarce, however two radiocarbon dates suggested activity at this time (AA-10274 2295±60bp (520calBC to 190calBC) and UB-3645 2374±36bp (730calBC to 380calBC)) (*ibid.)*. One of these dated an occupation layer, represented as a spread of burnt animal bone, lying directly on the bedrock and abutting a linear stone feature. The scarcity of prehistoric evidence may have been a result of "Early Christian activity in the area, land clearance associated with the creation of the present Kilmurvey farm in the nineteenth century, or more intensive cultivation on the hillside in the recent past," (Cotter 1996:14). Evidence of later activity at the site was observed through later rebuilds of the inner most drystone rampart, visible as internal wall-alignments (Cotter 1995), multi-phase constructions of the middle rampart (Cotter 1996) and the associated *chevaux de frise,* which all could be attributed to the Iron Age period (Henderson 2000b). Early Christian activity was recovered in areas protected from the elements, from a wall chamber and an entrance passage in the innermost and middle ramparts, respectively (Cotter 1996). Excavation evidence from this site suggested activity from the beginning of the 1st millennium BC to the Early Historic period. The foundation of the inner enclosure was laid prior to the second half of the 1st millennium and the construction of the wall afterwards.

Two earthen enclosures excavated at Ballyhenry in Co. Antrim demonstrated evidence 1st millennium BC occupation. Both of these sites were classified as CEA sites. Rath 1 (NI-1941) was located on a slight natural promontory, appeared as a low oval platform with a dished interior and was delineated by a bank and outer ditch on all sides except on the west (Figure 4.21). Two structures were uncovered in the interior of site (Lynn 1983). Stone footings set at a right angle represented a rectangular structure just inside the entranceway of the earthen enclosure. Souterrain ware recovered from an occupation layer around the stone footings suggested an Early Historic date. A penannular gully centrally located in the enclosure interior indicated a possible second structure. Two sherds of cordoned urn were associated with the gully, which possibly suggested a prehistoric date for the structure. Discussions concerning the date of this central structure state that a Middle Bronze Age construction date could not be confirmed due to inconclusive evidence; however early activity at the site is evident (Lynn 1983). It could be suggested that the earthen enclosure and central penannular gully may be possibly contemporary, considering none of the Early Historic finds listed in the publication were recovered from the bank. Also, all artefacts not associated with the stone structure at the entrance of the site were recovered from topsoil. Prehistoric occupation in the interior of Rath 2 (NI-1940) was confirmed by radiocarbon dates. Two semi-circular slot-trenches suggesting a structure with opposing entrances was centrally located on a large earthen platform surrounded by two ditches and a bank. Charcoal from one of the gullies branching off one of the foundation trenches dated to the second half of the 1st millennium BC (UB-943 2065±70bp (360calBC to calAD80)). Stratigraphy of the site illustrates that the central structure was constructed onto the top of the platform, but may predate the enclosing bank. Later occupation was suggested by limited Early Christian evidence including a stone-kerbed hearth, pavement and a scatter of souterrain ware. Both of these sites demonstrated prehistoric structures centrally located within earthen enclosures. The structure at Rath 1 is likely to be contemporary with the enclosing bank, whereas Rath 2 with the platform mound. The Early Historic evidence may indicate a re-occupation phase and later disturbance by modern cultivation.

Very few sites classified as promontory enclosures have been excavated in both Ireland and Northern Ireland and fewer have produced any evidence of archaeological significance. Though most of these sites are attributed to the Iron Age, excavated examples have suggested intermittent occupation over several centuries. The large promontory at Knoxspark in Co. Sligo (i.e. PA site) overlooked the Ballysadare river and was enclosed by a bank or wall and outer ditch (Mount 1994; 2002) (Figure 4.22a). Radiocarbon dates of animal bone from the ditch fill provided a *terminus ante quem* at calAD660 to calAD960 for the cutting of the ditch (GrA-2452 1260±40bp (calAD660 to calAD870) and GrA-2454 1190±40 (calAD690 to calAD970)). Excavations uncovered an abundance of metalworking evidence and the remains of a demolished internal stone-faced bank thought to have been in use during the Iron Age. The site was later reused as a cemetery for a substantial number of burials, of which one produced a radiocarbon date of calAD 700 (Mount 1994). Evidence from the site at Dunbeg, Co. Kerry indicated initial occupation during the Late Bronze Age (Barry 1981). This site consisted of four earthen banks and five ditches running across a promontory (i.e. PA site) (Figure 4.22b). A stone wall lies to the south of the series of banks and ditches and is the innermost defence. The interior of the site is dominated by a large stone-built hut (clochán), which yielded radiocarbon dates from two phases of occupation between calAD820 to calAD1270 (UB-2218 1050±65bp and UB-2217 960±100bp) (*ibid.*) (Figure 4.18). Dating of the material in the ditches suggested multiple phases of activity. A date from the first half of the 1st millennium BC was from charcoal recovered from a ditch running under the drystone rampart (UB-2216 2530±35bp). A second date range of calAD760 to calAD1020 (UB-2215 1150±75bp) was from material retrieved from the ditch lying between the stone rampart and the innermost bank. This second date may indicate secondary digging of the ditch in that the construction of the ditch and bank defences would be earlier. Material evidence from the promontory site at Dalkey Island, Co. Dublin suggested activity as early as the Mesolithic and intermittently to the Early Historic period. Several phases of early occupation at the site were suggested by the recovery of Beaker pottery (Liversage 1968). Late Bronze Age activity was represented by mould fragments. Later activity at the site included the construction of a bank and ditch across the promontory. A midden below the bank contained Class B and E wares and pins similar to Romano-British examples (*ibid.*).

A Royal Complex: Navan

Particular univallate hilltop enclosures have been typified as 'Royal Complexes or Centres' due to the distinctive layout of their outworks; an enclosing earthen rampart with an internal ditch (Edwards 1990; Herity & Eogan 1977; Lynn 1975). Four of these sites have been associated with the pre-Christian centres mentioned in early texts, particularly the *Félire Óengussa* (The Martyrology of Oengus the Culdee). They include the sites at Navan, Tara, Dún Ailinne and Rathcroghan (Raftery 1994; Waddell 1998). The former three sites are enclosed by an internal ditch and outer bank. Three of these have been partially excavated, but only Navan is located within the study area and is discussed below.

The site at Navan Fort (Emain Macha) in Co. Armagh (NI-1727) was part of a wider archaeological complex that included Haughey's Fort, monuments possibly dating as early as the 4th millennium BC and an artificial body of water called the King's Stables (Raftery 1987; Waddell 1998). Within the large enclosure at Navan Fort are two visible monuments; a ring ditch with traces of an external bank measuring 50m in diameter (Site A) and a similar sized circular flat-topped mound (Site B), are located in the interior (Lynn *et al*. 1997) (Figure 4.23a and b). Excavations on both monuments produced structures dating to the 1st millennium BC. However, there are debates on whether the structures in both areas represent ceremonial activity or elite domestic dwellings.

Excavation on the flat-topped mound (Site B) recovered five phases of activity, in which two are dated to the 1st millennium BC. Phase 3i was initiated with a large ditched enclosure with an eastern causeway and an internal ring of large pits. Both these features were considered contemporary, however, the radiocarbon dates are not congruent (Waterman 1997b). One of the post pits from the post-ring structure dated to the second half of the 2nd millennium BC (UB-974 3140±9bp (1620calBC to 1130calBC)), whereas the ditch yielded two dates from the first half of the 1st millennium BC (UB-188 2628±50bp (910calBC to 590calBC) and UB-979 2615±75bp (1000calBC to 500calBC)) (Waterman 1997b) (Figure 4.18). Features of Phase 3ii included a complex sequence of circular ring slots possibly representing the sequential rebuilding of a house structure with internal hearths and attached to a further set of ring slots representing an enclosed yard (Waddell 1998; Waterman 1997b). The plan of these two sets of ring slots created a figure-of-eight style layout (Figure 4.23b). Dating of Phase 3ii range between the 4th and 2nd Centuries BC (Warner 1997:189). A radiocarbon date produced from the skull and jaw of a Barbary Ape, recovered from this phase, corresponded with the dates yielded by the structures (OxA-3321 2150±70bp (390calBC to 30calBC)). Another series of ring slots, Phase 3iii, replaced the structures in Phase 3ii and were dated to the end of the 1st millennium BC (*ibid.*). Evidence from Phase 4 indicated a massive restructuring of the site, in which a single large wooden structure was constructed. This building consisted of five concentric rings of postholes surrounding a single large post and measured up to 38m in diameter (Lynn 1997) (Figure 4.23c). Dendrochronological analysis of the central post indicated a date in late 95 BC or early 94 BC for the felling of the tree (Warner 1997). Phase 5 immediately succeeded Phase 4 and involved the construction of a limestone cairn covered with turf.

Partial excavation of Site A uncovered two phases of activity. The first was the successive rebuilding of a circular timber structure averaging around 20m in diameter defined by a series of slots (Lynn 1997). Charcoal from two of the slots produced radiocarbon dates between 400calBC and 100calBC (UB-752 2175±45bp and UB-770 2240±50bp) (*ibid.*). Later excavations and magnetometer surveys uncovered a second enclosure in between Site A and B (Ambos & Larson 2002; Kvamme 1996). This third area, Site C, was revealed as a triple ring slot enclosure that was associated with the timber structure at Site A, in which the two structures represented a figure-of-eight structure and dated between 150 BC and 1 BC (Mallory & Lynn 2002). A second phase was recovered from Site A, in which a structure(s), represented by two concentric ring slots, cut the foundation slots of the earlier timber building. This later building was suggested to have been constructed during the Early Historic period on the evidence of two burials found east of the structure's entrance (Waddell 1998). Dating of the enclosing ring ditch is speculated, however, a probable later re-cutting was dated to the mid 1st millennium AD by a bronze brooch and two radiocarbon dates from materials in the upper fill (UB-3407 1645±25bp (calAD330 to calAD540) and UB-3408 1515±30bp (calAD430 to calAD620)) (Lynn 1997:141).

Coring of the ditch enclosing the entire site complex produced a radiocarbon date between 760calBC and 390calBC (UB-3091 2420±40bp) that suggested the construction of the ditch predated the structures at Site B in Phases 3ii, 3iii and 4 (Weir 1989). However, a later excavation on the outer ditch provided a dendrochronological date of 94±9BC from a timber stratigraphically lower than the radiocarbon date sample, which contradicted the earlier date (Mallory *et al.* 1999). It has been further suggested that the timber may have been from Phase 4 of the structure on Site B (*ibid.*:430).

Initially the excavator, D. Waterman, suggested that the figure-of-eight structures on Site B represented a domestic structure with a central hearth attached to a circular yard enclosure (Mallory & Lynn 2002). However, comparable evidence from the 'Rose' phase on the site Knockaulin, Co. Kildare, suggested this type of structure was for ceremonial purposes rather than domestic. The scenario presented by Mallory & Lynn (2002) implied that the entire complex at Navan was for ceremonial purposes. On Site B, two successive figure-of-eight structures (Phase 3ii and 3iii) were constructed and may have been roofed, in which the final one was replaced by the large timber structure (Phase 4). Possibly contemporary with the large timber structure was another figure-of-eight structure on Site A/C and was used as "part of the foundation ceremony of the monument" (*ibid*.: 539). This was founded on the assumption of the deliberate destruction by fire of Site A/C (Murphy 2000) and its possible burnt remains recovered from dumps in the mound. Similar structures were found at Dún Ailinne in Co. Kildare (Wailes 1990) and possibly at the Ráth of the Synods (*Ráith na Seanad*) at Tara (Cooney & Grogan 1991), which were also presumed to have been both 'Royal Centres' (Mallory & Lynn 2002). However, the presence of hearths in the figure-of-eight structure on Site B and its smaller size brings questions to the ceremonial scenario. The recovery of the Barbary Ape skull may indicate the inhabitants were of elite or royal status to obtain such an exotic object. The outer enclosing ditch suggested to be contemporary with Phase 4 of Site B might also mark the change from elite dwelling to royal complex around the turn of the millennium.

Though the structures and evidence recovered from Navan indicate this site to be of some importance during the later 1st millennium BC, this site was not included in the analyses. It is unique to the majority of the sites in the Northern Ireland study area and therefore may have different motives behind the location choice. This site would have had an impact on contemporary and subsequent settlements within the vicinity and is included in the interpretation of settlement patterns.

4.4.2 Occupation evidence during the turn of the millennia and early 1st millennium AD

Earthen ringforts are generally allocated to the Early Historic period, however, indications of activity prior to the second half of the 1st millennium AD were apparent at several sites. Under the current classification scheme these are termed CEA sites. Iron Age material uncovered from the earliest contexts at the Ráth of Feerwore, Co. Galway included occupation debris, an iron socketed axehead and an iron brooch dating the site to around the turn of the millennia BC to AD (Raftery 1944) (Figure 4.25a). Debates on whether the construction of the enclosure bank was contemporary with the early occupation or later rely on interpretations of the stratigraphic relationship between a cremation cist burial and the bank. Lynn (1983) suggests the burial was sealed by the enclosing bank on the north-west and provides a *terminus post quem* for the bank construction. Gilmour (2000:161) argues that "differential erosion and subsequent modifications" have altered the north-west section of the bank and therefore suggesting the burial could have been dug into the bank, which would provide a *terminus ante quem* for bank construction. Internal features at the earthen enclosure at Raheennamadra, Co. Limerick yielded a radiocarbon date range of 100calBC to calAD450 (Uppsala 1840±110bp) (Stenberger 1966) (Figure 4.24). A centrally located sub-circular structure defined by a gully was uncovered within the enclosure (Figure 4.25b). The dated sample was retrieved from a hearth located within, but beneath this structure. The structure possibly post-dated or was associated with a later 1st millennium AD souterrain constructed against the enclosure bank and therefore probably dates much later than the hearth. However, Gilmour (2000) argues that the stratigraphic evidence of a boulder clay surface layer may indicate an association between the hearth and the enclosing bank. The boulder clay overlay the hearth, but also was described as the main layer within the bank. He further suggests the boulder clay could have been laid as a surface anytime during the site's occupation, in which the hearth and the construction of the enclosure bank could be contemporary. The earthen enclosure sites, generally termed as raths, are usually associated with the Early Historic period, however a few examples have produced occupation evidence dating to the late 1st millennium BC to early 1st millennium AD.

Rescue excavations of a CEA site at Dunsilly, Co. Antrim (NI-2788) uncovered five periods of activity, in which occupation associated with the enclosure is presumed to date to the later 1st millennium AD (McNeill 1992). Radiocarbon dates indicated activity spanning from the 1st Century BC through to the Post-Mediaeval period. The excavator described the two earliest occupation periods as Pre-Rath and Rath in which the latter was defined by the construction of the enclosure bank. There are several issues with the chronological interpretation, based on the desire to date the construction of the 'rath' to post-6th Century AD. The Pre-rath B phase produced two very different radiocarbon dates from charcoal spreads (UB-967 1905±75bp (60calBC to calAD330) and UB-2002 1380±65bp (calAD540 to calAD780)) (Figure 4.24). A year later the enclosing bank was excavated, in which the occupation layer of Pre-rath B was allegedly exposed. At this time the UB-2002 sample was collected in order to address issues of possible contamination, because the excavator felt the date from UB-967 was incompatible with the material evidence (*ibid.*:106). The succeeding phase, Pre-rath C, produced a possible stone-revetted house platform and a date between calAD250 and calAD660 (UB-2001 1565±105bp). After this date is the presumed construction of the enclosure bank. The next dated phase of the site was the final phase of activity at the 'rath', Rath 3, between calAD1030 and calAD1220 (UB-968 890±40bp). The conflicting radiocarbon dates and assumptions on ringfort occupation dates indicate inaccuracies in the alleged chronology of the site, in which one of the conflicting dates from Pre-rath B phase is later than the subsequent phase. Also, this sample (UB-2002) used to pre-date the bank depends on whether it was stratigraphically sealed by the bank. Gilmour (2000) has suggested this date could provide an early *terminus post quem* for the bank construction. He also discussed the problems with using Souterrain Ware to date later activity at the site.

The evidence suggested continuous occupation from the 'pre-rath period' through to the 'rath' period. Only a small portion of the ringfort was excavated, in which there is likelihood that more substantial structures of the 'pre-rath' period were present and may have also been enclosed. The structural evidence from these 'pre-rath' phases may actually "reflect non-domestic external buildings" due to their insubstantial foundations (Gilmour 2000:157). The evidence and interpretation of this site is much more complex than is surmised from the report, however occupation, whether enclosed or unenclosed, spans over the 1st millennium AD.

4.4.3 Occupation evidence during the 1st millennium AD

A large mound with perimeter bank at the site of Rathmullan Lower, Co. Down (NI-2719) was classed as a CEA site, in which rescue excavations demonstrated a long periods of occupation from the mid 1st millennium AD and later. This site was considered a 'raised rath', in which successive occupation layers formed a mound (Lynn 1982) (Figure 4.25c). The earliest excavated phase did not investigate on whether the site was enclosed, but demonstrated evidence of roundhouse structures outlined by postholes. Sherds of Class E pottery were recovered from this phase and a rectangular stone-lined hearth in the interior of one of the roundhouses yielded a mid 1st millennium AD date (UB-2526 1500±40bp (calAD430 to calAD650))(Lynn 1986) (Figure 4.24). During the second phase of occupation, a layer of till was dumped across the surface, which raised the interior area up to a one metre high platform. Also a wicker roundhouse, 8m in diameter, was recovered from the same area as the structure from Phase 1. A bronze spiral-ringed pin, a plain bronze escutcheon and bone spindle-whorls may suggest a pre-9th Century AD date for activity during this phase. A dramatic change in the internal domestic buildings was indicated during Phase 3, with the appearance of a rectangular structure with stone footings. A floor layer from this structure dated between calAD770 and calAD1000 (UB-2527 1130±40bp). Fill from a souterrain leading from the rectangular structure yielded a date range of calAD890 to calAD1020 (UB-2525 1085±20bp). Plain-cordoned souterrain ware was also recovered from the infill of the souterrain. Evidence from this site suggested the use of circular domestic structures around mid 1st millennium AD along with the deliberate construction of the large platform. Later activity at the site indicated the replacement of circular structures with rectangular ones during the latter half of the 1st millennium AD along with the construction of a souterrain.

The interior of the drystone enclosure at Rinnaraw, Co. Donegal (DO-221), classed as a CSA, was excavated fairly recently. Prior to excavation, the clear remains of an internal structure could be observed. The CSA site was constructed of large boulders and measures between 20m and 25m across (Figure 4.26a). Excavations uncovered a rectilinear structure measuring 5m by 7m with a hearth and a possible delimitation of the interior marked by stone kerbing and double faced walls with an earth and rubble core (Comber 2006). The flooring of the structure consisted of paving and bedrock. Finds recovered from the yard area external to the rectangular house structure included iron slag, a whetstone, a tanged knife fragment, several furnace bottoms, saddle querns, rotary querns and two possible fragments of trough quern. Several of the finds, particularly the saddle querns and possible trough querns, suggested earlier activity dating to the 1st millennium BC. Samples taken from midden pits and hearths dated to the second half of the 1st millennium AD (*ibid.*) (GrN-18080 1330±60bp (calAD600 to calAD870); GrN-19758 1055±35bp (calAD890 to calAD1030); GrN-18078 910±50bp (calAD1020 to calAD1220); GrN-18079 790±50bp (calAD1150 to calAD1300)) (Figure 4.24).

The site at Deer Park Farms, Co. Antrim (NI-2767) consisted of a raised mound, 25m in diameter and enclosed by a perimeter bank. This site was classed as a CSAEA. Excavations uncovered several phases of rebuilding observed in the gradual build-up of occupation layers of the mound (Edwards 2005). An earlier period of settlement encompassed the enclosing circular earthen bank with stone revetment and an inturned entrance passage. Three well-preserved internal structures were uncovered in waterlogged conditions, including two figure-of-eight style structures incorporating double-walls and a circular roundhouse (Figure 4.26b). The wall constructions of the structures were built of two concentric rings of hazel wattle with a soft organic filling. A small bronze brooch dating to AD 800 was also recovered from this building (Lynn 1988a). A dendrochronological date of AD 648 was retrieved from the timber doorframe, however the use of this timber may have been secondary and utilised for another purpose prior to the construction of the house (Baillie 1995; Stout 1997). Samples from the wattle walling yielded radiocarbon dates after AD 670 (Edwards 2005). The range of dates from this structure would suggest occupation over several centuries between the radiocarbon date from the wattle and the date of the brooch, though the nature of the structure's building material would make this unlikely. Without a full excavation report comments on the earlier occupations dates of this site cannot be discussed in great detail. Similar internal figure-of-eight structures were recovered from the large enclosure at Dressogagh, Co. Armagh (NI-2929), classed as an ICEA (Figure 4.26c). Material evidence from this site suggested occupation during the second half of the 1st millennium AD (Collins 1966).

Subsequent occupation layers higher up in the mound at Deer Park Farms indicated the construction of up to 35 more roundhouses (Edwards 2005). Material evidence recovered included souterrain ware, 50 coloured glass beads and the outlines of burnt buildings. Samples for radiocarbon dating were taken throughout the occupation layers and suggested activity of the site between AD 608 and AD 973 (Stout 1997). The final phase of occupation demonstrated a massive outer revetment wall and the construction of two possible souterrains (Lynn 1988a).

Small-scale excavations at Ballyutoag, Co. Antrim (NI-3206) targeted two small roundhouses enclosed by a large irregular shaped earthen enclosure, classed as an IREA site. This site is located on the northwest margins of the Belfast Mountains between elevations of 176m OD and 243m OD and surrounded by field systems. Both houses were smaller than 9m in diameter. Samples from the central hearths in both of the houses yielded radiocarbon dates during the second half of the 1st millennium AD (Williams 1984). Finds appeared similar through all phases of House A including sherds of grass-tempered and plain souterrain ware. Similar finds were also recovered from House B with the addition of a small bronze pin fragment.

Rectangular structures were also frequently recovered from the interiors of CEA sites and were associated with activity to the latter half of the 1st millennium AD. The excavation at the CEA site at Antiville, Co. Antrim (NI-2736) uncovered a rectangular post-hole structure with small stone footings. A charcoal sample associated with souterrain ware from secondary flooring of this structure yielded a date range of calAD670 to calAD940 (UB-589 1220±45bp) (Waterman 1971) (Figure 4.24). This structure was enclosed by a shallow drainage ditch and slight inner bank.

Unfortunately, several of the excavated earthen enclosures failed to recover tightly dated evidence or coherent occupation layers, due to the nature of site degradation. The interior of the bivallate CEA site at Lisdoo (Castle Balfour), Co. Fermanagh was too disturbed by agriculture to gain any stratigraphic information, however a single date from the enclosing bank suggested activity at the site during the latter half of the 1st millennium AD (Brannon 1981-2). The excavation of the bivallate CEA at Killealy, Co. Antrim (NI-2803) recovered at least three main occupation phases. Radiocarbon dates indicated lengthy occupation throughout the 1st millennium AD from c. AD 250 to AD 900 (*Excavations 1970:*2). Timber structures and hearths were uncovered, possibly representing houses.

Excavations from a promontory enclosure at Larrybane, Co. Antrim (NI-1869) uncovered evidence of Early Historic occupation. This site was enclosed by a single stone-faced rampart with a possible secondary revetment and an outer ditch (Proudfoot & Wilson 1961-2). In the interior, four levels of occupation were detected. Hearths and stone paving suggested the presence of structures, which were rectangular in shape in the final phase. Material evidence including a glass bracelet, a bronze tinned bracelet, and an amber bead suggested a late 1st millennium AD date (*ibid.*).

Excavated evidence throughout the whole of Ireland has suggested a chronological sequence for particular site types. Many of the sites indicated intermittent occupation phases spanning over several centuries. All of the CSA and promontory sites indicated activity during the 1st millennium BC, with the exception of Larrybane. Figure-of-eight structures at the royal sites generally dated to the latter half of the 1st millennium BC. Several of the CEA sites indicated activity dating to the later 1st millennium BC and early 1st millennium AD, through the presence of artefacts, hearths, house gullies and platforms. The surviving banks/walls and ditches were often attributed to the later occupation phase; however, enclosures associated with the earlier activity were not often looked for. The latter half of the 1st millennium AD was represented in the secondary re-use of several sites, such as the stone forts of the west, the cemetery at the promontory site at Knoxpark and the continued construction of the CSA and CEA sites. Figure-of-eight structures appeared again, though much smaller in size and located within the interior of enclosed domestic sites.

A chronological evolution of the interior structures was suggested at several sites. Circular timber structures were often uncovered in the earlier phases of CEA sites, such as at Rathmullan Lower (NI-2719). The rectangular structures began appearing at CEA sites during the second half of the 1st millennium AD and replaced the circular house structure by the turn of the millennium (Lynn 1978; 1994). Though evidence recovered from a few sites appeared to contradict this sequence. Small circular structures from the interior of the IREA site, Ballyutoag (NI-1975) were dated to the latter half of the 1st millennium AD.

4.5 Comparative Analysis

A general assessment of the classification by morphological shape demonstrated that the curvilinear group have the largest number of sites out of all typologies in all three study areas (Table 4.3; Figure 4.27 to 4.29). Sites in Argyll demonstrate the most diversity by morphological shape, in which 56% of the sites are not curvilinear. The irregular and promontory classifications have the second and third largest number of sites respectively, with the remaining examples falling under the rectilinear and unknown headings. Sites in Northern Ireland demonstrate that 79% of the sites are curvilinear in shape. A further 18% are unknown and the remaining 4% fall under the rectilinear, promontory and irregular classifications. Comparable to the pattern demonstrated by the sites in Northern Ireland, the majority of sites (83%) in Co. Donegal are curvilinear. Sixty-four of the total 375 sites are considered rectilinear, irregular or promontory enclosures. The distribution of sites by morphology across the study region suggests a localised pattern in Argyll, in which rectilinear and irregular sites appeared in larger numbers than in Northern Ireland and Co. Donegal. This may indicate that a change in the settlement organisation occurred in Argyll, in which the morphology of sites changed from curvilinear to rectangular and irregular during the 1st millennium AD. In Northern Ireland and Co. Donegal, the excavation evidence indicated that generally the CEA sites are in occupation at this time. This pattern suggests that the shape of settlements in Argyll during the 1st millennium AD is distinct, however a few sites in the other study areas are comparable in shape.

Shape	Argyll	Northern Ireland	Co. Donegal
Curvilinear	44%	79%	83%
Rectilinear	9%	1%	3%
Irregular Curvilinear	14%	1%	1%
Irregular Rectilinear	9%	0.5%	3%
Irregular Irregular	4%	0.5%	1%
Promontory Enclosure	15%	1%	9%
Unknown	5%	18%	N/A

Table 4.3 Percentage of sites in each study area sorted by shape.

The proportions of sites by construction type demonstrate varying patterns between the three areas. Table 4.3 illustrates the percentage of sites by construction type for each of the study areas. The majority of known sites in Argyll are of drystone construction. The reverse is apparent in the Northern Ireland study area, in which the percentage of stone sites is much smaller than the earthen rampart sites. Drystone enclosures and earthen rampart sites surviving in Co. Donegal are approximately equal.

Construction Type	Argyll	Northern Ireland	Co. Donegal
Drystone	96%	4%	44%
Earth Rampart	1%	87%	41%
Stone and Earth Rampart	3%	8%	9.5%
Unknown	0%	1%	5.5%

Table 4.4: Percentage of sites in each study area sorted by construction type.

The proportion of land above 101m OD in each study area appears to mirror that of the stone sites to the earthen rampart sites respectively. The study area with the largest proportion of area below 100m OD is Northern Ireland, encompassing 56% of the study area. Argyll exhibits the smallest amount of low lying area of the three areas, with 35% of the land located below 100m OD (Figure 4.30). The percentage of land area below the 100m contour in Co. Donegal lies in between these two percentages at 47%.

The distributions of drystone sites in the three study areas are illustrated in Figures 4.31 to 4.33. In all three areas, these sites are located between 50m OD and 200m OD. Only seven sites constructed of earth are found throughout Argyll; too few are known to deduce a meaningful pattern (Figure 4.34). Earthen enclosure sites surviving in Northern Ireland and Co. Donegal are found at lower altitudes (Figures 4.35 and 4.36). Areas below 50m OD in the lowlands that are void of sites, for example the valley of the River Bann in Northern Ireland, are noted to have been the locations of several now destroyed enclosures, typically by agricultural practices over the last 200 years. These enclosure sites were marked on the Ordnance Survey 6" map series and detailed in the OS Memoirs by the Ordnance Surveyors in the 1800s (http://ads.ahds.ac.uk/catalogue). Unfortunately, a few of these site descriptions were too vague to determine between a field or stock enclosure and a domestic site. Therefore, sites without detailed descriptions on the enclosure construction, shape or size were omitted from the analyses (Figure 4.37). The number of remaining sites, 1345, is felt to be sufficient to represent general distribution patterns. The stone and earth monuments appear to follow a similar pattern to that observed with the drystone sites, along the section between 50m OD and 200m OD (Figures 4.38 to 4.40). As was the case with earthen rampart sites, there are very few stone and earth sites in Argyll, in which location of this type of site may be more related to the small stretches of lowlands.

The comparisons of the proportion of land below 100m OD and of sites by construction type illustrate an interesting relationship. The proportion of sites by construction type in Northern Ireland and Argyll reflect the extreme ends of a continuum between amount of land below 100m OD and the percentage of earthen enclosure sites. The relationship illustrated in Co. Donegal appears to be almost split between earth constructed sites and stone constructed sites. Distributions of the site types throughout their respective study area illustrate further emphasise of the lowland/upland distribution, in which stone sites are located on higher altitudes than earth constructed sites. This would possibly further suggest that areas encompassing both the drystone sites and the earthen enclosures are environmentally conducive to several different constructional preferences rather than representing a chronological continuum from stone to earth constructed sites. Though Henderson (2000b:130) suggested this difference in construction technique might be a result of chronological sequence, in which the curvilinear stone structures were an Atlantic west development (refer to Section 4.2.3).

Examination of sites by size demonstrated some similarities between sites in Argyll and Co. Donegal, but differences with Northern Ireland. The majority of curvilinear drystone sites (70%) in Argyll have internal diameter sizes smaller than 15m (internal area sizes below 180m^2) (Figure 4.41). Sites constructed of earth and stone in Argyll demonstrate a similar pattern to that illustrated by the drystone structures. Only one curvilinear site of earth construction has recorded dimensions, enclosing a space larger than most of the other curvilinear sites, measuring at 356m^2. The majority of curvilinear sites of all construction types in Northern Ireland enclosed larger areas than the sites in Argyll, in which only eleven sites have internal diameters below 15m (Figure 4.42). The distribution of earthen enclosures illustrate that 82% of the sites have internal measurements between 601m^2 and 5000m^2 (Figure 4.43). The drystone sites in Co. Donegal span the whole of the diameter size range, yet illustrate a slightly bell-curved distribution where 66% sites range between 141m^2 and 500m^2 (Figure 4.44). Sites with stone and earth ramparts illustrate a bipolar distribution, in which 29% measure between 61m^2 and 240m^2 and 61% fall between 481m^2 and 2000m^2. Earth constructed sites are also spread throughout the entire range, however they gradually increase in numbers the larger the diameter range. Seventy-eight percent of these sites enclose internal areas larger than 361m^2. The pattern of curvilinear sites by size illustrated the sites in Co. Donegal were comparable size to both Argyll and Northern Ireland, whereas the majority of sites in Argyll and Northern Ireland were at either end of the range.

Rectilinear sites in Argyll illustrate two size ranges, in which 80% of the sites had internal areas between 21m^2 and 260m^2 and the remaining sites are larger with several examples measuring up to 701m^2 and above (Figure 4.45). The rectilinear sites in Northern Ireland illustrate a similar pattern, with the majority of sites encompassing internal areas above 700m^2. Only one rectangular site is small enough to have possibly been roofed (Figure 4.46). Only three rectilinear sites have documented measurements in Co. Donegal, with two of them measuring internally between 321m^2 and 380m^2 and the third at 640m^2. This illustrates that this site type is generally larger in Northern Ireland and Co. Donegal than in Argyll, but a few sites are of comparable size.

All irregular variations of sites in Argyll illustrate the majority (70%) are larger than 180m^2. Figure 4.47 illustrates that almost half of sites (43%) enclose areas larger than 541m^2. The irregular-curvilinear sites did, however, have several examples with internal areas under 180m^2. Measurements on internal dimensions for twenty-one of the twenty-six irregular sites in Northern Ireland demonstrate fairly large areas, measuring above 500m^2 (Figure 4.48). All the irregular variations in Co. Donegal are distributed throughout the range, but are higher in numbers above 561m^2 (Figure 4.49). The distribution of irregular sites in the three study areas demonstrates that the majority of sites in Northern Ireland are large, whereas sites in Argyll and Co. Donegal illustrate a range of sizes.

Promontory sites in Argyll exhibit a range of sizes from 61m^2 to over 10,000m^2, however 58% have internal areas larger than 601m^2 (Figure 4.50). Only four of the seventeen sites in Northern Ireland have measurements suitable for accurately calculating internal area. All except one enclose areas above 700m^2. The internal area of the smaller site measures to c. 478m^2. Sites in Co. Donegal were generally large in size, in which nine out of thirteen measure above 1000m^2 (Figure 4.51). In all three study areas, these sites were generally large in size, but several sites in Co. Donegal and Argyll were of comparable size.

Sites with comparable architectural features are apparent throughout the study region. The site at Drumboghill (DN-103)(AFIR), near the south-west coast of Co. Donegal has features similar to several examples found on Scottish sites. The site Kildonan Bay (AR-073)(AFIR), on the eastern coastline of Kintyre, encompasses door checks, bar holes, interior twin staircases and is similar in morphological shape and wall width, comparable to those features on Drumboghill (Figure 4.52). A guard cell off the entrance passage at Drumboghill also has similarities to the example at Ardifuir 1 (AR-401)(AFCA), in which both cell entrances are raised above ground level. Small lintelled entrances leading into intramural cells or passages were noted in the interior wall face on several sites, curvilinear and irregular in shape. A few examples include Loch Glashan (AR-169)(AFCA) and Kildalloig (AR-413)(AFCB) in Argyll, Altagore (NI-55)(AFCA) in Co. Antrim and a previously unrecorded example at Doon Glebe (DO-118)(AFCA) in Co. Donegal (see Appendix 2 for more information).

In Argyll, over 70% of these sites have internal areas below 160m^2, however a few sites measured considerably larger (Figure 4.53). These larger sites vary in morphological shape and architectural features from the smaller examples. Three sites in Northern Ireland have architectural features apparent within the drystone wall. Two of the sites enclose internal areas measuring over 50m across, whereas the third is c. 15m in diameter. Five of the six sites with architectural features in Co. Donegal had measurements. Figure 4.54 illustrates these sites have a range in internal sizes between 180m^2 and 800m^2. The pattern between the study areas demonstrates that sites with architectural features in Northern Ireland and Co. Donegal are generally larger than those in Argyll.

The general distribution pattern of all sites in Argyll is along the coastlines with a concentration of sites in Mid-Argyll. Both the CSB and CSA sites are distributed throughout the study area with concentrations in Kintyre, Islay, Colonsay, Mid Argyll, the west coastline of Mull and Tiree (Figure 4.55). The distribution of RSB and RSA sites also illustrate concentrations in Kintyre, Islay, Colonsay and Mid Argyll, but are absent or few in numbers on Tiree and Mull (Figure 4.56). All variations of the irregular sites are scattered throughout the study area, and comparable to the distribution of the CSB and CSA sites (Figures 4.57 to 4.59). Figure 4.60 illustrates a lack of promontory sites in Kintyre, but high numbers of the PB and PA sites are located along the coastlines of Islay, Mull and Mid Argyll. Curvilinear sites encompassing architectural features such as intramural staircases and guard cells illustrated varying distributions in the study area (Figure 4.61). The AFCB sites are located throughout the study area, whereas the AFCA sites concentrate in Mid-Argyll with one outlier on Tiree. Distribution of the irregular shaped sites with architectural features are confined to Islay, Mid Argyll and a single site in Kintyre (Figure 4.62).

In Northern Ireland the CSB and CSA sites illustrate a distinct distribution near the southern border of the study area and are dispersed in the northern sector (Figure 4.63). The three CEB sites were found scattered through the study area, whereas the CEA sites illustrate a distribution on valley sides of the major glens, along the coastlines and surround the north-west shoreline of Lough Neagh (Figure 4.64). The CSAEA sites demonstrate a widely dispersed distribution throughout the study area and the three CSAEB sites are located to the southern half (Figure 4.65). Rectilinear sites are scattered throughout the whole study area with a higher number of sites in the south (Figure 4.66). A comparable pattern is depicted by the irregular sites distribution with additional irregular-rectilinear sites along the valley of the River Bann (Figure 4.67). A high number of the promontory sites are located in the northern half of the study area with distributions along the northern and north-western coastlines (Figure 4.68). Only three sites encompass architectural features. Two of these are located in the north and the third in Co. Down (Figure 4.69).

Geographical distribution of sites in Co. Donegal demonstrated concentrations of both CSB and CSA sites along the northern and south-western coastlines and a scatter of sites along the large central river valleys (Figure 4.70). A concentration of CEA sites is evident on the south-western coast around Donegal Bay and a dispersed distribution in the central section of the study area (Figure 4.71). The CEB sites are only located near Donegal Bay and inland with an outlier site on the north coast. Both the CSAEB and CSAEA sites are widely scattered throughout the study area, though there are no CSAEB sites located in the south-western sector (Figure 4.72). There are only a few sites classified as rectilinear and with the exception of one inland site, these are located along the north and south-west coasts (Figure 4.73). All irregular sites are scattered along the coasts and further inland (Figure 4.74). The majority of PA sites are along the length of the coastline with a few examples distributed further inland along the marginal land between lowland and highland (Figure 4.75). Sites encompassing architectural features are located along the coast and on Lough Swilly with one further inland along the River Swilly (Figure 4.76). A void of sites is apparent in the north-west, however, Chapter 3 described this area as upland plateaus with little soil cover. All site types appeared to be represented along the coastline, with several examples further inland, with higher frequencies of earth sites on the south-west coast.

4.6 Conclusion

A review of the previous terminology in each of the study areas has highlighted several issues. Several terms have been applied to the same site type and comparable sites have been categorised into separate headings, such as dun/fort in Scotland and ringfort/hillfort in Ireland. Sites of varying morphology and sizes have also been grouped under the same headings. The classification scheme employed in the research has attempted to resolve these issues by categorising sites firstly by morphological characteristics and then size. Possible chronological developments have been noted in Argyll, in which curvilinear sites are usually associated with 1st millennium BC settlements and irregular and rectilinear sites with the 1st millennium AD. Excavations in the study areas in the northern part of Ireland have concentrated on the CEA sites and few of the site types have been examined. The limited evidence suggests activity at curvilinear sites throughout the 1st millennia and large irregular sites in occupation during the latter half of the 1st millennium AD.

Comparative analysis in the study region demonstrated that the highest number of sites is curvilinear in all three areas. Sites of similar morphology and size are apparent between Argyll and Co. Donegal, for example the CSB, CSA, irregular sites and sites with architectural features. Sites in Co. Donegal are also comparable to those in Northern Ireland (CSA and CEA). Promontory sites in all three areas are of comparable sizes, though a number of sites in Argyll are also smaller. Classified sites throughout the study region illustrated predominantly coastal distributions with a few inland examples of the CSB and CSA sites in Argyll and Co. Donegal. These sites in Northern Ireland are few in number along the northern and eastern coastlines and are generally located along the southern border of the study area. Very few CEB and CEA sites are in Argyll, but are detected in large numbers Co. Donegal and Northern Ireland. These sites are mostly located inland, with few along the coastline. Several of the rectilinear and irregular sites in Co. Donegal and Argyll are located close to the shoreline, whereas these sites in Northern Ireland are typically inland. Sites with architectural features are distributed along the coastline in Argyll and found slightly inland in both Co. Donegal and Northern Ireland. The majority of promontory sites are coastal throughout the study region, however several examples are found inland in Northern Ireland.

Chapter 5: Theoretical Context and Methodology

5.1 Introduction

The core issue addressed in the study of settlement patterns is to investigate why particular locations were chosen over others for habitation. This research examines variables concerning both landscape exploitations and socio-cultural logic as indicators of settlement locations. Section 5.2 considers the role of GIS in archaeological research, the importance of particular variables in settlement distributions and how these are analysed in the current research. A critique of the development of GIS techniques and methodology and the strength, limitations and underlying data quality that affect this research are discussed under Section 5.3. The methodology undertaken in this research is described in detail under Section 5.4, including data requirements, acquisition and processing.

5.2 Theoretical Discussion

In the field of archaeology, the methodological approaches to analysing and verifying spatial patterns within archaeological site distributions were firmly established by the 1970s, following methods originating in the New Geography (Chorley & Haggett 1967; Haggett 1965). The developing theory, methodology and analysis tools advocated an underlying functionalist view with the application of techniques including Theissen Polygons, Nearest-Neighbour Analyses and trend surfaces (Clarke 1972; Hodder & Orton 1976). The introduction of GIS to archaeological methodology in the early 1990s has resurrected several of these techniques, for example Cost-Surface Analysis and inferential statistics. However, the use of GIS as an analytical tool for archaeological research was treated with scepticism for fear of re-establishing the processual approach to regional studies. The response led to a backlash of the environmentally deterministic approach GIS had on archaeology, mainly due to the nature of available data. This data typically modelled environmental attributes, including Digital Elevation Models (DEM), soil and hydrological data. From the mid 1990s, theory and GIS technology had been rapidly evolving in order to design methods of incorporating cultural aspects into the analysis of settlement patterns, such as Viewshed Analysis. As a result, archaeological site distributions can now be analysed in entirely different ways, in which socio-cultural concepts can be given quantitative values (Fisher *et al*. 1997; Lake & Woodman 2000; van Leusen 1993; Wheatley 1995; 1996). Now, the use of statistical analyses in the study of site distribution can incorporate a dual approach encompassing both environmental practicality and socio-cultural aspects to give an overall picture of settlement networks in the past.

A common question applied to regional studies concerns the degree of influence environmental conditions had on the site location choices made by past peoples. Previous site locational studies have indicated that particular settlements have higher frequencies on specific altitudes, slopes, and aspects (e.g. Harris 1984; Limbert 1996). These patterns may indicate the influence of the landscape on site location decisions. For example, steep ground may impede day-to-day activities and act as physical barriers, cause soil instability and have lower moisture retention (Bevan & Conolly 2002; Kvamme 1990a; Morgan 2000). Flat or gently sloping ground may be marginal, in terms of agriculture, as a result of poor drainage (Coppock 1976). Hillsides facing particular cardinal directions may afford protection against dominant wind directions and have increased exposure to sunlight for crop production (Harris 1984). Higher elevations may be less conducive to agriculture due to poorer soils (Bibby *et al*. 1982). The topographical landscape may have practicalities that inhibit or appear more favourable to the location of settlements, which can be deduced through statistical testing.

Socio-cultural influences are more difficult to model in terms of quantifiable research. Visibility is one way of defining cognitive perceptions of the landscape and gives balance to the culture/nature dichotomy (Wheatley 2004). Site locations may be influenced by expansive or focused views over the surrounding environment in order to attain visual control (Higuchi 1989; Llobera 2001) or to maintain visual continuity with ancestral monuments (Gaffney *et al.* 1996). A group or class of monuments may have a visual focus that has ritual or symbolic significance (cf. Tilley 1994). The Viewshed Analysis tools provide a means to explore the relationships of visibility and intervisibility between settlement locations in the landscape. This type of analysis provides a means for exploring site locations on a human symbolic level and to offer an alternative model to explain patterns outside of the economic rationality.

5.2.1 The Environmental Data Model

During the 1970s, associating settlement distributions with features of the environment became a widely used archaeological approach (Cottam & Small 1974; Plog & Hill 1971; Thomas & Bellinger 1976). The introduction of significance tests enabled researchers to determine whether the distribution patterns actually existed (Hodder & Orton 1976; Shennan 1997). For example, a distribution of 75% of archaeological sites located on south-facing slopes would not be a significant pattern if 75% of the land was south-facing. However, if only 20% of the land was south-facing then a significance test would indicate a correlation between site distribution and south-facing slopes. Though, "techniques of this (statistical) nature are ideal for testing hypotheses and relationships, …. their limitations must be constantly borne in mind as, in the extreme case, conclusions may become divorced from reality. A statistical model is nothing more than an aid to comprehension, and in itself is not an explanation," (Cottam & Small 1974:60).

More recently, a wide range of environmental variables has become available for manipulation in a GIS. Where data are in quantifiable form, they can easily be manipulated for statistical purposes. More powerful statistical tests, such as the one-sample Kolmogorov-Smirnov test, require a background population to compare with the site data. Digital map layers of environmental attributes are ideal for this purpose (Kvamme 1999; Wheatley & Gillings 2002). More often this data has been utilised for predictive modelling applications. The basic assumption underlying these models lies with the distribution patterning of cultural remains resulting from human decision-making activities within the conditions of the surrounding landscape (Duncan & Beckman 2000; Legg & Taylor 2006).

There are three physical variables chosen to test their influence on site location in the current research. These variables are selected due to their accessibility and frequent referral in locational analyses and predictive modelling (e.g. Gaffney & Stancic 1991; Kvamme 1990a; Legg & Taylor 2006; McClung de Tapia & Tapia-Recillas 1997; Morgan 2000; Snell 1999). These include elevation, slope and aspect. They are not claimed to represent the total range of influential factors on site location. Rather they are chosen to illustrate unambiguously that environmental factors are valid indicators that help in the identification and explanation of trends in settlement patterns. Other environmental variables are considered, but not included due to constraints of the current research and the available funding for costly digitised maps containing this data. Soil types, degree of climatic exposure and locally available resources are only a few of the variables that could be examined more fully in future research.

A Digital Elevation Model (DEM) is required for the processing of the environmental variables. In brief, a DEM is a gridded raster map comprised of rows and columns, in which each cell contains a value representing an elevation height (Figure 5.1). Slope and aspect data can be created from a DEM. The resulting maps would contain cell values representing the degree of slope angle for the slope layer and a directional compass degree for aspect (Figure 5.2)(see Section 5.3.3 for details on data quality and resolution).

Statistical testing is used to determine whether site distributions illustrate pronounced location preferences toward particular ranges within the environmental variable. The attribute table attached to each of the raster maps lists the amount of surface area in metres-squared for each value. These quantitative values represent the 'background' distribution in the statistical techniques, which the archaeological site distribution is correlated against. Statistical testing indicates whether the distribution of sites is significantly different from that of the 'background' distribution (i.e. the environmental attribute). The test may also highlight site locational preferences for particular categorical ranges within the variables, in which the proportion of sites is much higher than the 'background' distribution (Figure 5.3) (Kvamme 1990a; 1992; Morgan 2000).

The two statistical tests employed for analysing archaeological site distributions include the one-sample Kolmogorov-Smirnov goodness-of-fit test and the one-sample Chi-squared (χ^2) goodness-of-fit test. Both of these tests compare the frequency of environmental attribute distribution with archaeological site distribution, but each is designed for a particular data level, continuous and categorical data respectively. The Kolmogorov-Smirnov is used to test the cumulative distribution between the two populations (Shennan 1997). In other words, small differences throughout the whole of the site distribution, which appear non-significant, could add up to a large cumulative difference, that possibly signify a higher frequency of sites located within a particular environmental range(s) (Hodder & Orton 1979). Elevation and slope data are applied to this test. The Chi-squared test investigates the comparison of expected frequencies calculated for archaeological sites and the observed frequencies in each environmental categorical range (Shennan 1997). The aspect data values are categorised into the eight major cardinal directions (refer to Section 5.4.2) and are analysed using the Chi-squared test (refer to Section 5.4.3 for a more detailed discussion).

Both of these statistics are used to test the null hypothesis (H_0) that archaeological site distribution is roughly equal to the distribution of the environmental attribute data; there is no significant difference between the two distributions. A significance level of 5% is chosen to avoid the overstatement of a correlation between distributions when in fact there is none (*ibid.*). For a relationship to show significance at this level (5%) it must have 95% of the data fall under the assumptions made by the test, meaning only 5% of the archaeological site distribution can vary from the environmental variable distribution (*ibid.*). The aim of these statistical tests is to determine whether a correlation between site distribution and the environmental data existed or not.

5.2.2 The Visibility Data Model

The introduction of the Viewshed Analysis tool in GIS software expanded the possibilities for visibility analyses. The tool creates a binary raster layer calculated from a DEM indicating which areas are visible from a given geographic location in the landscape. The term 'Viewshed' defines the visible and non-visible topography from a location and etymologically relates to the term watershed. Initial studies experimenting with viewsheds lacked methodological structure, in which discussions revolved around visual interpretations (e.g. Gaffney & Stanĉiĉ 1991; 1992; Madry & Crumley 1990; Ozawa *et al.* 1995). More recently, methodologies are being developed and tested in order to quantitatively assess and accurately interpret viewshed data (e.g. Lake & Woodman 2000; Madry & Rakos 1996; Ruggles & Medyckyj-Scott 1996; van Leusen 1993; Wheatley 1995;

1996). This research investigates the extent to which visibility was an influence on site location using the viewshed analysis tool to extract visibility data and apply it to statistical testing.

Viewshed analysis is founded on the concept of visibility between two points, otherwise known as 'Line-of-Sight' (LOS). This process calculates whether or not Point 'B' is visible from the observation point, Point 'A' (Figure 5.4). The viewshed operation calculates which areas are visible and not visible from a given location using the data in a DEM. The resulting viewshed map is the calculation of LOS between the observer point and every cell in the DEM. The output Boolean raster map has the same size and cell resolution as the input DEM. Each cell is allocated a value of 1 or 0 for visible or not visible, respectively. An offset height can be assigned to the observation point to calculate visibility from an eye line height rather than from the ground surface. Previous studies have calculated viewsheds using a range of offset heights from 1.5m to 2m above ground level to reflect eye-level views or visibility from the top of a monument wall (Christopherson & Guertin 1996; Llobera 1996; Llobera *et al.* 2004).

Intervisibility within a group of observation points or sites can be investigated by calculating a 'Cumulative Viewshed' (CVS) or 'times seen' map (Tomlin 1990). Map algebra is used to sum the viewshed maps calculated from each site to create a single cumulative viewshed map. As apposed to a Boolean raster map, the cell attributes contain a value indicative of the number of archaeological sites that can see that particular cell. For example, four viewshed maps were created from four sites. These viewshed maps are then added together to create a single cumulative viewshed map, in which each cell attribute contains a number indicative of the frequency that particular cell is intervisible with all four sites (i.e. the highest value for a cell in this final map would be four and the lowest would be 1) (Figure 5.5). This map can also be statistically tested as further discussed below.

Four hypotheses are developed to test the locational patterns of archaeological sites. These approaches are designed with the underlying premise that there is a shared cultural tradition between the three study areas and that certain distribution patterns may reflect this. This analysis will also test whether or not the viewsheds of archaeological sites are sufficiently different from the background visibility properties. The objective of this analysis is to demonstrate whether visual communication was an influential factor in settlement location and if morphologically comparable sites in each of the study areas demonstrate similar patterns. Assumptions for each hypothesis are discussed under Section 5.3.2.

Visibility data are applied to the Monte Carlo statistical test to verify whether there are significant relationships between archaeological sites and the visibility from those locations. Basically, this test compares the viewsheds from archaeological locations to viewsheds from random locations in the landscape, i.e. the background population. The latter dataset is defined by a set of random locations within a given set of parameters (listed under Section 5.3.2). The use of random locations was chosen over analysing every cell in the DEM to shorten the computation into a more reasonable time frame (Fisher *et al*. 1997). The Monte Carlo test is applied to all four of the hypotheses.

The first hypothesis focuses on site location with consideration for site classifications. This analysis determines whether or not the areas visible from the sites are large and are generally larger than areas visible from other locations in the study area. The viewsheds calculated from the sites not only indicate which areas are visible from the site, but also from which areas the monuments can be seen. Addressing the issue of a site's level of visibility or prominence in the landscape may provide perceptions about hierarchy, rank and significance. "Prominent locations are related to visual and physical control (Higuchi 1989), which may contribute eventually towards their symbolic significance" (Llobera 2001:1007). This analysis may suggest that the locations of certain site types are deliberately placed in highly visible areas of the landscape as against those that are less visible.

The amount of sea visible from archaeological site locations compared to random sites is tested in the second hypothesis. The third hypothesis is an extension of the second, in which a ratio of the mean area of visible sea to the mean area of visible land is calculated and statistically tested. Sea and coastline visibility may have been important for coastal communities in terms of trade, sustenance and communication and the results from analyses two and three may support the idea that certain site classifications are located in order to have a large degree of visibility of the surrounding sea.

The fourth analysis tests whether or not particular features or locations in the landscape are a predominant focus for a significant number of archaeological sites or set of sites. A cumulative viewshed is created for each site classification and each set of random sites. The amount of visible area from the morphological sets of sites is then calculated. This is compared with the results from the random sets to determine whether specific areas are a focus for archaeological sites or if these areas are highly visible throughout the whole landscape. Areas of importance for water-bound trading may be revealed as a focus of visibility for groups of sites.

All four analyses are applied separately to each site classification in each of the study areas. Hopefully, the analyses will illuminate varying settlement patterns throughout the different site classifications and comparable patterns between the same site types across the study region. It is also anticipated that similar patterns may be observed along the coastlines and areas of visual focus will be identified for specific classification types on both sides of the North Channel.

5.3 Critique

One of the basic functions of a GIS is the rapid cartographic display of multiple map layers. Archaeological site databases with geographic coordinates can be inputted into a GIS to create a spatial database and display complex distribution maps. Reclassifying the data by site size or morphological shape can alter the visual distribution display, which may reveal basic patterns not previously observed. However, determining whether or not these patterns are representing an actual trend in the distribution can only be discerned through quantitative analysis (Harris & Lock 1995; Kvamme 1999; Lock 1995). A distribution map alone "only represents a series of points in space which is difficult to compare or relate to environmental features," (Cottam and Small 1974:44).

5.3.1 Archaeological Context

As discussed above (Section 5.2.1) analyses into archaeological locational tendencies with reference to environmental variables is a technique developed in the 1970s. The development of GIS and the available digital environmental data provide quicker and more precise results. Thus, these techniques are increasingly employed in numerous archaeological applications.

During the 1990s, several projects focused on the correlation between elevation, slope and aspect attributes and archaeological distributions. Kvamme (1990a) devised a methodology to test correlations between environmental variables and archaeological site locations using the Kolmogorov-Smirnov statistical test. His example illustrated that archaeological sites were located on hillsides of particular slope gradients and on particular elevations and these were most likely the result of locational decisions. Morgan (2000) demonstrated the changes in locational preference of various site classifications in correlation with particular environmental attributes using the Chi-square statistic. The reverse can also be determined, in which the results of the Kolmogorov-Smirnov statistical tests in McClung de Tapia and Tapia-Recillas's (1997) research indicated that elevation, slope and aspect were not contributing factors to site location decisions on Middle-Terminal Formative period sites in the Teotihuacan region of Mexico. Instead, these results suggested that there are other underlying cultural or environmental influences affecting the location of sites.

Predictive modelling is becoming a more popular and refined technique in the field of archaeology, particularly within the sphere of cultural resource management (Conolly & Lake 2006). This approach investigates the probability of occurrence of archaeological sites in uncharted areas using one or more independent variables, which usually include elevation, slope and aspect among others (e.g Duncan & Beckman 2000; Kvamme 1990b; Warren & Asch 2000; Woodman 2000b). Espa *et al.* (2006) devised a method of determining the level of importance of variables in the predictive model. Elevation, slope and aspect were all found to be highly important predictor variables in the prediction of archaeological site locations in the Cures Sabini area of the Mid Tiber valley. Predictive modelling of ringforts in the Inny River catchment in Ireland illustrated that elevation, slope and soil were also significant influences on their locations (Legg & Taylor 2006).

Visibility approaches to site location have been investigated well before the advent of GIS and its associated techniques. In the past, the exploration of avenues such as site localities on visually commanding positions and site intervisibility has been the focus of several site distribution studies. A generation ago, research in Orkney explored the concept that site location was influenced by the visibility of the surrounding land with preferences of a specific visual landscape (Davidson 1979; Davidson *et al.* 1976; Fraser 1983). Site intervisibility with regards to dominant and subservient site locations have been investigated for a range of site types such as Neolithic chambered cairns and Iron Age brochs in Orkney (Fraser 1983) and Shetland (Fojut 1980); and the intervisibility of Bronze Age barrows was noted in Dorset (RCHME 1970). Theories employed for these earlier studies have the same basis as more recent research employing the Viewshed Analysis tool, but now the technology has broadened the scope for this technique. Rather than relying on field observations, manual cartography and the laborious task of manually extracting data for quantitative analyses, GIS can provide a less demanding and quicker means of gaining the same results.

Viewsheds have been used to interpret "the intervisibility level among monuments, in order to determine social cohesion and the importance of visible awareness, as a way of establishing territorial rights (Wheatley 1995), to assess the level of cross-visibility (Llobera 1999) or visual continuity among monuments belonging to different periods (Gaffney *et al.* 1996)" (Llobera 2003:33). Gaffney and Stanĉiĉ (1991) used this method to test whether watchtowers on Island of Hvar were placed with intervisibility to a central tower. Unfortunately, their use of this method was rather simplistic in its approach to the data. Interpretations appeared to be the results of simple observations of the viewsheds indicating whether a specific site or landscape feature was located in the visible area, and a disregard of the many other locations also falling within the visible area. Maschner (1996a) showed Late Phase villages possessed significantly greater viewshed areas than Middle Phase villages, suggesting defensibility became more important through time.

New approaches to visibility demand a rigorous use of viewshed analysis to produce quantitative data that would lead to more meaningful interpretations. The proposal and testing of hypotheses on site locations against a background set of data to determine whether there are significant visibility differences or simply coincidental circumstances would be an adequate resolution. Such an approach is needed to counteract criticism such as that voiced by van Leusen (2002:6.12) "It is all too easy to employ viewshed analysis simply to support one's preconceived ideas about the cultural and cognitive significance of archaeological monuments, especially if there is little or no methodological control on these quantitative models." For example, Wheatley's (1995) research on the downlands of Wiltshire statistically tested whether the locations of long barrows were influenced by their visibility of each other using the 1-tailed Kolmogorov-Smirnov (K-S) statistical test. The null hypothesis "that the sites are distributed irrespective of the number of other sites which are visible" (*ibid:*173) was tested. This methodology compared the number of times all locations within each study area are visible from the barrows with the number of times the barrows are visible with each other. Wheatley's analysis demonstrated barrows having a high degree of intervisibility, as opposed to being visible from the surrounding landscape.

Following Wheatley's (1995) introduction of testing hypotheses on visibility, researchers have further developed sophisticated means for interpreting viewshed results. Chistopherson and Guertin (1996) convincingly demonstrated that visible communication between hinterland sites played an important role in local settlement strategies by comparing and statistically testing the cumulative viewsheds of archaeological sites with those of random sites. Lake, Woodman and Mithen (1998) developed an algorithm to process cumulative frequency distribution of viewshed sizes and statistically tested results in a 2-tailed K-S statistical test to determine whether Mesolithic sites were located at positions of good visibility compared with other potential locations. Fisher *et al.* (1997) devised a method for statistically testing hypotheses based on the comparisons of visible areas from random locations against site locations to illustrate a rigorous statistical method for testing site location with regards to visibility. This strategy employed three separate approaches on three hypotheses. These included the analysis of the viewshed from archaeological site locations and random locations, visible land and sea areas from site locations and random locations and the differences in viewsheds taken from the immediate vicinity of a site using the random sampling, stratified random sampling and proximity to random sampling approaches. It is this methodological strategy outlined by Fisher *et al.* (1997) that is the basis for visibility analysis in the current research.

5.3.2 Strengths and Limitations

Analysis tools for reconstructing past landscapes and identifying ancient distributions are consistently evolving around archaeological questions. Past human actions have left permanent traces in the landscape observable as monuments, remnants of agricultural practices and topographic modifications. Since the 1990s, there have been thorough discussions on whether GIS is the appropriate tool to handle these archaeological issues, theoretically and methodologically (Gaffney *et al.* 1996; Gaffney & van Leusen 1995; Wheatley 1993). GIS does have the capability of rapidly manipulating and querying data in order to display distribution patterns defined by specific parameters. Elevation data can be correlated with the site data in order to apply more rigorous and robust spatial analyses. Recently, data available for manipulation in a GIS is becoming more precise, in which DEMs are available in higher resolutions and coordinates for site data are being refined. Analyses such as cost-surface, visibility, catchment and trend surface have been methodologically developed and are constantly re-assessed for their application in a GIS in order to explain locational influences.

The enthusiastic uptake of GIS in the early 1990s and the possibilities that such a tool could provide for spatial analysis in archaeology led to the debate of determinisms. Primarily environmental data, such as hydrological, soil and contour maps digitised into elevation raster data that could then produce slope and aspect maps, was the available data for GIS manipulation at that time. This, in turn, led to major criticisms on the use of approaches using GIS analysis tools to solve archaeological and geographical questions. Analyses on settlement distributions and predictive modelling appeared to rely solely on environmental data, which led to functionalist/deterministic explanations (Gillings & Goodrick 1996; Hirsch 1995). Wheatley (1993) also suggested that interpretations on distribution patterns based solely on environmental data do not further enlighten the archaeological picture, but rather states the obvious. The lack of socio-cultural data in distribution analyses was largely criticised to the point of whether GIS based research was appropriate in the field of archaeology (Gaffney & van Leusen 1995).

The suggested alternative for the environmentally deterministic issue was to reject the environmental attributes entirely and focus on methodology that introduces socio-cultural data into a GIS-based approach (Gaffney *et al.* 1995; Gillings & Goodrick 1996; Harris & Lock 1995; Llobera 1996; Lock & Harris 1996). Rather than relying on interpretations derived from environmental variables, archaeological research should include a variety of socio-cultural factors that would have affected site location strategies. Cost-surface and visibility (or viewshed) analyses are two approaches that can produce 'cultural' data for analysis.

(Gaffney & Stanĉiĉ 1991; Wheatley 1995; van Leusen 2002). Both of these analyses are examples of techniques that provide quantifiable data, thus providing a means to significantly test socio-cultural aspects of locational influences.

From this backlash of the environmental deterministic use of GIS in archaeology, a dichotomy between environmental and cultural determinism approaches has been strongly questioned. Discussions on external influences on people's behaviour is certainly not a new topic, nor the dichotomy between nature and cultural (Ingold 1986b; 1992; McGlade 1995; Tilley 1994). Unfortunately, the negative response towards approaches analysing distribution patterns using environmental attributes appears to be firmly established in most GIS-based research. However, the acceptance of the underlying assumption that ancient peoples lived, worked and settled within the constraints of their natural environment, but were not influenced by it might be just as misleading. Landscape is varied in terms of resources and topography, in which the relationship between decision making processes and the 'resource landscape' will be reciprocal, both are shaped by the other (Maschner 1996b; van Leusen 2002). "Moreover, it seems silly…to argue over an implicit assumption that environment and human systems are somehow not part of the same world" (Kvamme 1999:182). This dichotomy also attaches undeserved biases onto distribution analyses incorporating logically associated attributes such as statistically correlating agriculturally based settlements with soil classes (Kvamme 1997). Entirely excluding the environment attributes appears obtuse due to the fact that landscape will have some causal affect on locational decisions, such as slopes that are too steep for building on, elevations too high for cultivation or flat areas prone to flooding thus inhibiting agriculture and habitation.

Similar environmental criticisms have plagued distribution analyses during the age of the paper map; however, the advent of the GIS has made it possible to incorporate the socio-cultural aspect. Oddly enough, discussions have covered whether or not GIS can be 'a-theoretical' towards analyses, meaning theoretical biases may inherently be attached to GIS-based approaches (Gaffney *et al.* 1996; Wheatley 1993; Zubrow 2006). Regardless of whether GIS is an analysis technique similarly to Radiocarbon dating being a dating technique or shaping a particular theoretical position, Maschner (1996b) stressed the interrelationship between the social-cognitive and environmental domains in locational decisions, in which one aspect relies on the other. He used Wheatley's (1995) socio-cultural interpretation of long barrow locations influenced by inter-site visibility as an example, and questioned to what extent the topographic landscape also contributed to this pattern. Both natural and cultural features belong to the same continuum, which is structured by or structures the dynamic of past activities in which all variables and methods should be considered together to enhance the overall interpretation of the analysis results. GIS based approaches in regional studies may take advantage of the availability of environmental data, however, unlike paper-map based investigations, socio-cultural aspects are also being incorporated into the analyses and interpretations of distribution patterns.

With viewshed analysis becoming more popular, several major concerns over the mechanics of the technique are now coming to light (van Leusen 2002). The first is concerned with realism or accuracy compared to true visibility field in the real world. Concerning the data, both the accuracy and resolution of the DEM and site location have underlying influences on the overall viewshed result. DEMs with lower resolution or erroneous DEMs would create imprecise viewsheds that would over- or under-estimate the visible area. Site locations need to be as accurate as possible in order to calculate viewsheds from the correct geographic location.

The viewshed calculation process may also produce inaccurate results and the output maps need to be approached with caution (Fisher 1991), however these visibility maps can be verified by ground truthing. Comprehensive notes and photographic evidence can provide a comparison to the accuracy of the viewshed maps. Viewshed results are applied to statistical analyses, however as discussed further below, it is the ranking of the total visibility for a group of archaeological sites compared to the visibility of a set of random sites, in which the overall pattern is analysed as opposed to the viewsheds of individual sites. Currently there is no benchmark available for the viewshed analysis tool in different GIS software, thus visibility results were compared visually between viewshed maps created in IMAGINE and ArcGIS and digital photographs obtained in the field. The Viewshed maps created in both GIS packages were comparable with minor differences. Comparisons with fieldwork photos suggested the IMAGINE viewsheds correlated slightly better with the actual visibility witnessed in the field.

The second concern deals with the issue of edge effects. Excluding visible areas outside the study region from calculations or analyses would lead to incorrect and misleading interpretations. The current research calculates visibility from random locations in each study area. Visibility values would be skewed if any of these viewsheds fell beyond the border of the DEM. The resulting values could not properly support significance and statistical testing would be useless. This issue is resolved by including an additional buffer area of the DEM around the study area under analyses (Lake *et al.* 1998; Llobera *et al.* 2004). Applying a radius limit to the viewshed calculation would ensure that every viewshed map contains the same number of cells (see Figure 5.5).

Higuchi (1989) developed a series of quantifiable indexes that could characterise a given visual environment termed the Higuchi Viewshed. This comprised of eight characteristics that affect the appearance of a visual environment. The distance index defines the visual perception of objects into three distance ranges or bands. A short-range distance measures between the observer point to a 360m radius in which objects within this range are distinguishable and have a direct sensory impact. The middle-range includes distances between 360m from the observer point to 6,600m. This is considered the scenic landscape where vision is paramount. The third band is labelled as the long-range and includes visibility from 6,600m radius and beyond. This is the 'vertical' backdrop in which features in the landscape within this range are visible, but not identifiable. Wheatley & Gillings (2000) introduced the Higuchi Viewshed model into archaeological research. They quantified the proportions of each range and assumed an 18km radius as the maximum visible distance.

Using a radius limit may also address the field-of-view issue. The horizon level and vision clarity affect long-distance view and thus make visibility beyond a certain limit ineffective and useless for statistical analyses. The current research calculates viewsheds using the 18km radius surrounding the sites suggested by Wheatley & Gillngs (2000). Sites located on high elevations and hilltops may have visibility ranges beyond 18km as researched in other visibility projects. Research in the Wessex chalklands utilised a viewshed radius of 20km as the maximum distance over which visibility is possible in ideal conditions (Llobera *et al.* 2004) however, for the purposes of the current research, an 18km radius distance is selected as the best choice for an island/coastal environment under a reasonable computational time. Use of larger viewsheds greatly increased computational times, which under the constraints of the current research were deemed unrealistic. A margin area of 18km wide is added to each study area boundary in order make sure that the viewshed of every site is calculated within the DEM. Sites located within this 'buffer' area are discarded.

Misinterpretation of statistical significance falls under the third major concern outlined by van Leusen (2002). The affect of cumulative viewshed radius size on visibility investigations was summarised by van Leusen. He suggested that by increasing the radius size of the calculated viewshed map "the higher visibility values will concentrate on areas of higher ground, ridges and peaks" (*ibid:*16-21). If sites are located on ridges and peaks then they will most likely see other ridges and peaks. Results of using a smaller viewshed radius indicated visibility was directly affected by the surrounding geomorphology, in which sites with higher visibility were found in areas of lower elevations such as valley bottoms. Statistically testing site visibility will be affected by the size of the radius chosen. The interest of the current research is the visibility of features at a distance concerning coastal travel, sea routes and other archaeological monuments located on prominent hilltops and ridges and is argued that in such a case a viewshed radius of 18km is justified. This is not to deny that the immediate surrounding visible environment of a site may have had influence on site location, but rather the focus for this investigation is the overall vista.

Palaeovegetation covers one of the "most established" criticisms within visibility investigations (Wheatley and Gillings 2000). The available DEMs only reflect modern topography. Unfortunately, data regarding vegetation cover contemporary with the time period under question is extremely difficult to obtain and would require landscape reconstruction. Also, seasonal climates will affect the amount of tree-cover and thus the amount of visibility perceived at that time. Consideration is taken into account that the viewshed calculated in the current research may not wholly reflect the reality due to the exclusion of ancient tree-cover. However the primary interest of this research is concerned with views across the water, which would not have been affected greatly by vegetation. "In spite of not having complete information about the 'skin' of the earth's surface, without being able to reconstruct the exact nature of landforms and vegetation of the ancient time-period/s, we can still use, to a certain extend, the 'bones' of the landscape as we know it by geology and topography" (Llobera 1996:622).

5.3.3 DEM Quality

Digital elevation information is obtained through two sources. For the Argyll study area, Land-Form PROFILE Digital Terrain Model (DTM) is downloaded from *Digimap*[2], an EDINA service funded by the Joint Information Systems Committee (JISC) that provides digital Ordinance Survey map data to UK Higher Education by the University of Edinburgh. The DTM is mathematically derived from the 1:10,000 contour data from the skeletal topography (Digmap 2001). The final format is comprised of tiles available in grided array at a 10m resolution that are merged to form a single map layer (Figure 5.6). Unfortunately, the Digimap dataset only covers Scotland, England and Wales. The topographic data for the Irish study areas is obtained through the Seamless Data Distribution System, provided by the U.S. Geological Survey and EROS Data Center[3]. This data is a remotely sensed raster elevation dataset gathered by the Shuttle Radar Topography Mission (SRTM), which is a joint project between NASA and the National Geospatial-Intelligence Agency (NGA) to produce a 3-dimensional map of the world and to provide publicly an edited elevation data at 3 arc second (90m) resolution. The NGA edited 1 arc second (30m) resolution data by defining coastlines and water bodies more accurately, removing 'spikes' and 'wells' and filling in voids to create the finished product averaged to a 90m resolution (Figure 5.7).

Vertical accuracy of the SRTM data is tested using a statistical methodology provided by the National Standard for Spatial Data Accuracy (NSSDA). This methodology was developed to test the positional accuracy of raster, point and vector geospatial data against georeferenced ground positions and/or digital maps of higher accuracy (FGDC 1998). This statistic has been effectively implemented on several mapping projects to test elevation accuracy. These include Light Detection and Ranging (LIDAR) data on "varying" surfaces against GPS control points (Veneziano 2002), the difference between LIDAR and the SAMB (West Virginia State Addressing and Mapping Board) DEM data with the assumption that the LIDAR data is of higher accuracy (Fedorko 2005a), and the difference between the inverse distance weighting interpolation technique and the Triangular Irregular Networks (TIN) method to create elevation data from the same source data (Fedorko 2005b).

---

[2] http://edina.ac.uk/digimap/
[3] http://seamless.usgs.gov/

The NSSDA vertical accuracy statistic is calculated from the root mean square error (RMSE) value by multiplying the value 1.96 by the derived RMSE value. The RMSE value is simply the square root of the mean-squared-error and is "the most widely used and excepted measure of error employed in spatial science today," (Fedorko 2005b:3). The resulting value represents the mean at a 95% confidence level, in which 95% of the values in the raster layer will have an error with respect to the independent dataset which is equal to or smaller than the calculated NSSDA value (FGDC 1998).

The contour accuracy of the Land-Form PROFILE DTM from *Digimap* is typically better than 1.8m RMSE (Digmap 2001). The RMS value is multiplied by 1.96 and gives a 3.93m vertical accuracy at a the 95% confidence level implying that the differences in the contour heights between the DTM and OS ground points are never greater than 3.93m. The vertical accuracy of certain areas of the SRTM data is no more than 10m RMSE (http://seamless.usgs.gov/). Because the former dataset has a higher accuracy than the SRTM data, it is used as the independent dataset or 'ground truth' data. The supposition of resampling the SRMT data into a higher resolution to create a DEM with improved accuracy is tested. Raster layers are analysed and compared using different resolution sizes and two interpolation techniques to distinguish which size illustrates the smallest amount of overall difference are used (see Table 5.1). The tested datasets include the SRTM dataset, *Digimap*'s 50m resolution Landform Panorama DTM raster which is derived from the Ordnance Survey 1:50,000 Landranger maps and a 30m resolution DEM generated from a remotely sensed elevation dataset at a map size of 106,490m by 133,350m including areas of sea (see Figure 5.8 and 5.9). This latter dataset was acquired in 2003 from Landmap[4], a MIMAS Service run by Manchester Computing at the University of Manchester. The Landmap dataset has been included in this exercise because the resolution scale is higher than the available SRTM data.

Firstly, the positional accuracy statistic of each raster map is calculated using RMSE. The difference between the two map layers is calculated by subtracting the test raster from the independent and the resulting data is applied to the following formula:

$$RMSE_z = \sqrt{\frac{\sum \left(X_{independentvalue_i} - X_{testvalue_i} \right)^2}{n}}$$

[4] http://www.landmap.ac.uk

Where

$X_{independentvalue_i}$ = ground truth point of the i^th point in the dataset

$X_{testvalue_i}$ = test point of the i^th point in the dataset

n = the total number of test points

i is an integer from 1 to n

This methodology is easily implemented with the 'Spatial Analyst' tools in the ArcGIS environment. The difference in elevation height values between the two datasets is calculated using the 'Raster Calculator'. Both layers need to be in the same resolution prior to this calculation. All raster datasets in which the cell sizes are changed are resampled using the bilinear interpolation technique, which is best applied to continuous data (ESRI 2005). Cubic interpolation is also tested to confirm that the accuracy of the resulting DEM is not higher than the bilinear interpolated DEMs. All calculated results are illustrated for each raster layer tested in Table 5.1.

Dataset	Original Resolution	Interpolation Technique	Resampled Resolution	RMSE	NSSDA
SMRT	90m	Bilinear	10m	0.1757	3.4437
SMRT	90m	Cubic	10m	0.2000	3.9200
Landmap	25m	Bilinear	10m	1.4443	28.3083
SMRT	90m	Bilinear	30m	0.5126	10.0470
Landmap	25m	Bilinear	30m	3.1894	62.5122
Digimap	50m	N/A	N/A	0.2761	5.4116
Digimap	50m	Bilinear	10m	0.1156	2.2658

Table 5.1: Results of all raster layers tested for accuracy.

Results of the statistical test suggest that the SMRT data resampled to a 10m resolution using the bilinear interpolation technique has the highest accuracy, with the exception of the Digimap 1:50,000 digital data. Calculations for the original 50m Digimap data show there is an error of 0.28m and that 95% of the data has no more than a 5.4m elevation difference from the 10m Digimap data (the independent data). These figures improve when the 50m Digimap data was resampled to a 10m resolution with bilinear interpolation. The resampled SMRT data to 10m resolution with bilinear interpolation is only slightly less erroneous than the 50m Digimap resampled to 10m and the second most similar to the independent dataset. Results of the cubic interpolation test suggest only a slight difference when compared to the bilinear interpolation. All resampled Landmap data examples indicated much larger height differences up to several tens of metres. Conclusions from the statistical results indicate that the resampled SMRT data to 10m resolution by bilinear interpolation is the best choice and sufficient for spatial analyses in this research.

5.4 GIS and Statistical Methodology

Two different approaches on settlement distribution are investigated in this research. The first considers the distribution of site types with regards to the environmental attributes. This analysis examines the distribution of site locations as influenced by elevation, slope and aspect. Patterns detected for particular site types throughout the three study areas are compared to determine cross-channel or regional similarities. The Kolmogorov-Smirnov and Chi-squared statistical tests are employed to identify significant relationships between the site and the environmental attribute distribution. The second approach investigates the influence of the topographic landscape with regards to visibility on the locations of settlements. Different aspects of visibility, such as degree, views of sea or land and views of specific areas, are computed for each archaeological site and a set of random sites in each study area. The data is then analysed to determine whether visibility features from archaeological sites differ from other locations in the landscape. These visibility features are then assessed between comparable site classifications in each of the study areas to investigate similarities or differences. The results from both of these approaches will attempt to enlighten settlement model of the North Channel region.

5.4.1 Data Requirements

Spatial analyses, visualizations and Map Algebra techniques are conducted on the ESRI ArcGIS Desktop version 9.1 GIS package. Viewshed maps are generated in ERDAS IMAGINE version 8.7 image processing software from Leica Geosystems GIS and Mapping, LLC. Statistical analyses and formula calculations are computed in Microsoft Excel 2000.

5.4.2 Data Acquisition

Data from Scotland was downloaded from the National Monuments Record, Scotland through the online Canmore[5] database. Northern Ireland site data was acquired through the Northern Ireland Sites and Monuments Record available through the Archaeological Data Service, ArchSearch[6]. Site data in Co. Donegal was acquired through an assessment of both the site inventory in the archaeological survey of Co. Donegal published by Lacy (1983) and the Sites and Monument Record available in ArcInfo polygon map coverage format through the Department of Environment, Heritage and Local Government, Republic of Ireland[7]. ID numbers from Appendix 2 have been attached to sites discussed in the text.

Slope and aspect maps are generated from the DEM grids in Arc/Info grid module. The resulting raster data are created with the same cell size and count as the DEM from which they are derived. Each cell attribute in the slope raster map is assigned a value representing the degree of slope angle for that particular cell. Both elevation and slope data are maintained in continuous scales. Patterns may become concealed if either of these attributes are collapsed into interval bands. For aspect, the cell attribute is assigned a compass direction from 0° to 359°, in which 0° is true north, 180° is due south and -1 represents flat ground. Aspect is then simplified by reclassifying the data into the eight cardinal directions. Considering the general orientation of the slope face rather than the exact compass degree may provide more meaningful interpretations. Table 5.2 lists all the variables analysed and their levels of measurements.

[5] http://www.rcahms.gov.uk/search.html
[6] http://ads.ahds.ac.uk/catalogue
[7] http://www.heritagedata.ie/en/NationalMonuments/

Variable	Levels	Description
Altitude	Interval Scale	Collapsed to 10m OD intervals
Slope	Interval Scale	1 degree intervals (starting at 0.00-0.99 = 0; 1.00-1.99 = 1)
Aspect	Nominal Scale	
	1 North	0°-22.5° and 337.5°-360°
	2 Northeast	22.5°-67.5°
	3 East	67.5°-112.5°
	4 Southeast	112.5°-157.5°
	5 South	157.5°-202.5°
	6 Southwest	202.5°-247.5°
	7 West	247.5°-292.5°
	8 Northwest	292.5°-337.5°
	9 Flat	N/A

Table 5.2: List of environmental attributes investigated in statistical analyses.

Extraction of the environmental data for each archaeological site is preformed through IMAGINE software. Polygonal data is required for this process; therefore a small proximity buffer is created for each site point using the 'buffer' tool in ArcToolbox available in ArcMap. This created a coverage file that contained a circular polygon shape for each site with a diameter of 1m. The coverage file was then imported into IMAGINE, in which the 'zonal attribute' tool is used to extract the data from the DEM, slope and aspect map layers for each site location. Finally, the IDENTITY command in Arc/Info is employed to attach the environmental data to the original point file of the site data.

To prevent biased results in the statistical calculations, the DEM for each study area is clipped so as to only include areas that archaeological sites are located in. An elevation cut-off point of 600m OD is chosen for all study areas, on the basis that land above 200m OD is generally unsuitable for arable farming, but may still sustain rough grazing up to 600m OD (Alcock 2003; Coles *et al.* 1999). Sites in all three areas are not located on slopes steeper than 24° (Table 5.3). The DEM and slope grid are each reclassified by assigning 'NoData' to the values higher than 600m OD and 24°, respectively and zero to the remaining values. The two reclassified maps are then added together in Map Calculator to create a third map that will act as a mask. Essentially, this 'mask' layer contains only one value, zero, covering all areas that are to be included in the analyses. In Map Calculator, the original DEM is added to the mask map and the resulting map layer only contains information for those cells falling within the set of elevation and slope parameters (Figure 5.10).

The statistical test used in the visibility analysis requires the viewshed data from 19 sets of randomly located sites to compare with the viewsheds from archaeological site locations. The number of sites per set is equal to the number of archaeological sites for each classification (Table 5.3). Each site classification is analysed separately. Random sites are chosen through the random sampling approach and grouped into N sets of n locations. The number of random sites from localised locations, such as Islay in Argyll or Inishowen in Co. Donegal is proportionally similar to that of archaeological site distributions in these areas. The same area limits determined by the environmental parameters discussed above is used for possible locations of random sites. The study area of Northern Ireland is clipped to a smaller area consisting of coastline areas in Co. Antrim and Co. Londonderry, due to the high number of sites and computational time required to calculate the viewsheds from random points (Figure 5.11). This area is chosen because of the intervisibility with parts of Argyll and Inishowen in Co. Donegal. Duplicate locations of random sites and archaeological locations are checked for and discarded from the initial group of random sites.

Study Area	Elevation	Slope	Aspect	Total number of random sites
Argyll	0-600m OD	< 24	all	4666
Northern Ireland coastline	0-600m OD	< 24	all	2127
Co. Donegal	0-600m OD	< 24	all	3001

Table 5.3: List of environmental parameters applied during the random site compilation.

Visibility maps are processed in IMAGINE using the viewshed analysis tool. Single site viewsheds are calculated from a specified coordinate location using a DEM to determine visibility. A boundary is set at an 18km radius from the coordinate location, visibility will not be calculated beyond this point. An observation height of 1.85m above ground level is assigned to account for the uppermost eye-level height of the observer.

The resulting viewshed data is imported into ArcGIS to define visible sea and land area. The DEM is first reclassified into two categories, in which any number with a value below sea level equals 100 and all positive numbers equal 200 (Figure 5.12). In the Raster Calculator, this reclassified map and the viewshed map are added together to produce a viewshed map with values representing visible and non-visible sea area and land area separately (Figure

5.13). This is done in order to statistically test the visibility from site locations with regard to the amount of visible sea (see Section 5.4.3: Monte Carlo).

Cumulative viewsheds are also calculated in IMAGINE using the 'multiple viewshed' option. Coordinates from all sites included in the set are inputted into the corresponding X and Y columns. The radius boundary distance and observer height are the values applied to the single site viewsheds. The resulting map associates a number to each cell, which represents the number of sites that are visible from that location (refer to Figure 5.5).

5.4.3 Data Processing

One-sample testing approaches of the Kolmogorov-Smirnov and Chi-squared tests are chosen over two-sample tests due to their suitability for the type of data available in the current research (Kvamme 1990a). Two-sample tests compare randomly sampled points of the background environment to the archaeological site distribution. The representation of the background environment by randomly sampled points and the number of points may cause additional sampling variance, thus producing less powerful statistical deductions (Lock 1991). One-sample tests use the entire background environment as a constant population and archaeological sites as a sample population and are statistically more robust (Kvamme 1990a). The nature of the environment data is in raster format, in which values for the entire area are known.

<u>Kolmogorov-Smirnov goodness-of-fit</u>

As described briefly in Section 5.2.1, the Kolmogorov-Smirnov statistic calculates the degree of uniformity between the distribution of an observed set of values (archaeological sites) with a specified theoretical distribution (environmental data) (Cohen & Holliday 1996). This test is used to determine whether the locations of archaeological sites are influenced by the environmental attributes, altitude and slope inclination. The cumulative frequencies of each distribution are calculated: from which a test statistic (*Calc*) is derived from the largest absolute difference between the two cumulative frequencies (see Table 5.4 and Figure 5.14 for an example). The critical value (*Crit*) is dependant on the number of sites and is derived from the following equation:

$$Crit = \frac{1.36}{\sqrt{n}}$$

where

n = number of archaeological sites

The value of 1.36 is used to test at a 5% significance level (Shennan 1997).

The hypotheses set out for the Kolmogorov-Smirnov test are as follows:

H_0 = there is no difference between the archaeological site and background distributions.

H_1 = there is a difference between the archaeological site and background distributions.

If $Calc \geq Crit$, reject H_0

If $Calc < Crit$, accept H_0

Table 5.4 illustrates a hypothetical example of a calculation of the Kolmogorov-Smirnov test for the slope attribute, where n = 39 and column D is the difference between the accumulated percentages (illustrated in Figure 5.14). The largest difference (*Calc*) is 27.27. The following formula illustrates the calculation of *Crit*.

$$Crit = \frac{1.36}{\sqrt{39}} = 21.78$$

According to the hypotheses stated above, results from this example indicate that:

$Calc > Crit$, therefore the null hypothesis is rejected

This result suggests that site locations are influenced by the slope angle of land. As stated above, the largest difference is 27.27, where 23% of the total sites are located on 7% of the available land. This indicates that there are preferences for constructing sites on slightly sloping ground. Table 5.4 also indicates that none of the sites are located on flat ground, which makes up 16% of the available land. This would also suggest that flat ground is avoided.

Slope Categories	Site Distribution	% of Site Distribution	Accumulated Site %	Area Distribution (m^2)	% of Area Distribution	Accumulated Area %	D
0	0	0	0	677113600	16	16	-15.53
1	10	26	26	231056300	5	21	4.81
2	5	13	38	444735300	10	31	7.42
3	5	13	51	394852600	9	40	11.19
4	9	23	74	304863200	7	47	27.27
5	2	5	79	537401200	12	59	20.07
6	6	15	95	380733100	9	68	26.72
7	0	0	95	328949900	8	76	19.17
8	2	5	100	459740900	11	86	13.75
9	0	0	100	294668800	7	93	6.99
10	0	0	100	304812600	7	100	0.00
Total	*39*	*100*		*4358927500*	*100*		

Table 5.4: Example of distribution of observed settlement sites on different slope categories and the calculated difference between two cumulative distributions (Largest difference (Calc) = 27.27; (Crit) = 21.78).

<u>Chi-squared goodness-of-fit</u>

The Chi-squared test is employed to determine whether the locations of archaeological sites are influenced by the cardinal direction of the landscape. This test involves the calculation of the expected number of archaeological sites in each categorical range. The expected value comes from a number calculated by multiplying the categorical proportional area by the total number of sites. This value can then be compared to the observed values, the actual distribution of sites in each category. This illustrates if a certain categorical range, such as south facing slopes, are preferred over other categories, thus demonstrating deviance among site locations from the distribution of environmental variables (see Table 5.5 for a hypothetical example). If there is no correlation between the two distributions, then the percentage of each land category in area terms should equal the percentage of observed site distribution. The expected value is then subtracted from the observed value and then the residual is squared. Then the value is divided by the expected value in each category and summed, which can also be read in the following formula:

$$\chi^2 = \sum\left(\frac{(Oi - Ei)^2}{Ei}\right)$$

where

χ^2 = the Chi-squared statistic

Oi = the observed count of the ith case

Ei = the expected count of the ith case

Statistical significance is tested by comparing the calculated Chi-squared statistic to a value derived from the theoretical Chi-squared distribution table in accordance with the value of the degrees of freedom at a significance level of 95% (Shennan 1997; Cohen & Holliday 1996). The standard calculation of the degrees of freedom consists of subtracting one from the total number of categories (Shennan 1997):

$$df = k - 1$$

where

df = degrees of freedom

k = number of categories

The hypotheses set out for the chi-square test are as follows:

H_0 = archaeological sites are equally distributed across all hillside aspect categories.

H_1 = archaeological sites are not equally distributed across all hillside aspect categories.

If $\chi^2_{calc} \geq \chi^2_{\alpha}$, reject H_0

If $\chi^2_{calc} < \chi^2_{\alpha}$, accept H_0

where

$$\alpha = 0.05$$

Table 5.5 illustrates a hypothetical example of a calculation of the Chi-squared test for the aspect attribute. The resulting calculation of χ^2_{calc} equals 140.93 and the following formula illustrates the calculation of df.

$$df = k - 1 = 9 - 1 = 8$$

where a tabulated value for χ^2_{α} is 15.51 (see Shennan 1997:336-337).

According to the hypotheses stated above, results from this example indicate that:

$\chi^2_{calc} > \chi^2_{\alpha}$, therefore the null hypothesis is rejected.

This result suggests that site locations are influenced by the cardinal direction of hillsides. In this scenario, the largest percentages of sites are located on south-eastern, southern, south-western and western aspects. However, the greatest difference between percentages of sites compared to area of cardinal aspects are on south-western and western facing hillsides, in which 60% of the sites are located on 22% of the available land. This suggests that there are preferences for constructing sites on these particular hillsides. Table 5.4 would also suggest that flat ground, northern, north-eastern, eastern and north-western facing hillsides are avoided due to the lower percentages of sites to land.

Category	Oi	% of Sites	Area (m^2)	% of Area	Ei	Oi - Ei	Calculated Value
Flat	1	1	823621400	10	12	-11	10
N	9	7	1178121300	14	17	-8	4
NE	3	2	755092000	9	11	-8	6
E	4	3	790780900	10	12	-8	5
SE	12	10	1015736000	12	15	-3	1
S	17	14	839801000	10	12	5	2
SW	47	39	875186300	11	13	34	91
W	25	21	888307500	11	13	12	11
NW	3	2	1098464000	13	16	-13	11
Total	*121*	*100*	*8265110400*	*100*	*121*		*140.193*

Table 5.5: Example of observed and expected numbers of settlement sites on different hillside aspects and the calculated chi-square value (χ^2_{calc} = 140.193; *df* = 8; χ^2_{α} = 15.51).

To avoid claiming a significant relationship when there is none, the expected value (*Ei*) needs to be greater than five (Cohen & Holliday 1996). Categories with values less than five are, therefore, combined/collapsed with a neighbouring category, thus reducing the number of categories but increasing the expected frequency.

Monte Carlo

The Monte Carlo statistical test is employed to determine whether the locations of archaeological sites are influenced by visibility in four different approaches: the amount of total visible area, the amount of visible sea area, the amount of visible sea area over land area and the amount of shared visible areas. This statistical technique investigates the assumption that the set of archaeological sites is one possible random subset of the background population. The set of archaeological sites are tested against the *N* number of subsets from that background population. For the set of archaeological sites to test significant, the rank of the value of a summary statistic (**x**) is determined when $N + 1$ samples are arranged in rank order by **x** (Fisher *et al.* 1997). The normally employed scale of the reference set of the target population is *N* = 19 (Hope 1968; Jöckel 1986). In one-sided tests, the probability of the set of archaeological sites at the highest rank (*k*) is (Ripley 1987):

$$x = \frac{1-k}{(N+1)}$$

Whereas the probability of the set of archaeological sites at the lowest rank was (*ibid.*):

$$x = \frac{k}{(N+1)}$$

If *N* =19 and *k* = 1 or 20, then a significance of **x = .05 or .95**, respectively, is found and the null hypothesis is rejected. Also, if *k* = 2 or 19 then a significance of **x = .01 or .90** is found, which also can be considered significant (Kvamme 1997; Tuovinen 2002). The current research only tests the data at a significance of .05.

The first hypothesis set out for the Monte Carlo statistical test is as follows:

H_0 = There is no difference in the amount of visibility from the location of archaeological sites and of the background population.

H_1 = There is a difference in the amount of visibility from the location of archaeological sites and from the background population.

The mean, minimum and maximum visible area are calculated and compared between the set of archaeological sites and sets of random sites and then tested for significance using the Monte Carlo statistical test. A random sampling approach is used to obtain the background population data. Standard statistical methods are not ideal for analyses addressing influences of the landscape on the site or vice versa, “and when the point influences a wider polygonal area such as the area visible…[the] Monte Carlo testing is the method of choice,” (Fisher *et al* 1997:585).

The same descriptive statistics calculated in hypothesis one is also employed for hypotheses two and three, but only for visible areas of the sea and the ratio of visible sea to visible land respectively. Hypothesis two is as follows:

H_0 = There is no difference in the amount of visibility of the sea from the location of archaeological sites and of the background population.

H_1 = There is a difference in the amount of visibility of the sea from the location of archaeological sites and from the background population.

The mean, minimum and maximum visible sea area are calculated and compared between the set of archaeological sites and sets of random sites using the random sampling approach and statistically test using the Monte Carlo test.

Hypothesis three is as follows:

H_0 = There is no difference in ratio visibility of sea to land from the location of archaeological sites and of the background population.

H_1 = There is a difference in ratio visibility of sea to land from the location of archaeological sites and from the background population.

The ratio between the means of visible sea and land areas is calculated and compared between the set of archaeological sites and sets of random sites.

Hypothesis four tests the cumulative viewshed from a set of sites and is as follows:

H_0 = There is no difference in the amount of shared views from the locations of archaeological sites and of the background population.

H_1 = There is a difference in the amount of shared views from the locations of archaeological sites and from the background population.

A cumulative viewshed is calculated for the set of archaeological sites and for each of the sets of random sites. Values of the amount of area seen for each number of observations are inputted into a table. A weighted mean (*w*) is calculated for each set using the equation below (Fisher *et al.* 1997),

$$w = \frac{\sum_{m=0}^{j} (A_m * m)}{\sum_{i=0}^{j} Ai}$$

Where

j is the highest frequency of non-zero areas,

A is the area associated with a particular frequency,

A_m is the area visible from m locations,

If the set of archaeological sites does have a higher frequency of more visible areas, then this is brought out by the weighted mean. Significance of the weighted mean is determined by the same method used in hypothesis one through three.

5.5 Conclusions

The use of GIS has been theoretically debated and justified for the purposes of this research. Discussions covered how the analyses and techniques fit theoretically into the archaeological methodology and the accuracy of the data was also assessed. Finally, an explanation of the analyses methodology was demonstrated in detail.

Chapter 6: Settlement Patterns within the Topographic Landscape

6.1 Introduction

This chapter attempts to identify and explore key issues in the settlement patterning of Argyll, Co. Donegal and the coastal counties of Northern Ireland. Particular environmental variables are statistically analysed to assess the full spectrum of monument types through the later prehistoric and Early Historic periods. Section 6.2 discusses the results of the data analyses. The results for each site classification in the study areas are discussed independently under sub-sections 6.2.1 to 6.2.3. Statistical analyses are employed to determine whether there are any general identifiable distribution patterns or if the sites are randomly distributed. Results from these analyses might indicate particular topographical locational preferences. Patterns that are observed in each study area are then compared and contrasted with each other to assess the wider regional settlement patterns across the North Channel and discussed under Section 6.3.

6.2 Site Distribution

The distribution pattern of archaeological sites may partially be affected by agricultural practices and other factors, or by unsystematic survey and therefore be biased. However, the potential role of environmental factors in influencing settlement location is evaluated nevertheless. Previous research indicates that elsewhere certain types of settlement are perpetually located at particular altitudes, slopes and aspects (e.g. Harris 1984; RCAHMS 1990; Morgan 2000). Poor quality soils at higher elevations and additional exposure to the elements may have limited settlement location to particular altitudes. Steep slopes may have restricted habitation and hillsides facing particular directions may have afforded protection against dominant wind directions, increased exposure to sunlight for crops and domestic activities or a greater aesthetic visibility of a landscape.

Patterns that are visually obvious in distribution maps and those that are not so obvious, but detected through GIS manipulation, can be strengthened when applied to statistical tests (Kvamme 1990a). As discussed under Section 5.4.3, site and environmental data were tested in either the Kolmogorov-Smirnov (K-S) or the Chi-squared (χ^2) statistical test to determine whether locational preferences can be identified within the environmental variables. Both tests treat the environmental attributes as a constant population and the archaeological sites as a sample population, whereas the nature of the environmental data (i.e. continuous or categorical) determines the test (Shennan 1997). The null hypothesis states that there is no significant difference between site location and the distribution of environmental attributes. All tests are calculated using a significance level of 5%. Statistical results are displayed in a bar chart illustrating the percentage of archaeological sites located in each environmental range. A trend line representing the percentage of area depicts the amount of land for each range. If the null hypothesis is rejected, the percentages of sites are significantly above or below the land area trend line. If the sites and the land area trend line have the same percentage, then this indicates that there is no significant relationship between the archaeological sites and the environmental attribute. Only results that reject the null hypothesis are discussed in the text. See Appendix 3 for results of all site classifications. The distribution bar graphs illustrating the results below only depict an altitudinal scale up to 300m OD for visual ease (see Appendix 3 for results of the entire range).

6.2.1 Topographical Analyses of Argyll

<u>Curvilinear drystone sites with an internal area below 180m^2</u>

Statistical analysis results for the CSB sites demonstrate significant relationships with all three environmental variables, meaning the null hypothesis is rejected for each test (Table 6.1). Figure 6.1 plots the percentage of surface area by elevation against the percentage of sites at each elevation, depicting the difference between area and sites. In this instance, the amount of land area below the 100m contour line consists of 36% of the total area. However, 75% of the CSB sites are located at this elevation range, suggesting that lower elevations are the preferred locations of this site type. Though sites are detected at elevations up to 220m OD, the difference between the number of sites to amount of area at the lower elevations is large enough to indicate a significant difference between the two distributions (Figure 6.2). The CSB sites are found at slopes up to a 17° incline (Figure 6.3). Results from the slope analysis demonstrate few sites located on flat areas and significantly higher sites on slopes between 2° to 6° and on slightly steeper slopes of a 12° to 13° incline (Figure 6.4). Figure 6.5 illustrates the distribution of sites within each of the cardinal direction categories. Seventy-four percent of the CSB sites are located at southern, south-western and western facing hillsides. However, figure 6.6 indicates that the percentages of sites are much higher than the percentage of available land only on south-western and western hill faces. This figure also implies that the percentages of sites is much lower in the other aspect categories, possibly suggesting these areas are less preferred for settlement locations. Location preferences for this site type are on elevations between sea level and 120m OD, on slopes inclines steeper than flat ground and on south-western and western aspects.

<u>Curvilinear drystone sites with an internal area above 180m^2</u>

Significant relationships are also detected in the statistical analyses between CSA sites and all three environmental attributes. Figure 6.2 illustrates that the distribution of this site type ranges from sea level to 220m OD. However, significantly higher percentages of sites than the percentages of area are observed on elevations below 120m OD (Figure 6.1). Figure 6.3 illustrates the distribution of these sites on level ground up to slopes of 11°. Percentages of sites are significantly higher than the percentages of area on sloping hillsides, but not on level ground (Figure 6.4). Results from the analysis of aspect indicate that higher frequencies of sites are found on south-western and western aspects (Figure 6.5). Figure 6.6 confirms this relationship by illustrating the significantly higher percentages of sites than percentages of area in these aspect categories. Results from the statistical analyses suggest that CSA sites prefer locations below 120m OD, sloping ground and hillsides facing the south-west and west.

Rectilinear drystone sites with an internal area below $180m^2$

Results from the analyses of elevation and slope demonstrate statistical significance for the RSB sites (Table 6.1). Unfortunately, there are not enough sites to accurately test the distribution of sites against aspect. RSB sites are distributed on elevations between sea level and 120m OD, in which the largest difference between the percentage of sites and percentage of area is below 10m OD (Figures 6.7 and 6.8). This site type is found on hillsides of up to a 16° angle, in which the statistical results indicate that the percentage of sites is higher on gently sloping land up to a 2° slope and on much steeper slopes of a 16° inclination (Figures 6.9 and 6.10). Even though statistical testing could not accurately determine whether there is a relationship between RSB sites and aspect, Figure 6.11 illustrates that the southern and south-western hill faces have the highest distribution of sites. Statistical analyses suggest RSB sites favour lower elevations and slightly sloping ground with a couple of outliers located on steeper hillsides.

Rectilinear drystone sites with an internal area above $180m^2$

A significant relationship between RSA sites and both the elevation and slope variables is demonstrated through the statistical analyses (Table 6.1). The RSA sites are distributed on elevations between sea level and 250m OD; however, only sites located below 90m OD have percentages significantly higher than the percentages of land area (Figures 6.7 and 6.8). This site type also demonstrates preferences for gently sloping ground and slightly steeper slopes up to a 16° inclination (Figures 6.9 and 6.10). Figure 6.11 illustrates that over 70% of the sites are located on southern, south-western and western aspects, however, this observation cannot be accurately tested due to the small number of sites. Statistical testing suggests that the RSA sites have locational preferences for altitudes up to 90m OD on gently sloping ground and had several outliers located on steeper slopes.

Irregular-curvilinear drystone sites with an internal area below $180m^2$

Statistical analyses indicate significant relationships between ICSB sites and both the altitude and slope variables, however the number of sites is too few to accurately test aspect (Table 6.1). Figures 6.12 and 6.13 illustrate the distribution of sites between sea level and 170m OD, in which significantly higher percentages are indicated for sites below 10m OD and approximately between 51m OD and 110m OD. A single outlier site is located at 161m OD. Figure 6.14 illustrates site locations on areas of flat ground and up to slopes of a 12° angle. However, only slopes with an inclination between 3° and 12° have significantly higher percentages of sites than the available land (Figure 6.15). Results of the analyses suggest ICSB sites prefer heights up to 10m OD or at the slightly higher elevation range of 51m OD to 110m OD and sloping ground.

Irregular-curvilinear drystone sites with an internal area above $180m^2$

Statistical results for ICSA sites suggest significant relationships with all three environmental variables (Table 6.1). Sites are located on altitude up to approximately 230m OD, however, significantly higher percentages of sites than the percentages of land area is only apparent on elevations below 100m OD (Figures 6.12 and 6.13). The ISCA sites are found on slopes of up to a 16° inclination. Figure 6.15 illustrates the percentage of sites on level ground was much lower than the available land percentage and higher on the slightly steeper slopes (Figure 6.14). Figure 6.16 illustrates that the highest number of sites are located on south-western aspects. This distribution pattern is confirmed by figure 6.17, illustrating the percentage of sites is significantly higher than the percentages of available land. Percentages for southern and western aspects are also slightly higher for sites than land area. Preferences for ICSA site locations indicated by the statistical results include elevations below 100m OD, on southern, south-western and western aspect and an areas of sloping ground.

Irregular-rectilinear drystone sites with an internal area above $180m^2$

Results for IRSA indicate significant relationships between all three variables (Table 6.1). Sites are distributed up to elevations of 220m OD (Figure 6.18). However, figure 6.19 illustrates higher percentages of sites than available land on altitudes below 40m OD. Percentages of sites are higher than the percentage of area on gently sloping ground approximately between 1° and 4° angle, with a few outliers on steeper slopes up to a 16° incline (Figure 6.20 and 6.21). The southern, south-western and western aspect categories contain the largest number of sites, in which the percentages of sites are significantly higher than the percentages of available land (Figure 6.22 and 6.23). The statistical analyses results suggest specific locations within the landscape are preferential for IRSA sites, particularly elevations below 40m OD, gentle slopes and southern, south-western and western aspects.

Irregular-irregular drystone sites with an internal area above 180m^2

The variables of altitude and slope are found to be statistically significant with respect to the locations of IISA sites (Table 6.1). However, these sites are too few in numbers to accurately test the relationship with respect to aspect. Distribution of this site type is found at elevations between sea level and 180m OD (Figure 6.24). Figure 6.25 depicts a possible bipolar distribution in which sites with significantly higher percentages than area are located on altitudes below 70m OD and at a higher altitude range between approximately 121m OD and 160m OD. Sites are located on slope angles up to a 13° incline and also illustrate a possible bipolar distribution (Figure 6.26). This relationship is further supported by figure 6.33 in which higher percentages of sites than land are evident on slopes inclinations from 1° to 4° and 9° to 13° (Figure 6.27). Locational preferences depicted for IISA sites tend to favour on elevations up to 180m OD and on gently sloping or slightly steeper hillsides.

Promontory sites with an internal area above 180m^2

Statistical results for PA sites indicate significant relationship with all three environmental variables (Table 6.1). Sites are distributed on elevations up to 200m OD, however, percentages of sites significantly higher than the percentages of land are only apparent for altitudes below 50m OD (Figures 6.28 and 6.29). Distribution of sites by slope indicate a bell-shaped curve distribution (Figure 6.30). Figure 6.31 illustrates higher percentages of sites between slopes of a 2° to 9° incline. The majority of sites are located on southern, south-western and western aspects, in which Figure 6.32 illustrates significantly higher percentages sites than the percentages of area in these categories. Environmental values found to influence the distribution of the PA sites suggests preferences for elevations under 50m OD, southern, south-western and western hill faces and slightly sloping, but not level or steep ground.

Curvilinear sites with an internal area below 180m^2 and encompassing architectural features

Results for AFCB sites demonstrate significant relationships with all three environmental variables. This site type is found at elevations between sea level and 180m OD (Figure 6.33). Figure 6.34 illustrates higher percentages of sites than area, however, the largest differences between the two are apparent on altitudes below 70m OD. Sites are located on gently sloping ground approximately between a 1° and 14° incline (Figure 6.35). Figure 6.36 illustrates a significantly higher percentage of sites over area on the slightly steeper slopes. Seventy-five percent of the sites are located on southern, south-western and western aspects, which also have much higher percentages of sites than the percentages of available land (Figure 6.37). Locational preferences of AFCB sites suggested by statistical analyses include elevations below 70m OD, sloping land and hillside facing south, south-west or west.

Site Type	Environmental Variable	Test	Calculated Value	Critical Value
CSB	Altitude	K-S	0.42	0.12
CSB	Slope	K-S	0.25	0.12
CSB	Aspect	χ^2	140.19	15.5
CSA	Altitude	K-S	0.46	0.19
CSA	Slope	K-S	0.4	0.19
CSA	Aspect	χ^2	38.48	15.5
RSB	Altitude	K-S	0.59	0.33
RSB	Slope	K-S	0.36	0.33
RSA	Altitude	K-S	0.41	0.24
RSA	Slope	K-S	0.25	0.24
ICSB	Altitude	K-S	0.55	0.28
ICSB	Slope	K-S	0.35	0.28
ICSA	Altitude	K-S	0.44	0.21
ICSA	Slope	K-S	0.31	0.21
ICSA	Aspect	χ^2	64.45	12.59
IRSA	Altitude	K-S	0.41	0.24
IRSA	Slope	K-S	0.34	0.24
IRSA	Aspect	χ^2	22.47	7.81
IISA	Altitude	K-S	0.44	0.32
IISA	Slope	K-S	0.33	0.32
PA	Altitude	K-S	0.53	0.18
PA	Slope	K-S	0.3	0.18
PA	Aspect	χ^2	72.68	15.5
AFCB	Altitude	K-S	0.47	0.29
AFCB	Slope	K-S	0.29	0.29
AFCB	Aspect	χ^2	15.81	5.99

Table 6.1: Statistical results for archaeological sites in Argyll discussed in the text (see Appendix 3 for all results).

Conclusions

The results for the archaeological sites and their distribution with regards to the environmental variables suggests small variations between the site types. The CSB and CSA sites demonstrate comparable distribution patterns in elevation, in which the majority of sites are located between sea level and 120m OD. The distribution at particular slope inclinations and aspects slightly vary, in which the locations of CSB sites indicate higher percentages on gently sloping ground and steeper slopes and for south-western and western facing hillsides. The CSA sites are consistently detected through a range of slope gradation and also on southern facing hillsides. This suggests that the curvilinear site types are distributed in similar topographic settings and may reflect the locational preferences by contemporary builders. Interestingly, the AFCB sites are illustrated at a slightly smaller and lower elevation range between sea level and 70m OD. This pattern suggests that the builders of these sites may have additional underlying motivations for locations on lower altitudes. The RSA sites are located at the highest altitudes compared with the other classifications, however the majority of these sites are located below the 90m contour line. A slightly wider distribution range is illustrated by the RSB sites for altitudes between sea level and 110m OD, comparable to that of the curvilinear site types. Both of the rectilinear site types demonstrate distributions on comparable slope gradients. This may indicate that the builders of the smaller rectilinear sites preferred similar altitude locations to those of the curvilinear sites, whereas the larger rectilinear sites may have additional influences that vary their distribution. The site locations of the sub-classes for the irregular classifications that measure below 180m^2 do not appear have been affected by any of the three environmental variables, with the exception of the ICSB sites. This latter site type illustrates a unique distribution in which 22% of the sites are at altitudes below 10m OD and over half of the sites located between 51m OD and 120m OD. The larger irregular site type variations demonstrate varying distributions with regards to elevation. Higher percentages of sites than percentages of land are illustrated at the highest altitudes for the IISA sites and the lowest elevations for the IRSA sites. These varying patterns suggest that these sites may have been built by different groups of people, are not contemporary with each other or there are additional variables that influence their topographic location. The PA sites demonstrate distributions on altitudes lower than observed in the other classifications and may reflect their general coastal distribution.

The general pattern observed across all classification types demonstrates comparisons of the distributions at slope and aspect. Most of the sites preferred locations on gently sloping ground and avoided flat areas. The CSB, IRSA and IISA sites, however, include several examples that indicate preference for locations at steeper hillsides. Unfortunately, several of the classifications have too few sites to accurately test aspect, though all remaining groups indicate strong preferences for locations at southern, south-western and western facing hills.

6.2.2. *Topographical Analyses of Northern Ireland*

Curvilinear drystone sites with an internal area above $180m^2$

Statistical results for CSA sites demonstrate significant relationships with the elevation and aspect variables (Table 6.2). These sites are distributed on altitudes between 11m OD and 210m OD (Figure 6.38). Significantly higher percentages of sites than the percentages of area are depicted on elevations between 81m OD and 130m OD (Figure 6.39). Figure 6.40 illustrates the distribution of this site type in all cardinal aspect categories. However, only northern and north-eastern hill faces have higher percentages of sites than percentages of the available land (Figure 6.41). Significant correlations are detected for only elevation and aspect, in which CSA sites appear to favour higher altitudes and northern and north-eastern facing hillsides.

Curvilinear sites constructed of earth with an internal area above $180m^2$

Results from statistical analyses indicate significant relationships between CEA sites and both elevation and aspect (Table 6.2). CEA sites are located on elevations between sea level and 260m OD, depicting a bell-shaped curve distribution (Figure 6.42). However, figure 6.43 illustrates significantly higher percentages of sites than percentages of area are on altitudes between 81m OD and 120m OD. This site type is found on slopes ranging from flat ground to a 14° incline (Figure 6.44). Figure 6.45 illustrates site percentages higher than area percentages in the level to slightly sloping ground of a 5° angle attributes. CEA sites are found on all aspect categories, with higher frequencies on northern and north-western hillsides and on level ground (Figure 6.46). Figure 6.47 illustrates that these three categories have significantly higher percentages of sites than the available land. Preferences for CEA site locations suggested by the statistical results include elevations between 81m OD and 130m OD, level to gently sloping ground and northern and north-western aspects.

Over 14% of the CEA sites encompass additional ramparts. Therefore univallate and multivallate sites are also statistically tested independently to compare the distributions. The results between both sets of sites illustrate similar distribution patterns on both elevation and aspect, which suggests that the number of enclosing outworks do not represent separate classifications with respect to the environmental analyses (Figures 6.48 to 6.50; see also Appendix 3 for more information).

Site Type	Environmental Variable	Test	Calculated Value	Critical Value
CSA	Altitude	K-S	0.25	0.23
CSA	Aspect	χ^2	11.52	9.49
CEA	Altitude	K-S	0.21	0.04
CEA	Slope	K-S	0.51	0.04
CEA	Aspect	χ^2	131.61	15.50

Table 6.2: Statistical results for archaeological sites in Northern Ireland.

Conclusions

Of the curvilinear sites, only the sets of larger sized sites reject the null hypothesis in the statistical analyses. Generally, all curvilinear sites demonstrate distributions across a wide altitude range from sea level up to 260m. A significant number of CSA sites concentrate on altitudes between 51m OD and 120m OD, whereas 60% of the CSA sites are found at a slightly higher range between 81m and 130m OD. Statistical analyses only detect a correlation with slope between the CEA sites, in which the majority of these sites are located on gently sloping to level ground. Aspect appears to influence settlement locations for CSA and CEA sites only, for which northern facing slopes are favoured in both classifications. This suggests that these two site types are distributed in similar topographic settings and may reflect the locational preferences by contemporary or successive builders. Sites in the remaining classifications are few and statistical results imply that the environmental variables do not affect site location or could not guarantee accurate results.

6.2.3 Topographic Analyses of Co. Donegal

Curvilinear drystone sites with an internal area below 180m^2

Results from statistical analyses only indicate a significant relationship between CSB sites and elevation (Table 6.3). Figure 6.51 illustrates this site type is distributed on altitudes ranging from sea level to 220m OD. However, significantly higher percentages of sites than percentages of available land are only observed between 21m OD and 130m OD with two outliers at elevations between 151m OD and 160m (Figure 6.52). Of the environmental variables tested, only altitude appears to influence the settlement locations of CSB sites, in which the preferential locations appear to lie between 21m OD and 130m OD.

Curvilinear drystone sites with an internal area above $180m^2$

Statistical analyses between CSA sites and the environmental variables of elevation and slope conclude as significant (Table 6.3). This site type is detected at elevations up to 250m OD (Figure 6.51). Figure 6.52 illustrates significantly higher percentages of sites than percentages of area at altitudes from sea level to 100m OD. Sites are located on slopes ranging from level ground up to a 17° incline, however higher percentages of sites than percentages of area are only detected on slope angles between 1° and 4° incline (Figures 6.53 and 6.54). Results of the statistical tests indicate correlations between two of the environmental variables and CSA sites, which are preferentially located at elevations up to 100m OD and on gently sloping ground.

Curvilinear sites constructed of stone and earth with an internal area above $180m^2$

A correlation between CSAEA sites and the environmental variable of elevation is detected by statistical testing (Table 6.3). This site type is distributed on elevations between sea level and 180m OD (Figure 6.55). However, percentages of sites significantly higher than the percentages of available area is only detected on elevation between approximately 31m OD and 90m OD (Figure 6.56). Only the altitude variable appears to influence CSAEA site locations, in which elevations above 31m OD and below 90m OD are favourable.

Curvilinear sites constructed of earth with an internal area above $180m^2$

Significant correlations between CEA sites and environmental variables are found between elevation and aspect (Table 6.3). This site type is distributed at elevations ranging from sea level up to 130m OD (Figure 6.57). However, figure 6.58 illustrates higher percentages of sites than percentages of area in an altitude range between 11m OD and 80m OD. The CEA sites are distributed on all aspect categories with the highest number of sites on northern and north-western facing slopes (Figure 6.59). This observation is confirmed by figure 6.60, which illustrates significantly higher percentages of sites than percentages of area in these particular categories. Correlations between the environmental variables and CEA sites are demonstrated by the statistical results, in which sites are preferentially located at elevations between 11m OD and 80m OD and on northern and north-western hill faces.

Promontory sites with an internal area above 180m²

Results from the statistical analyses indicate a significant relationship between PA sites and elevation (Table 6.3). This site type is distributed at altitudes up to 130m OD (Figure 6.61). However, higher percentages of sites than percentages of land are evident only on altitudes below 20m OD (Figure 6.62). The statistical analysis demonstrates that lower elevations between sea level and 20m OD are favoured locations for all promontory sites.

Site Type	Environmental Variable	Test	Calculated Value	Critical Value
CSB	Altitude	K-S	0.28	0.25
CSA	Altitude	K-S	0.34	0.14
CSA	Slope	K-S	0.21	0.14
CSAEA	Altitude	K-S	0.46	0.27
CEA	Altitude	K-S	0.38	0.12
CEA	Aspect	χ^2	40.81	15.5
PA	Altitude	K-S	0.67	0.24

Table 6.3: Statistical results for archaeological sites in Co. Donegal.

Conclusions

All of the curvilinear classifications with larger sized sites, the CSB and the promontory sites demonstrate correlations with the environmental variables in Co. Donegal. Both sets of the drystone curvilinear sites illustrate significantly higher percentages on higher elevations than the other curvilinear classifications. Eighty percent of the CSB sites are at elevations between 21m OD and 130m OD and 77% of the CSA sites are located between sea level and 100m OD. Over half of the CSAEA sites and the CEA sites are distributed on elevations between 30m OD to 90m OD and 11m OD to 80m OD, respectively. These varying distributions between the curvilinear sites possibly suggest differences in locational rationale. Fifty-nine percent of the promontory sites are distributed on relatively low altitudes, below the 10m contour line, which may reflect their primarily coastal distribution. The CSA sites are the only classification to indicate influences on location by slope incline.

The only set that is influenced by aspect is the CEA sites. Very few sites fall into the remaining classificatory headings, where the results of the statistical analyses indicate that these sites are either not influenced by environmental variables or could not be accurately tested.

6.3 Discussion

A comparison of the results demonstrates distinct differences in the distribution of comparable site types between Argyll and Northern Ireland. Co. Donegal appears to exhibit similarities with both Argyll and Northern Ireland.

Comparable distributions are observed between the CSB sites in Argyll and Co. Donegal. Sites in both these areas preferred locations at elevations below 120m OD and 130m OD, respectively. Too few CSB sites are detected in Northern Ireland to recognize any patterns. The location of CSB sites in Argyll are also affected by slope and aspect, whereas sites in Co. Donegal are not. This suggests that the distribution of CSB sites in Argyll are more affected by the topography of the land than sites in Co. Donegal, however they do have comparable distributions concerning altitude. The CSA sites in the two latter areas also illustrate similar distributions to their corresponding CSB sites, at elevations below 120m OD and 100m OD, respectively. The CSA sites in Northern Ireland, however, demonstrate a different pattern. These sites are detected in significant numbers at higher elevations than the other two study areas, between 81m OD and 210m OD. The distribution of these sites on aspect is also distinct between Argyll and Northern Ireland. Sites in Argyll are primarily on south-western and western facing slopes, whereas sites in Northern Ireland are found on northern and north-eastern facing slopes. This indicates that the locations of CSA sites in these two areas are both affected by the direction of slope, but for different reasons. South-western and western facing slopes may have increased exposure to sunlight, whereas northern and north-eastern slopes provided protection from the westerly winds of the North Atlantic Drift. Protection from winds may have been more important for choosing site locations in Northern Ireland due to their significant distribution at the higher elevations.

The majority of the earth-constructed sites are classed as CEA. The number CEB sites is too small throughout the study region to observe meaningful patterns with their distributions.

The CEA sites, however, are numerous in both Co. Donegal and Northern Ireland. The locations of these sites are affected by altitude and aspect in both study areas, however the distribution patterns vary slightly. CEA sites from both areas demonstrate significant distributions on north and north-western slopes. The majority of CEA sites in Co. Donegal are located at lower elevations ranging from 11m OD to 80m OD, whereas sites in Northern Ireland show a predominate distribution at altitudes between 81m OD and 120m OD. This pattern is more comparable to the one observed in the CSA sites, in their respective areas than to the similar construction types between the two areas. These distributions demonstrated by the statistical analyses results suggest a different pattern than the one discussed in Chapter 4. Section 4.5 discussed the distribution of sites by construction type in relations to the local geology, in which the drystone sites were detected on higher elevations than the earthen examples. The statistical results suggest that the CSB, CSA and CEA sites in Co. Donegal have comparable distributions with regards to elevation and these vary from the ones observed in Northern Ireland. In Northern Ireland the highest number of CSA and CEA sites are located at altitudes between 81m OD and 130m OD, whereas the sites in Co. Donegal are detected between sea level and 100m OD. The CEA sites in Northern Ireland would be expected at lower altitudes in higher numbers if geology were an influencing factor on construction material. Instead, the CEA sites are distributed along side the CSA counterparts.

The distributions of PA sites exhibit similar patterns between Argyll and Co. Donegal, concentrating on locations on the lower altitudes below 50m OD. This site type in Northern Ireland did not demonstrate a correlation with any of the environmental variables. This suggests these sites were located without regard to the landscape, but their locations may have been influenced by other factors, such as visibility of the sea. PA sites in Argyll in Co. Donegal illustrate comparable distributions with regards to elevation.

Statistical analyses demonstrate that all the environmental variables influence the distribution of other site classifications in Argyll, but not for sites in Co. Donegal and Northern Ireland. This suggests that the sites are proportionally spread throughout the environmental variables in Northern Ireland and in Co. Donegal. These site types in Argyll are more frequent than in the other two study areas and the analyses results indicate the topography of the land influences their location more than these sites types in the other two areas. This may suggest that other features not tested in the current research are affecting their locations in Co. Donegal and Northern Ireland.

Patterns are evident between site distribution and environmental variables in all three study areas. In general, sites in Argyll appear to be more affected by the environmental variables than in the other two study areas. The curvilinear sites in Northern Ireland and Co. Donegal did indicate locational influences by particular environmental attributes. Distributions of sites in Co. Donegal suggest parallels with corresponding site classification distributions in both Argyll and Northern Ireland. These results may be suggesting a regional pattern in which Co. Donegal appears to be an intermediary between the other two study areas.

Chapter 7: The Visibility of Settlement Sites

7.1 Introduction

Landscape is the 'stage upon which culture and society are enacted' (Hirsch 1995:3). Interpreting ancient peoples understanding and reaction to the surrounding landscape can be approached through the concept of visual perception. Visual connection between places and site intervisibility is essential for communication and therefore critical for site location strategies (Christopherson & Guertin 1996). The importance of reciprocal visual contacts between sites or particular areas and the placement of sites in the landscape for visual confirmation of control has been conjectured in several studies (Lake *et al.* 1998; Lake & Woodman 2000; Tilley 1994; 1996; Wheatley 1995). The application of Viewshed Analysis in the current research represents an attempt to introduce an alternative GIS approach to distribution analyses that is less environmentally deterministic, in which the aim is to identify settlement patterns in relation to the visible landscape.

Chapter 5 reviews the mechanics behind the viewshed calculations and data acquisition. The first three hypotheses investigate visibility influence on site location and are concerned with the amount of visible area. The first Hypothesis examines the range of visibility within an 18km radius from the site locations. This states that archaeological sites are located in areas with larger degrees of visibility than other locations in the landscape. If sea travel across the channel was a prevalent means of communication then visual contact with the sea and coastline would have been extremely important, thus the second Hypothesis investigates the amount of sea visibility from archaeological site locations. To expand on this last Hypothesis the third considers the ratio of visible sea area to visible land area, in which it is conjectured that the viewshed from each archaeological site has larger amounts of sea area than land. Primary results from these three hypotheses are illustrated in table and graphical format. The table depicts the numerical values for the mean, minimum and maximum values of the set of archaeological sites and the highest and lowest values in the random sets for each Hypothesis that has tested as significant. The calculated rank order and significance value of the archaeological set are also given. This rank order of the archaeological sites determines if the corresponding visibility data is significantly different from that of the surrounding landscape. A rank of 1 or 20 is needed to reject the null Hypothesis. The line graphs illustrate the rank order of all sets of sites. Maximum and minimum values are included to show whether there are outlier values that may greatly influence the mean value.

The final Hypothesis investigates the visibility of particular areas by the frequency of sites, essentially testing whether the location of archaeological sites are affected by the preference to view specific locations. The Monte Carlo test is used to determine whether the degree of visibility from archaeological sites is statistically significant when compared to the degree of visibility from randomly chosen locations. Results are depicted in tabular form that listed the amount of area per km^2 visible by a given number of sites and the weighted mean calculated for each set.

The main body of this chapter discusses the results of the viewshed analysis. Sections 7.2 to 7.4 examine only statistical results that indicate the visibility from archaeological site locations as significantly different from the reference set. Each study area is analysed separately, Argyll, Northern Ireland and Co. Donegal respectively. Each site typology is tested individually in all four hypotheses. A detailed interpretation of the wider implications of these results is discussed under Section 7.5.

7.2 Visibility Results

7.2.1 Argyll

Curvilinear drystone sites with an internal area below 180m^2

The summary statistic values for CSB sites are presented in Table 7.1. For Hypothesis 1, the mean and the maximum values for the set of archaeology sites are statistically different when compared with the values of the reference set. In this case, the archaeological site values demonstrate larger values than all of the reference sets, implying that the archaeological sites generally have larger viewsheds than other locations in the landscape. The minimum value for the archaeological set is also found to be statistically significant, however, for having the smallest visible area out of all sites in the reference sets. This is caused by the viewshed from a single site (AR-505), a denuded small stone enclosure located on a shelf along the side of a ridge with views restricted to the immediate vicinity. The archaeological set is then re-tested with the exclusion of site AR-505 to observe the impact of the visibility from this site on the statistical results. The only major difference in the results is the change in significance of the minimum area of viewshed (Table 7.2). Figure 7.1 illustrates the rank order by visible mean for all sets. Results of Hypothesis 2 indicate the amount of sea visible from archaeological sites is significantly different in both the mean and the maximum areas when compared with the random locations. The average percentage of locations with no visual connection with the sea in the random sets is 29%, whereas this is only 15% of the archaeological sites. The mean value for visible sea is much higher than that of visible land, suggesting large visible expanses of the sea is favoured over land for most sites (Figure 7.2). Examination of Hypothesis 3 indicates the mean ratio of sea area to land area is significant for the archaeological set when compared to the random sets, but not for the maximum value (Figure 7.3). For Hypothesis 4, the cumulative viewshed results indicate that the areas visible from multiple sites are generally larger for the archaeology sites than the random sets (Table 7.3). The weighted mean value demonstrates a statistical difference between the random sets at a 0.10 significance level. The CSB sites have the second largest value of 1.82 compared with a range from 1.39 to 1.87 in the random sets. This indicates several areas in the study area are overlooked by numerous sites, but that this situation also occurs using the random sites. Figure 7.5 illustrates a map of the cumulative viewshed from the archaeological sites, in which the majority of the coastline is visible from at least one archaeological site and the areas visible from multiple sites are located between Kintyre and the islands of Islay and Jura up to the east side of Lismore (refer to Figure 7.4 for place names).

Overall, these results imply that the majority of the CSB site locations demonstrate larger visibility ranges than other locations in the landscape, however there are instances where the vistas from archaeological sites are much smaller. These sites are also located in areas with a large proportion of sea visibility over land. Most of the coastline is overlooked by at least one site and there are several areas of the sea that are visible from numerous sites, which correlates with the coastal distribution of the majority of these sites. This suggests that the CSB sites are generally located in areas that overlook large expanses of the sea. Most of the western coastline of Kintyre and the eastern coastlines of Islay and Jura are visually overlooked by these sites. This suggests the sites might be working as a network to observe an area of frequent sea travel and possibly indicate a major route way.

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km^2)					
Mean	69.78	104.24	131.01	20	0.05
Minimum	0.048	1.17	0.045	1	0.05
Maximum	394.91	614.06	670.73	20	0.05
Area of visible sea (km^2)					
Mean	55.34	90.01	113.24	20	0.05
Minimum	-	-	-	-	-
Maximum	365.73	595.05	642.94	20	0.05
Area of visible land (km^2)					
Mean	13.32	18.09	17.78	18	0.20
Minimum	0.02	0.54	0.03	2	0.10
Maximum	50.16	94.54	147.31	20	0.05
Ratio of sea area to land area					
Mean	7.80	102.39	138.71	20	0.05

Table 7.1: Comparisons of visible areas for CSB sites in Argyll (m = 121, n = 19).

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km^2)					
Mean	70.24	105.07	132.10	20	0.05
Minimum	0.05	2.20	0.42	9	0.45
Maximum	394.91	614.06	670.73	20	0.05
Area of visible sea (km^2)					
Mean	55.80	90.76	114.18	20	0.05
Minimum	-	-	-	-	-
Maximum	365.73	595.05	642.94	20	0.05
Area of visible land (km^2)					
Mean	13.43	18.13	17.92	18	0.15
Minimum	0.02	0.54	0.03	2	0.10
Maximum	50.16	94.54	147.31	20	0.05
Ratio of sea area to land area					
Mean	7.84	103.24	139.86	20	0.05

Table 7.2: Comparisons of visible areas for CSB sites in Argyll with the exclusion of site AR-505 (m = 120, n = 19).

Number of sites with visibility of a location (**a**)	1	2	3	4	5	6	7	8	9	10	11	12	Weighted average
Area visible from **a** CSB sites/km^2	4989.75	1899.86	894.39	407.80	124.18	105.71	95.20	50.74	16.35	0.22	0.0007	-	1.82
Minimum area visible from **a** random sites/km^2	3127.19	979.71	361.53	103.22	19.35	2.24	0.09	0.01	-	-	-	-	1.39
Maximum area visible from **a** random sites/km^2	4971.14	2033.29	961.73	492.59	165.23	65.83	29.22	11.52	0.66	0.21	0.08	0.004	1.87
Number of random groups with values of **a**	19	19	19	19	19	19	19	19	16	11	3	2	
Rank	20	19	19	18	17	20	20	20	20	20	18	-	19
Significance	0.05	0.10	0.10	0.15	0.20	0.05	0.05	0.05	0.05	0.05	0.15	-	0.10

Table 7.3: Areas of the study area, which are visible from multiple CSB sites in Argyll and multiple random sets of locations (m = 120, n = 19).

Curvilinear drystone sites with an internal area above 180m^2

The visibility analyses results for CSA sites demonstrate a slightly different pattern than those observed in the CSB discussed above. Hypothesis 1 results indicate that the visibility from archaeological site locations is statistically significant for the mean and maximum values when compared to the random sets (Table 7.4; Figure 7.6). Results for Hypothesis 2 demonstrate that the mean and maximum values for the area of visible sea are significant for the archaeological set (Figure 7.7). All sets contain sites that do not view the sea, thus the minimum value for sea visibility is not conclusive. This suggests that a few of the CSA sites are located inland and visibility of the sea is obscured by the topography. Only the mean of visible land for archaeological sites tests significant when compared with the random set. The null Hypothesis cannot be rejected for Hypothesis 3, suggesting that several of the CSA sites have visibilities over large amounts of land, which corresponds with the inland sites. The implication of large landscape views is reflected in the visible land mean value in Table 7.4, in which archaeological sites demonstrates the highest value. Results for Hypothesis 4 are presented in Table 7.5, which indicates that the amount of area visible from multiple locations are generally larger in the CSA set and the value calculated in the weighted mean is significant. The combined viewsheds of all CSA sites illustrate a number of regions that are visible from multiple sites (Figure 7.8). The CSA set have the largest value of 1.46 compared with a range from 1.05 to 1.38 in the random sets. The frequency of sites is higher, up to ten sites, than the highest frequency found in the random sets, up to eight sites. Areas of overlapping viewsheds with respect to the curvilinear sites are located near Machrihanish Bay near the south end of Kintyre, and the body of water along the west side of Kintyre up to Lismore (Figure 7.8). A second concentration was located around Lochgilphead between Loch Fyne on the east and Loch Crinan on the west. This suggests that the CSA sites are located in positions that overlook the sea route discussed with the CSB sites (*supra*).

These results suggest that the vistas from CSA sites are generally larger than those from other locations in the landscape, but not all viewsheds from the CSA sites are large. These sites have larger vistas of both the sea and the land than from other locations in the study area and that visibility over the entire landscape is favoured over views focusing on the sea. Several of these sites are located inland on prominent positions and may reflect the desire to overlook and be observed from the surrounding area. Two specific coastal areas are the foci for several CSA sites. This may indicate control over these areas, but not necessarily contact due to their slightly inland localities.

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km^2)					
Mean	57.10	88.49	108.65	20	0.05
Minimum	0.10	2.15	0.97	17	0.20
Maximum	314.87	537.19	525.32	19	0.10
Area of visible sea (km^2)					
Mean	39.61	69.88	86.19	20	0.05
Minimum	-	-	-	-	-
Maximum	298.92	529.78	494.58	19	0.10
Area of visible land (km^2)					
Mean	11.65	21.59	22.45	20	0.05
Minimum	0.04	1.50	0.26	9	0.45
Maximum	41.62	104.91	66.81	12	0.45
Ratio of sea area to land area					
Mean	3.39	105.57	19.25	13	0.40

Table 7.4: Comparisons of visible areas for CSA in Argyll (m = 53, n = 19).

Number of sites with visibility of a location (**a**)	1	2	3	4	5	6	7	8	Weighted average
Area visible from **a** actual sites/km^2	2775.88	683.62	277.31	96.45	30.34	31.80	0.01	0.003	1.46
Minimum area visible from **a** random sites/km^2	1891.05	121.77	23.48	0.12	-	-	-	-	1.05
Maximum area visible from **a** random sites/km^2	3358.97	195.80	195.80	140.26	7.21	0.97	0.35	-	1.38
Number of random groups with values of **a**	19	19	19	19	17	7	2	0	
Rank	11	20	20	19	20	20	18	20	20
Significance	0.50	0.05	0.05	0.10	0.05	0.05	0.15	0.05	0.05

Table 7.5: Areas of the study area, which are visible from multiple CSA sites in Argyll and multiple random sets of locations (m = 53, n = 19).

Rectilinear drystone sites with an internal area above 180m^2

The results from the RSA sites indicate that visibility is an influential factor on site location. All summary values for Hypothesis 1 are significantly different in the archaeological set from the random sets. (Table 7.6; Figure 7.9). Results of Hypothesis 2 also illustrate all summary values have the highest values in the archaeological set (Figure 7.10). The RSA sites are the only set in which every site has visibility of the sea. Results for Hypothesis 3 indicate that the ratio of visible sea area to visible land area is statistically significant for the archaeological set, suggesting sites are located in areas with large sea vistas and limited visibility of the land (Figure 7.11). Figure 7.12 illustrates that the area along the south-eastern coasts of Islay and Jura and between Kintyre is highly visible from a number of sites. Also the areas around the Sound of Gigha and along Loch Fyne up into the mainland illustrate visibility of up to three sites. However, the result of Hypothesis 4 on multiple viewsheds did not detect any statistical difference between the archaeological set and the random sets (Table 7.7). This suggests that only the sites located within these areas focused on possible sea routes along these bodies of water. Several sites are located in isolation from the other RSA sites and may represent outliers of the central group. Overall, these results suggest that RSA sites are located in areas with a large degree of visibility, in which all sites demonstrate a visual connection to the sea.

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km^2)					
Mean	43.73	99.91	166.46	20	0.05
Minimum	0.30	3.25	7.34	20	0.05
Maximum	243.33	462.07	491.40	20	0.05
Area of visible sea (km^2)					
Mean	29.79	85.96	149.31	20	0.05
Minimum	-	-	0.46	20	0.05
Maximum	219.34	444.09	459.74	20	0.05
Area of visible land (km^2)					
Mean	11.19	21.85	17.15	10	0.50
Minimum	0.05	2.72	0.14	2	0.10
Maximum	37.65	112.31	56.27	8	0.40
Ratio of sea area to land area					
Mean	2.67	76.85	101.17	20	0.05

Table 7.6: Comparisons of visible areas for RSA sites in Argyll (m = 31, n = 19).

Number of sites with visibility of a location (**a**)	1	2	3	4	5	6	7	8	Weighted average
Area visible from **a** archaeological sites/km^2	3370.66	741.55	97.01	0.11	-	-	-	-	1.22
Minimum area visible from **a** random sites/km^2	1179.59	63.14	0.70	-	-	-	-	-	1.05
Maximum area visible from **a** random sites/ km^2	2285.21	545.72	111.68	10.85	0.09	0.01	0.0014	0.0011	1.32
Number of random groups with values of **a**	19	19	19	16	6	1	1	1	
Rank	20	20	19	9	-	-	-	-	16
Significance	0.05	0.05	0.10	0.45	-	-	-	-	0.25

Table 7.7: Areas of the study area, which are visible from multiple RSA sites in Argyll and multiple random sets of locations (m = 31, n = 19).

Irregular-curvilinear drystone sites with an internal area above 180m²

The summary values for Hypotheses 1 and 2 suggest that the degree of visibility has an influential impact on the location of ICSA sites. Statistical results of Hypothesis 1 demonstrate that the mean value of visible area from archaeological sites is statistically different from the mean value of the random sets (Table 7.8; Figure 7.13). The summary mean values for Hypothesis 2 regarding the area of sea visibility are also statistically significant for the archaeological set even though five of the sites have no visibility of the sea (Figure 7.14). This suggests the sites that do have a visual connection with the sea are located in positions with large vistas overlooking the sea. Results of Hypothesis 4 are presented in Table 7.9. Despite several areas that are visible from multiple archaeological sites, results of the statistical analysis demonstrate no significant difference in the degree of visibility and site frequency between the archaeological sites and the reference set (Figure 7.15). These results suggest that the locations of ICSA sites have large vistas overall and view large expanses of both sea and land. The cumulative viewshed results and the dispersed distribution suggest that the locations of these sites are more affected by having large vistas than with working as a coastal network to visually cover the area as observed in other classifications. This suggests that these were positioned in prominent areas in order to overlook the surrounding landscape and to be observed.

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km^2)					
Mean	54.39	113.56	145.62	20	0.05
Minimum	0.18	3.95	0.90	12	0.45
Maximum	268.71	584.44	472.62	17	0.20
Area of visible sea (km^2)					
Mean	39.40	97.57	123.89	20	0.05
Minimum	-	-	-	-	-
Maximum	262.19	567.79	461.11	17	0.20
Area of visible land (km^2)					
Mean	11.79	19.34	21.75	20	0.05
Minimum	0.05	1.16	0.19	6	0.30
Maximum	32.85	100.76	102.37	20	0.05
Ratio of sea area to land area					
Mean	6.19	65.18	59.21	19	0.10

Table 7.8: Comparisons of visible areas for ICSA sites in Argyll m = 43, n = 19.

Number of sites with visibility of a location (**a**)	1	2	3	4	5	6	Weighted average
Area visible from **a** actual sites/km^2	3551.48	892.80	99.17	0.31	0.0045	-	1.24
Minimum area visible from **a** random sites/km^2	1636.54	123.72	3.74	0.01	-	-	1.04
Maximum area visible from **a** random sites/km^2	3957.25	892.80	68.36	6.70	1.79	0.33	1.32
Number of random groups with values of **a**	19	19	19	19	15	6	
Rank	19	20	20	9	9	-	19
Significance	0.10	0.05	0.05	0.45	0.45	-	0.10

Table 7.9: Areas of the study area, which are visible from multiple ICSA in Argyll and multiple random sets of locations (m = 43, n = 19).

Irregular-rectilinear drystone sites with an internal area above 180m^2

The degree of visibility appears to have been an important factor for the location of the IRSA sites. Results of Hypothesis 1 demonstrate the mean and minimum summary value to be statistically significant in the archaeological set when compared to the random set (Table 7.10; Figure 7.16). The only set that all sites have visibility of the sea is the archaeological set and this circumstance is further supported by the statistical significance of mean and minimum values for Hypothesis 2 (Figure 7.17). Although the mean area of visible land is the largest in the archaeological set when compared with the random set, results for Hypothesis 3 show that the ratio between visible sea area to land area is also significant. This result may be skewed by a single outlier value, reflecting the ratio of a single site with a large visibility of the sea and very little of the surrounding land (Figure 7.18). If this value is removed from the set, the resulting ratio value is much lower, suggesting that IRSA sites may not have as strong a preference for visibility of the sea over land. This suggests that these sites preferred locations along the coastline or with visibility of the sea and with large vistas over the surrounding sea- and landscape. Table 7.11 illustrates the weighted average for archaeological sites are the largest value at 1.46, suggesting that the null hypothesis is rejected for Hypothesis 4. This result may be reflecting the cumulative viewshed from the sites located near the southern half of Kintyre. Figure 7.19 illustrates a concentration of sites overlook Machrihanish Bay and the area between Colonsay and Islay, but the remaining sites are too dispersed through the landscape to share views of particular areas. The statistical results suggest that IRSA sites are located in areas with large visibilities and have views of the sea. A small group of sites appears to visually control the area around Machrihanish Bay. The scattered distribution of the remaining sites suggests these may possibly reflect a subset of a larger group. The distribution and viewshed results suggest their locations were chosen in order to overlook and be observed from the sea.

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km^2)					
Mean	56.44	135.49	173.31	20	0.05
Minimum	0.05	4.76	5.03	20	0.05
Maximum	291.08	569.89	456.81	16	0.25
Area of visible sea (km^2)					
Mean	42.38	121.70	151.68	20	0.05
Minimum	-	-	2.12	20	0.05
Maximum	272.47	564.91	448.22	17	0.20
Area of visible land (km^2)					
Mean	10.67	17.93	21.63	20	0.05
Minimum	0.03	1.93	0.03	2	0.10
Maximum	32.17	112.31	80.15	15	0.30
Ratio of sea area to land area					
Mean	7.06	197.94	405.08	20	0.05

Table 7.10: Comparisons of visible areas for IRSA sites in Argyll (m = 32, n = 19).

Number of sites with visibility of a location (**a**)	1	2	3	4	5	6	7	Weighted average
Area visible from a archaeological sites/km^2	2652.88	575.36	199.45	79.55	31.47	61.42	1.19	1.46
Minimum area visible from **a** random sites/km^2	1395.02	59.33	0.13	-	-	-	-	1.03
Maximum area visible from **a** random sites/ km^2	2701.61	782.76	254.44	26.96	0.02	-	-	1.43
Number of random groups with values of **a**	19	19	19	13	3	0	0	
Rank	19	19	19	20	20	20	20	20
Significance	0.10	0.10	0.10	0.05	0.05	0.05	0.05	0.05

Table 7.11: Areas of the study area, which are visible from multiple IRSA sites in Argyll and multiple random sets of locations (m = 32, n = 19).

Irregular-irregular drystone sites with an internal area above 180m^2

Visibility appears to have an important affect on IISA site location strategies. Statistical analysis results indicate that there is a difference in the visibility between the archaeological and random sets in the mean, minimum and maximum value for all hypotheses (Table 7.12; Figures 7.20 to 7.22). Calculation of Hypothesis 2 indicates that the archaeological sites are the only set in which all sites have visibility of the sea. Hypothesis 3 also demonstrates that out of all the sets the archaeological sites have the highest ratio of sea area to land area. Figure 7.22 illustrates a large difference between the maximum values in the IISA set and the reference sets. A single site with a large ratio value is the cause for this difference. The remaining sites in the set all exhibit ratio values much smaller, which are comparable to the reference set rather than significantly different. Therefore, the statistically significant difference detected for Hypothesis 3 may be strongly influenced by an outlier site rather than reflecting an actual pattern. Figure 7.23 illustrates the distribution of this site type and the corresponding viewsheds. Results for Hypothesis 4 indicate that there is a statistical significance in the cumulative viewshed of archaeological sites and site frequency compared to the values of the random sets (Table 7.13). Areas that are visible from multiple sites are located in between Islay and Kintyre. Overall, the visibility results suggest that IISA sites are built on locations with expansive views, particularly over the sea. This may reflect the location rationale where these sites were to overlook and be highly visible from the sea.

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km^2)					
Mean	67.09	156.14	226.80	20	0.05
Minimum	0.28	6.73	32.02	20	0.05
Maximum	268.53	554.97	662.62	20	0.05
Area of visible sea (km^2)					
Mean	56.27	139.94	210.77	20	0.05
Minimum	-	-	23.75	20	0.05
Maximum	265.17	531.34	659.47	20	0.05
Area of visible land (km^2)					
Mean	8.48	21.69	16.04	14	0.35
Minimum	0.06	1.91	0.02	1	0.05
Maximum	30.00	112.31	61.66	14	0.35
Ratio of sea area to land area					
Mean	8.70	76.06	210.35	20	0.05

Table 7.12: Comparisons of visible areas for IISA sites in Argyll (m = 18, n = 19).

Number of sites with visibility of a location (**a**)	1	2	3	4	5	Weighted average
Area visible from **a** archaeological sites/km^2	2839.98	408.53	54.55	16.38	0.13	1.17
Minimum area visible from **a** random sites/km^2	1082.13	2.54	-	-	-	1.01
Maximum area visible from **a** random sites/km^2	2142.56	319.16	155.54	0.14	0.0004	1.06
Number of random groups with values of **a**	19	19	12	2	1	
Rank	20	20	19	20	20	20
Significance	0.05	0.05	0.10	0.05	0.05	0.05

Table 7.13: Areas of the study area, which are visible from multiple IISA sites in Argyll and multiple random sets of locations (m = 18, n = 19).

Promontory sites with an internal area below 180m²

Results of the statistical analyses indicate that some aspects of visibility affect the location of PB sites. Results of Hypothesis 1 indicate that differences in the visibility from the archaeological sites locations and random locations are significantly different in the mean and minimum value, but not for the maximum value suggesting that these sites are generally located in positions with large vistas (Table 7.14; Figure 7.24). Analysis of Hypothesis 2 demonstrates that the visibility from archaeological site locations is statistically significant in the mean and minimum values (Figure 7.25). All five PB sites have visibility of the sea, whereas only four of the random sets have all the sites intervisible with the sea. Although, the results of Hypothesis 3 are not significantly different between the archaeological and the random sets, suggesting large amounts of land is also visible from the PB locations (Figure 7.26). Figure 7.27 illustrates that only two of the viewsheds overlapped; therefore Hypothesis 4 is not further examined. Overall, these results suggest that PB sites favour locations with large vistas and to have a visual connection with the sea regardless of the amount of visible land. There are, however, a few locations in the landscape that have larger degrees of visibility than those observed in the archaeological set, but the PB sites generally have the largest viewsheds. The coastal distribution and extremely large vistas of the sea suggests site locations were chosen in order to view large expanses of the sea and to be observed from the sea. The low numbers in this site type may suggest that they are actually part of a larger group (*supra*).

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km^2)					
Mean	20.44	163.80	222.58	20	0.05
Minimum	0.79	23.08	58.52	20	0.05
Maximum	29.24	569.89	461.65	18	0.15
Area of visible sea (km^2)					
Mean	5.27	151.03	208.60	20	0.05
Minimum	-	2.52	45.47	20	0.05
Maximum	10.95	564.91	456.46	18	0.15
Area of visible land (km^2)					
Mean	8.21	28.53	13.99	7	0.35
Minimum	0.08	9.60	4.08	16	0.25
Maximum	13.65	73.47	36.18	10	0.50
Ratio of sea area to land area					
Mean	0.82	47.06	36.68	14	0.35

Table 7.14: Comparisons of visible areas for PB sites in Argyll (m = 5, n = 19).

Promontory sites with an internal area above $180m^2$

Statistical analyses for the PA sites demonstrate similar results to those of the PB sites. Results for hypotheses 1 and 2 indicate the mean value is statistically significant for the archaeological set when compared to the random sets, indicating this site type prefers locations with large visibilities particularly over the sea (Table 7.15; Figures 7.28 and 7.29). The result of Hypothesis 3 identifies a significant difference between the archaeological and random sets. Figure 7.30 illustrates the extreme difference in maximum values between the sets. This is caused by the visibility of a single site in which the amount of visible land is very small and the amount of sea is large. However, even with the removal of this site value from the calculation of the mean, the PA set still demonstrates the highest value. This suggests that the results detected in Hypothesis 3 are an account for the pattern and not skewed, in which the PA sites are located in positions with larger vistas of the sea over land. Table 7.16 presents the results for Hypothesis 4 regarding the cumulative viewshed analysis. Random sets demonstrate higher frequencies of sites visible with single locations up to 11 sites, however, the visibility from multiple archaeological site locations encompass much larger areas. The weighted mean value is statistically significant, which suggests that the larger promontory sites are located so as to share the view of particular areas. Figure 7.31 illustrates the distribution of this site type and the corresponding viewsheds. Visible areas from a high frequency of sites are observed off the south-eastern tip of Islay, along the west coast of the Sound of Jura and along the Firth of Lorn between Mull and mainland Argyll. The pattern illustrated in Figure 7.31 suggests the PA sites are located along the coastlines of the larger islands and may act as a visual buffer along the southern and western edge of the study area. These sites may have functioned as watchtowers or warning mechanisms for contemporary sites. Areas with a concentration of sites may suggest a chronological sequence of site construction and occupation, in which older sites were abandoned.

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km^2)					
Mean	64.18	117.60	203.02	20	0.05
Minimum	0.19	1.42	1.36	18	0.15
Maximum	271.80	614.06	573.35	18	0.15
Area of visible sea (km^2)					
Mean	49.72	99.58	189.03	20	0.05
Minimum	-	-	-	-	-
Maximum	259.34	595.05	530.41	18	0.15
Area of visible land (km^2)					
Mean	12.94	19.34	13.98	4	0.20
Minimum	0.05	0.75	0.01	1	0.05
Maximum	42.12	104.91	82.01	15	0.30
Ratio of sea area to land area					
Mean	13.20	44.49	405.34	20	0.05

Table 7.15: Comparisons of visible areas for PA sites in Argyll (m = 57, n = 19).

Number of sites with visibility of a location (**a**)	1	2	3	4	5	6	7	8	9	10	11	Weighted average
Area visible from **a** archaeological sites/km^2	3422.71	1609.55	565.55	315.87	131.97	45.96	-	-	-	-	-	1.73
Minimum area visible from **a** random sites/km^2	1904.30	442.93	105.38	13.60	0.65	0.01	-	-	-	-	-	1.22
Maximum area visible from **a** random sites/km^2	3637.37	1075.13	321.71	141.73	52.64	7.22	2.47	0.89	0.07	0.01	0.00002	1.52
Number of random groups with values of **a**	19	19	19	19	19	19	17	13	12	6	1	
Rank	18	20	20	20	20	20	-	-	-	-	-	20
Significance	0.15	0.05	0.05	0.05	0.05	0.05	-	-	-	-	-	0.05

Table 7.16: Areas of the study area, which are visible from multiple PA sites in Argyll and multiple random sets of locations (m = 57, n = 19).

Curvilinear sites with an internal area below 180m^2 and encompassing architectural features

Statistical analyses on the visibility from AFCB site locations suggest that visibility was an influential factor on site location strategies. The results of Hypothesis 1 and 2 indicate that the mean and maximum summary values are statistically significant for the archaeological sites, suggesting AFCB sites are located in areas with large visibility ranges and of the sea (Table 7.17). Both figures 7.32 and 7.33 illustrate the ranking order of all sets, with the AFCB sites having an extremely large maximum value. This is reflecting the viewshed values from a single site in both cases. However, when this site is removed from the archaeological set the mean values for total visibility and sea visibility are still higher than those of the reference sets, suggesting that these are genuine patterns. Figure 7.35 further illustrates the large degree of visibility for several of the sites. The analysis on the ratio of visible sea area to land area for Hypothesis 3 indicates that there is no significant difference between the archaeological set and the random set. Figure 7.34 depicts random set 13 in rank 20 as having a large difference in the maximum value compared to the other sets. The ratio value of one site in set 13 is an outlier and skews the mean value higher. If this site value is removed, then the mean value lowers substantially placing the set in rank 3 and the archaeological set in rank 20. This re-analyses suggests that the AFCB sites may prefer locations with larger views of the sea as opposed to land. Results for Hypothesis 4 demonstrate that there is not a statistical significance in the frequency of sites and visibility of particular areas for the archaeological sites (Table 7.18). The four sites located on Tiree may reflect a subgroup and possibly demonstrate a strategic distribution in order to visually cover the majority of the island's coastline. The distribution of the remaining sites and the corresponding viewsheds imply that the majority of the sites are located along the coast and have visual contact with the nearby coastline.

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km2)					
Mean	51.09	115.59	196.77	20	0.05
Minimum	0.270	6.25	5.380	18	0.15
Maximum	204.08	550.37	796.27	20	0.05
Area of visible sea (km2)					
Mean	37.02	95.64	178.28	20	0.05
Minimum	-	-	-	-	-
Maximum	198.88	525.49	761.89	20	0.05
Area of visible land (km2)					
Mean	297.23	348.93	18.49	13	0.40
Minimum	0.03	2.71	0.18	4	0.20
Maximum	31.62	98.15	73.66	15	0.30
Ratio of sea area to land area					
Mean	3.68	275.70	144.40	19	0.10

Table 7.17: Comparisons of visible areas for AFCB sites in Argyll (m = 22, n = 19).

Number of sites with visibility of a location (**a**)	1	2	3	4	5	Weighted average
Area visible from **a** archaeological sites/km^2	2892.08	509.18	133.62	0.01	-	1.22
Minimum area visible from **a** random sites/km^2	993.18	34.44	0.26	-	-	1.03
Maximum area visible from **a** random sites/km^2	1876.45	429.43	94.58	40.88	1.23	1.34
Number of random groups with values of **a**	19	19	19	18	2	
Rank	20	20	20	2	-	16
Significance	0.05	0.05	0.05	0.10	-	0.25

Table 7.18: Areas of the study area, which are visible from multiple AFCB sites in Argyll and multiple random sets of locations (m = 22, n = 19).

Conclusions

Overall, the visibility results indicate that the locations of sites in several of the classifications have correlations with particular visibility conditions. The CSB sites illustrate preferences for locations with large vistas over the sea. Their coastal distribution suggests that these areas might possibly reflect points of contact and their desire to view the surrounding waters. The CSA sites also demonstrate locational preferences in reference to visibility, in which locations with large vistas were chosen. A number of these sites are located slightly inland and in prominent locations. This suggests a pattern of sea contact with the CSB sites, which are in turn overlooked by the more inland CSA sites. Both of these site types demonstrated a visual focus over the area of sea between Kintyre and the islands of Islay and Jura. This may indicate a desire to view travel along this seas route by both site types. The AFCB sites also demonstrate large vistas and their pattern may reflect a subgroup of sites in the north-western sector of the study area.

The PA sites appear to favour locations with large viewsheds. Results also suggest that there is a focus on particular areas of the sea and the amount visible land area may have been sacrificed for larger vistas over the sea. There were few PB sites, however the visibility results are comparable to those observed with the PA sites. This suggests that the PB sites may not reflect a separate site type and should be considered comparable to the PA sites.

Of the rectilinear and irregular site types, only the larger sized sites demonstrate correlations with site location and visibility. This suggests that larger sites are located in prominent areas with wide spread views, especially of the sea and coastline over the visibility of the surrounding land. Only the ICSA sites illustrate large vistas over both land and sea. This suggests that generally the locations of larger sites were chosen in areas that could be viewed from the sea. The ICSA sites also indicate control over areas of land. Smaller groups within the IRSA and IISA classification indicate visual foci over areas between Kintyre and Islay.

This may suggest that the CSB sites were active in trade and communication from across the sea. The CSA sites appear to overlook the CSB sites and may have had the control. The larger sized irregular and rectilinear sites illustrate similar viewshed results to those of the CSA sites, which may reflect a comparable role of control over the surrounding visible sea and land. Interestingly none of smaller sized rectilinear or irregular sites demonstrate correlations with visibility and site location. This may indicate that either other variables these affected these site locations or their role in coastal trade and communication was too a much lesser degree than the other site types.

7.2.2 The north and north-east coastlines of Northern Ireland

Curvilinear sites constructed of earth with an internal area above 180m^2

Only Hypothesis 4 demonstrates a significant difference between the CEA sites and the reference set. Cumulative viewshed results for Hypothesis 4 indicate that up to twenty-four archaeological sites have visibilities over a single area. Table 7.19 depicts that areas visible by twelve or more sites statistically differ from the cumulative viewsheds of the random sets. The archaeological sites exhibit the largest value of the weighted mean, which indicates that the visibility of specific areas might be a factor for site location. Areas that are intervisible with a high frequency of sites are located at the inlet of Belfast Lough, along the valley that connects the modern day villages of Larne and Ballyclare on the east, along the River Bann and at along the north coast near to outlet of the River Bann (Figure 7.37; refer to Figure 7.36 for place names). These results suggest that the degree of visibility probably did not influence the location rationale for CEA sites even though several of the archaeological sites did demonstrate the visibility of large areas of land. Rather the locations of sites may be influenced by a preference to view particular areas. CEA sites with larger views focused along the northern coastline and Belfast Lough may reflect the first places of contact, in which trade goods and ideas filtered inland to the sites with smaller vistas along the corresponding valleys.

Number of sites with visibility of a location (**a**)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Area visible from **a** archaeological sites/km^2	1137.50	775.26	486.14	267.35	118.29	63.49	50.97	39.30	26.21	21.62	27.92	25.92	11.96	31.39	1.26	0.32
Minimum area visible from **a** random sites/km^2	1414.14	651.02	332.71	147.78	73.53	44.12	13.61	3.59	1.25	0.52	0.04	0.01	0.0047	0.0002	-	-
Maximum area visible from **a** random sites/km^2	2273.92	1048.71	607.33	383.75	231.45	136.47	50.97	74.25	39.14	63.71	47.95	24.67	7.5	4.59	0.69	0.06
Number of random groups with values of **a**	19.00	19.00	19.00	19.00	19.00	19	19	19	19	19	19	19	19	19	15	11
Rank	1	7	16	14	6	8	13	16	18	18	19	20	20	20	20	20
Significance	0.05	0.35	0.25	0.35	0.30	0.40	0.40	0.25	0.15	0.15	0.10	0.05	0.05	0.05	0.05	0.05

Number of sites with visibility of a location (**a**)	17	18	19	20	21	22	23	24	Weighted average
Area visible from **a** archaeological sites/km^2	0.22	0.11	0.11	0.08	0.05	0.04	0.0039	0.0018	2.77
Minimum area visible from **a** random sites/km^2	-	-	-	-	-	-	-	-	1.83
Maximum area visible from **a** random sites/km^2	0.02	0.01	0.01	0.0015	-	-	-	-	2.42
Number of random groups with values of **a**	7	4	4	2	0	0	0	0	
Rank	20	20	20	20	20	20	20	20	20
Significance	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05

Table 7.19: Areas of the study area, which are visible from multiple CEA sites along the northern coastline of Northern Ireland and multiple random sets of locations (m = 92, n = 19).

All Irregular sites

Seven irregular shaped sites are located in the study area boundaries regarding visibility analysis, in which five enclose internal areas larger than $180m^2$. In the whole study area of Northern Ireland, 23 of the total 26 irregular sites have recorded dimensions, in which all measure larger than $180m^2$. Due to the small number of sites all irregular sites are tested as a single group.

Statistical analyses suggest that the degree of visibility may influence the location of irregular sites. The summary value of the mean and minimum for Hypothesis 1 significantly differs in the archaeological sites from the random set (Table 7.20; Figure 7.38). Results for Hypothesis 2 are also significantly different in the mean value of the archaeological sites when compared to the random sets (Figure 7.39). There are sites in the archaeology set that have no visibility of the sea, whereas only one of the random sets has all sites with visibility of the sea. Results for Hypothesis 3 depict no significant difference between the irregular sites and the random sets. Results from the cumulative viewshed analysis for Hypothesis 4 indicate that there is no statistical significance between the archaeological and the random sets. Figure 7.40 further illustrates these results in which no more than two viewsheds overlapped, as a result of the distribution throughout the landscape. Overall, irregular sites appear to favour locations with large visibilities over the landscape, particularly of the sea. This suggests that the coastal sites were located in areas that have large vistas over the sea, possibly to overlook sea travel.

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km^2)					
Mean	24.57	153.22	203.19	20	0.05
Minimum	1.60	26.94	33.06	20	0.05
Maximum	74.66	419.81	364.51	19	0.10
Area of visible sea (km^2)					
Mean	3.10	108.43	144.59	20	0.05
Minimum	-	1.26	-	-	-
Maximum	18.26	367.62	362.96	19	0.10
Area of visible land (km^2)					
Mean	28.35	58.66	58.60	19	0.10
Minimum	0.99	26.69	1.55	2	0.10
Maximum	69.54	128.22	96.99	10	0.50
Ratio of sea area to land area					
Mean	0.05	44.23	40.07	19	0.10

Table 7.20: Comparisons of visible areas for irregular sites along the northern coastline of Northern Ireland (m = 6, n = 19).

All Promontory sites

Twelve of the total seventeen promontory sites throughout the Northern Ireland study area are distributed in the visibility analysis area. The majority of sites under this classification have recorded dimensions, in which all enclosed internal areas larger than $180m^2$. However, only seven of the twelve sites included in the visibility analysis have measurements. Therefore, the analyses include all twelve sites considering the overall pattern indicates that this site type is generally large in size.

The visibility analyses on all promontory sites along the northern coastline suggest that visibility is an influential factor for site location. The results of Hypothesis 1 and 2 indicate that summary mean and maximum values are statistically significant for the archaeological set when compared to the random sets (Table 7.21; Figures 7.41 and 7.42)). Results for Hypothesis 3 demonstrate that the ratio of visible sea to land area for the archaeological set is also significantly different (Figure 7.43). This suggests that the sites were located in areas with large vistas particularly of the sea and limited landscape views. Table 7.22 presents the results of Hypothesis 4, indicating that the weighted mean for the archaeological set is not statistically significant. Figure 7.44 illustrates the distribution of this site type and the corresponding viewsheds. Geographic distribution of the visibilities for promontory sites suggest that the sites might be strategically located along the coastline in order to allocate a section of the coast to each site rather than to have a visual foci on particular areas. This may suggest these sites functioned as landmarks for sea travellers due to their dispersed distribution along the north-eastern coastline. Overall, the results suggest that large degrees of visibility, especially over the sea is an important factor for site location, in which visible areas of land are sacrificed over visible areas of the sea.

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km2)					
Mean	46.23	130.03	234.00	20	0.05
Minimum	3.12	22.53	10.41	13	0.40
Maximum	172.15	275.94	425.33	20	0.05
Area of visible sea (km2)					
Mean	18.51	93.80	213.23	20	0.05
Minimum	-	-	-	-	-
Maximum	162.48	256.31	417.39	20	0.05
Area of visible land (km2)					
Mean	22.64	51.25	21.43	1	0.05
Minimum	10.16	1.68	0.15	1	0.05
Maximum	41.98	121.87	92.88	14	0.35
Ratio of sea area to land area					
Mean	0.74	24.19	230.79	20	0.05

Table 7.21: Comparisons of visible areas for all promontory sites along the coastline of Northern Ireland of Northern Ireland (m = 12, n = 19).

Number of sites with visibility of a location (**a**)	1	2	3	4	5	6	Weighted average
Area visible from **a** archaeological sites/km^2	985.12	678.46	145.98	5.85	-	-	1.44
Minimum area visible from **a** random sites/km^2	372.52	9.19	-	-	-	-	1.01
Maximum area visible from **a** random sites/km^2	1371.10	228.88	103.49	8.54	2.19	0.01	1.56
Number of random groups with values of **a**	19	19	18	12	5	3	
Rank	15	20	20	19	-	-	19
Significance	0.30	0.05	0.05	0.10	-	-	0.10

Table 7.22: Areas of the study area, which were visible from multiple promontory sites along the coastline of Northern Ireland and multiple random sets of locations (m = 12, n = 19).

Conclusions

Classification groups that demonstrate locational strategies influenced by visibility include CEA, all the irregular sites and all the promontory sites. Results for the CEA sites suggest locations are purposefully chosen in order to view particularly areas of the landscape. Sites along the coastline may reflect different status or function as first places of contact for sea travellers. This may be supported with the small distribution of sites with large vistas along the northern coastline and near the mouth of Belfast Lough. All the irregular sites and promontory sites are included in their respective classification for testing as a result of the small number of sites and minimal information pertaining to those sites. Both of these categories indicate location rationale for areas with large vistas, particularly of the sea. The primarily coastal distribution on prominent points in the landscape of the promontory sites and their corresponding viewsheds suggest these site may have been used as watchtowers for inland sites or landmarks for sea travellers.

7.2.3 Co. Donegal

<u>Curvilinear drystone sites with an internal area below 180m^2</u>

The results of the visibility analyses for the CSB classification are only significant for Hypothesis 4, which suggests that several sites may be positioned on the basis of viewing a particular area in the landscape. Figure 7.46 illustrates the viewshed from sites, in which the highest frequency of sites visible with an area is apparent in the south-western part of the study area near McSwyne's and Fintragh Bay and in central Donegal along the north and south sides of the valley that the River Foyle runs through (refer to Figure 7.45 for place names). Results of Hypothesis 4 are presented in Table 7.23. Examination of these values indicates that no more than four sites are able see a particular area, whereas the random sets have much higher frequencies, up to 8 sites at one time. Only one of the observation site frequencies is significantly different from the random set. However, the value of the weighted mean for archaeological sites is found to be statistically significant with the largest value of 1.24. This may indicate that sites located near the two bays, McSwyne's and Fintragh, and sites along the River Foyle valley sides are situated in order to have visibility particularly over these areas. Figure 7.46 also illustrates that the locations of CSB sites are slightly inland, which may reflect the lack of vistas over the sea and coastline. Overall, site locations do not appear to have been chosen on the basis of the degree of visibility, but rather to view particular areas of the landscape. The sites distributed along a river valley in central Donegal and along the coast in the southern most section of the study area may be positioned by the need to view these specific areas. This suggests that these sites may not have an invested interest in communication from the sea, with the exception of the group around the two bays in the southern sector of the study area.

Number of sites with visibility of a location (**a**)	1	2	3	4	5	6	7	8	Weighted average
Area visible from **a** archaeological sites/km^2	1134.81	267.37	40.97	0.65	-	-	-	-	1.24
Minimum area visible from **a** random sites/km^2	858.77	58.79	2.00	0.01	-	-	-	-	1.06
Maximum area visible from **a** random sites/km^2	2160.93	377.73	40.02	9.41	2.01	0.06	0.0023	0.0002	1.20
Number of random groups with values of **a**	19	19	19	19	18	9	5	1	
Rank	5	18	20	9	-	-	-	-	20
Significance	0.25	0.15	0.05	0.45	-	-	-	-	0.05

Table 7.23: Areas of the study area, which are visible from multiple CSB sites in Co. Donegal and multiple random sets of locations (m = 30, n = 19).

Curvilinear drystone sites with an internal area above 180m^2

Results of the visibility analysis on CSA sites for Hypothesis 1 demonstrate that the archaeological set is statistically significant from all sets of random locations in the mean and minimum summary values, but not for the maximum value (Table 7.24; Figure 7.47). The mean visibility of the sea value is also significantly different between the archaeological and random sets for Hypothesis 2 (Figure 7.48). Hypothesis 3 results are not statistically significant for the archaeological set when compared with the random set. However, over 25% of the CSA sites do not view the sea. In other words, the majority of large curvilinear stone sites along the coastline may have opted for locations with a high degree of visibility, whereas this does not appear as an important feature for the inland sites. Table 7.25 presents the results of Hypothesis 4. Archaeological sites have frequencies up to 13 sites that share visibility with a particular area. The random sets did demonstrate slightly higher frequencies of sites intervisible with particular areas; however, the weighted mean value is found to be statistically significant. This suggests that there are other locations within the landscape that also have large vistas over these particular areas, but the general pattern depicted by the CSA sites is over larger areas and a higher frequency of sites. Figure 7.49 illustrates that areas visible from a high number of archaeological sites are located in Donegal Bay and along the north coast between the points of the Bloody Foreland and Fanad Head, which consist of several sandy bays with easy access from the sea.

These results suggest that locations with large vistas over the sea and over particular areas may be preferential locations for this particular site type along the coast. The results, however, suggest that there were other locations in the landscape that had larger viewsheds. This indicates that the location of CSA sites may have additional underlying influences that affect the locational decisions in conjunction with visibility. Visibility from these sites visually overlooked the northern and northern-western coastlines, particularly areas of easy access from the sea. This suggests that these sites focused on sea travel from the north and south and are located in areas of contact.

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km^2)					
Mean	50.76	72.41	88.09	20	0.05
Minimum	0.38	3.60	5.81	20	0.05
Maximum	280.36	880.31	350.44	8	0.40
Area of visible sea (km^2)					
Mean	21.32	43.56	58.37	20	0.05
Minimum	-	-	-	-	-
Maximum	169.79	868.57	320.52	11	0.50
Area of visible land (km^2)					
Mean	22.92	33.22	29.72	15	0.30
Minimum	0.11	2.61	1.13	11	0.50
Maximum	82.17	578.11	247.58	18	0.15
Ratio of sea area to land area					
Mean	1.03	38.52	7.71	16	0.25

Table 7.24: Comparisons of visible areas for CSA sites in Co. Donegal (m = 95, n = 19).

Number of sites with visibility of a location (**a**)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Weighted average
Area visible from **a** archaeological sites/km^2	2490.13	896.59	381.93	186.30	120.98	93.27	77.72	18.38	0.34	0.07	0.05	0.02	0.01	-	-	1.88
Minimum area visible from **a** random sites/km^2	1893.74	631.42	160.34	36.37	8.65	1.59	0.32	0.05	0.0025	0.0001	-	-	-	-	-	1.32
Maximum area visible from **a** random sites/km^2	3020.85	1168.18	381.93	157.48	57.84	16.03	3.08	1.08	0.45	0.22	0.07	0.02	0.0024	0.0011	0.0004	1.64
Number of random groups with values of **a**	19	19	19	19	19	19	19	19	19	19	15	7	3	2	1	
Rank	10	8	20	20	20	20	20	20	19	19	18	19	20	-	-	20
Significance	0.50	0.40	0.05	0.05	0.05	0.05	0.05	0.05	0.10	0.10	0.15	0.10	0.05	-	-	0.05

Table 7.25: Areas of the study area, which are visible from multiple CSA in Co. Donegal and multiple random sets of locations (m = 95, n = 19).

Curvilinear sites constructed of stone and earth with an internal area above 180m²

The results of the statistical analyses on site location with reference to visibility suggest that the degree of visibility and views of specific areas in the study area influenced the locations of CSAEA sites. Both the mean and maximum summary values for Hypothesis 1 are significantly different from the archaeological set when compared to those of the random sets (Table 7.26; Figure 7.50). Results of Hypothesis 2 indicate that the mean values of visibility of the sea are statistically significant between the archaeological and the random sets (Figure 7.51). The mean summary value of visible land also tests as significantly different, possibly due to the number of inland sites. This is comparable to the results of Hypothesis 3, in which there is no difference between archaeological sites and the random sets with regards to the ratio of visible sea area to visible land area. This indicates that these sites are located in prominent areas to view and be observed from the surrounding sea- and landscape. The cumulative viewshed analysis for Hypothesis 4 indicates that there are areas in the landscape that are intervisible with a high frequency of sites (Figure 7.52). The largest weighted mean value is produced by the archaeological set, therefore demonstrating a significant difference between the locations of archaeological and random sites, even though the random sets have a higher frequency of sites visible with a single area (Table 7.27). The highest degree of visibility between multiple sites is located at the section of sea at Donegal Bay. This suggests that this small group of sites is strategically located to control travel and communication over this area or are correlated with the CSA sites also located in this vicinity. These results indicate that the CSAEA sites are located in areas with large degrees of visibilities of both land and sea and there appears to be no inclination for sea visibility over land. This suggests that these sites preferred locations with large vistas, both coastal and inland, with a small group of sites focused on Donegal Bay.

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km^2)					
Mean	36.25	81.82	88.49	20	0.05
Minimum	0.79	10.24	8.91	19	0.10
Maximum	130.98	474.51	310.84	10	0.50
Area of visible sea (km^2)					
Mean	12.17	19.06	53.54	20	0.05
Minimum	-	-	-	-	-
Maximum	123.99	454.99	277.87	11	0.50
Area of visible land (km^2)					
Mean	23.57	33.90	34.95	20	0.05
Minimum	0.70	10.24	8.91	19	0.10
Maximum	56.93	122.92	115.74	18	0.15
Ratio of sea area to land area					
Mean	0.31	14.31	2.08	12	0.45

Table 7.26: Comparisons of visible areas for CSAEA sites in Co. Donegal (m = 26, n = 19).

Number of sites with visibility of a location (**a**)	1	2	3	4	5	6	7	Weighted average
Area visible from **a** archaeological sites/km^2	853.82	377.77	157.24	44.04	5.52	-	-	1.59
Minimum area visible from **a** random sites/km^2	715.38	69.88	1.55	0.01	-	-	-	1.04
Maximum area visible from **a** random sites/km^2	1883.78	257.74	105.23	5.74	1.27	0.29	0.0004	1.29
Number of random groups with values of **a**	19	19	19	19	14	2	1	
Rank	4	20	20	20	20	-	-	20
Significance	0.20	0.05	0.05	0.05	0.05	-	-	0.05

Table 7.27: Areas of the study area, which are visible from multiple CSAEA sites in Co. Donegal and multiple random sets of locations (m = 26, n = 19).

<u>Curvilinear sites constructed of earth with an internal area below 180m^2</u>

Statistical results for the CEB sites suggest that small degrees of visibility influenced the locations of these sites. Results of Hypothesis 1 and 2 demonstrate that the mean summary values are statistically significant for the archaeological set when compared with the random sets (Table 7.28). The summary mean value for visible land area also tests as significantly different in the archaeological set. These differences in visibility, however, are significant for having the smallest degree of visibility rather than the largest (Figures 7.53 and 7.54). The maximum values for both overall visibility and visible sea area are also statistically significant for having values of the smallest visible area. These results suggest that archaeological sites are located in areas with very limited visibility, including the sites along the coastline. The distribution of this site type illustrate that about half of the structures are located inland and the remaining sites have very restricted views of the sea (Figure 7.55).

Cumulative viewshed results for Hypothesis 4 indicate that the largest weighted mean is apparent in the archaeological set when compared to the random sets, however only one frequency indicated a significant difference (Table 7.29). This high weighted mean value may be reflecting the overlapping viewsheds of the sites around the Donegal Bay area. The distribution of these sites might imply the strong desire to view this particular area over locations with large vistas, and thus this result reflects the pattern of a few sites rather than the entire archaeological set. Overall, these results suggest that there may be other underlying influential factors that cause sites to locate in areas with very limited visibility and a focus on Donegal Bay for those particular sites located in that area.

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km^2)					
Mean	25.07	85.53	19.85	1	0.05
Minimum	2.95	15.97	4.60	3	0.15
Maximum	68.86	412.27	44.14	1	0.05
Area of visible sea (km^2)					
Mean	5.32	63.03	4.70	1	0.05
Minimum	-	-	-	-	-
Maximum	31.79	408.63	17.56	1	0.05
Area of visible land (km^2)					
Mean	18.17	39.23	15.15	1	0.05
Minimum	2.95	13.96	2.98	2	0.10
Maximum	22.73	37.63	41.78	7	0.35
Ratio of sea area to land area					
Mean	0.16	13.37	0.47	6	0.30

Table 7.28:Comparisons of visible areas for CEB sites in Co. Donegal (m = 9, n = 19).

Number of sites with visibility of a location (**a**)	1	2	3	4	5	Weighted average
Area visible from **a** archaeological sites/km^2	128.90	20.77	2.49	-	-	1.17
Minimum area visible from **a** random sites/km^2	211.32	1.56	0.00	-	-	1.00
Maximum area visible from **a** random sites/km^2	724.84	547.87	1.73	0.21	0.0038	1.13
Number of random groups with values of **a**	19	19	15	4	2	
Rank	1	13	20	-	-	20
Significance	0.05	0.4	0.05	-	-	0.05

Table 7.29: Areas of the study area, which are visible from multiple CEB sites in Co. Donegal and multiple random sets of locations (m = 9, n = 19).

Curvilinear sites constructed of earth with an internal area above 180m^2

Contrary to the results observed for the CEB sites, statistical analyses on the CEA sites indicate that large vistas of the surrounding landscape is influential to site location. Statistical calculations of Hypothesis 1 demonstrate that the mean value of visibility is significantly different between the archaeological sites and the random sets (Table 7.30, Figures 7.57). Results of Hypothesis 2 indicate that visibility of the sea is also statistically different in the mean summary value of the archaeological sites, even though 30% of the sites are located inland and views of the sea are obstructed by topography (Figure 7.58). The viewsheds from these inland sites may possibly affect the result of no significant difference for Hypothesis 3. Up to thirty-two sites are able to see a single location in the landscape (Figure 7.59). Table 7.31 lists the frequency of archaeological sites with the random sets, in which the CEA sites demonstrate much higher frequencies. This pattern is further emphasized in the weighted mean value, in which archaeological sites exhibit the highest value, 3.23, as compared to the random sets, 1.56 to 2.05. Therefore the null hypothesis for Hypothesis 4 is rejected. Figure 7.59 illustrates the highest frequency of visibility is in the waters surrounding Donegal Bay. This suggests that the majority of CEA sites in this area are located in positions to overlook Donegal Bay and its coastline. This may indicate an area of frequent sea traffic and communication. Other areas with a high frequency of visibility are located in the north part of the study area, covering the area of Lough Foyle to the east of the Inishowen peninsula, the area surrounding and in between Culdaff Bay and Trawbreaga Bay, along the southern half of Lough Swilly and the section where Mulroy Bay meets Broad Water near the Fanad peninsula. These results suggest that CEA sites generally have large vistas and many focus on the sea, however there are other locations in the landscape with larger vistas. In other words, the amount of visibility may influence a number of the site locations, but there may also be additional influential factors that supersede visibility, for example a desire to view a particular coastline.

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km^2)					
Mean	42.00	70.68	82.60	20	0.05
Minimum	0.38	2.10	0.91	6	0.30
Maximum	292.99	887.09	460.92	17	0.20
Area of visible sea (km^2)					
Mean	14.82	45.68	55.18	20	0.05
Minimum	-	-	-	-	-
Maximum	221.54	871.07	399.64	10	0.50
Area of visible land (km^2)					
Mean	0.82	0.38	27.41	13	0.40
Minimum	0.11	1.78	0.55	5	0.25
Maximum	97.37	578.11	103.22	5	0.25
Ratio of sea area to land area					
Mean	0.88	32.60	6.90	18	0.15

Table 7.30: Comparisons of visible areas for CEA sites in Co. Donegal (m = 122, n = 19).

Number of sites with visibility of a location (**a**)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Area visible from **a** archaeological sites/km^2	1654.89	543.48	341.40	268.51	60.62	67.82	43.87	43.97	51.06	41.46	24.52	20.81	16.06	21.27	22.68	16.47
Minimum area visible from **a** random sites/km^2	1778.93	611.82	187.24	90.35	48.39	24.60	9.51	4.18	1.43	0.55	0.06	0.02	0.0027	0.0001	0.0001	-
Maximum area visible from **a** random sites/km^2	2936.66	114.04	602.53	180.28	125.96	88.64	63.29	34.61	32.96	15.79	10.11	4.59	2.94	1.24	0.88	0.74
Number of random groups with values of **a**	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	18
Rank	1	1	14	20	5	19	18	20	20	20	20	20	20	20	20	20
Significance	0.05	0.05	0.35	0.05	0.25	0.05	0.15	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05

Number of sites with visibility of a location (**a**)	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	Weighted average
Area visible from **a** archaeological sites/km^2	14.77	14.39	12.26	14.29	16.84	14.55	8.67	4.14	1.93	0.87	0.18	0.02	0.01	0.0039	0.0018	0.0005	3.23
Minimum area visible from **a** random sites/km^2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.56
Maximum area visible from **a** random sites/km^2	0.35	0.31	0.25	0.07	0.03	0.02	0.01	0.01	0.01	0.0011	0.0009	0.0034	0.0013	-	-	-	2.05
Number of random groups with values of **a**	18	17	16	14	8	7	6	5	3	3	2	1	1	0	0	0	
Rank	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
Significance	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05

Table 7.31: Areas of the study area, which are visible from multiple CEA sites in Co. Donegal and multiple random sets of locations (m = 122, n = 19).

Rectilinear drystone sites with an internal area above 180m²

Results of the statistical tests indicate that only Hypothesis 2 demonstrates a significant difference between RSA sites and the reference set. (Table 7.32; Figure 7.60). Figure 7.61 illustrates that three of the sites have large viewsheds. This may reflect the coastal distribution by most of the sites, in which large vistas over the sea visibility would be expected. Overall, the location of RSA sites may possibly be influenced by visibility of the sea; however there may be additional factors that affect their primarily coastal distribution.

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km^2)					
Mean	24.89	139.08	126.96	19	0.10
Minimum	4.06	31.76	5.07	3	0.15
Maximum	38.67	385.63	323.06	18	0.15
Area of visible sea (km^2)					
Mean	4.04	97.97	112.88	20	0.05
Minimum	-	-	-	-	-
Maximum	10.61	362.73	314.33	19	0.10
Area of visible land (km^2)					
Mean	16.31	48.72	14.08	1	0.05
Minimum	2.82	30.91	5.07	5	0.25
Maximum	26.76	116.98	37.68	5	0.25
Ratio of sea area to land area					
Mean	0.20	15.51	11.74	19	0.10

Table 7.32: Comparisons of visible areas for RSA sites in Co. Donegal (m = 5, n = 19).

All Irregular sites with an internal area above 180m²

All irregular-shaped sites with internal sizes larger than 180m² are included in the statistical analysis due to the small number of sites in this classification. Results of the statistical testing demonstrate a significant difference between the archaeological sites and the random sets only in Hypothesis 4. Table 7.33 demonstrate that the irregular sites produce the largest weighted mean value over all random sets. However, further investigation suggests that the random sets had a higher frequency of sites visible with a particular location. The results for Hypothesis 4 may indicate that there are specific foci areas of only two or three sites, but whether visibility of these areas is an influential factor in site location remains questionable. Figure 7.62 does illustrate that irregular sites may have been strategically located to have visibility coverage over certain areas of the landscape. These include Donegal Bay in the southwest, the northern half of Lough Swilly, where it runs into the Atlantic and the lower ground between Culdaff and Trawbreaga Bay on the northern end of the Inishowen peninsula.

Number of sites with visibility of a location (**a**)	1	2	3	4	5	6	7	Weighted average
Area visible from **a** archaeological sites/km^2	623.24	333.64	95.61	1.14	0.0003	-	-	1.50
Minimum area visible from **a** random sites/km^2	550.35	25.41	0.12	-	-	-	-	1.02
Maximum area visible from **a** random sites/km^2	1298.27	265.85	34.73	4.26	0.11	0.01	0.01	1.31
Number of random groups with values of **a**	19	19	19	15	6	2	1	
Rank	4	20	20	17	15	-	-	20
Significance	0.2	0.05	0.05	0.2	0.3	-	-	0.05

Table 7.33: Areas of the study area, which are visible from multiple irregular sites in Co. Donegal and multiple random sets of locations (m = 17, n = 19).

<u>All Promontory sites</u>

A total of thirty-three promontory sites are analysed for visibility as an influence on the location of sites. Unfortunately over half of these sites lack recorded measurements, in which remaining sites encompass spaces over 180m^2. Similar to the situation in the Northern Ireland section above, all promontory sites are tested as a single group.

The examination of visibility from the locations of all promontory forts suggests that the degree of visibility is an influential factor during the site location process. Results of Hypothesis 1 indicate a significant difference in the mean and minimum values between archaeological sites and the random sets (Table 7.34). However, the significance of the minimum value pertains to promontory sites located in areas with the smallest degree of visibility (Figure 7.63). Hypothesis 2 results demonstrate that the mean value for visibility of the sea is also statistically significant (Figure 7.64). Archaeological sites demonstrate the smallest mean and minimum values for visible land area. This relationship between visible sea and land is confirmed by the results of Hypothesis 3. The ratio mean value for archaeological sites, are statistically significant when compared to the random sets. Figure 7.65 illustrates the archaeological sites as the highest-ranking set with a much larger maximum value than the other sets. The maximum range for the promontory sites is reflecting two extremely large ratio values. However, when both of these values are removed from the mean calculation, the resulting mean value is still higher than those of the reference set. This suggests that the promontory sites are placed in areas that generally have more visible sea area than land. Figure 7.66 illustrates the distribution of promontory sites and their corresponding viewsheds. Results of Hypothesis 4 demonstrate that particular areas in the landscape are visible from a number of archaeological sites. The weighted mean value for promontory set is the largest when compared to the random sets (Table 7.35). There are random locations that have a higher frequency of random sites than the archaeological sites, however the size of the visible area is always larger with the archaeological sites. Figure 7.66 depicts that the majority of the Co. Donegal coastline is covered by the visibility from these sites. The area visible from the highest number of sites is located at Culdaff off the north coast of the Inishowen peninsula. Other areas visible from a high frequency of sites are observed along the north-western coastline between the points of Bloody Foreland and Horn Head and along the northern coastline of Donegal Bay. Interestingly, the sites in Co. Donegal were widely distributed around the Donegal Bay area and did not illustrate the intensity of vista focus observed in other site types in this area. This would suggest that this site type may have functioned as watchtowers or landmarks for sea travellers. Overall, these results suggest that not only is visibility an important factor for site location, but also the amount of visible land may be rejected in order to gain large visible expanses of particular areas of the coastline and the sea beyond.

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km^2)					
Mean	50.15	120.07	209.79	20	0.05
Minimum	0.96	8.35	0.72	1	0.05
Maximum	229.58	880.31	483.65	19	0.10
Area of visible sea (km^2)					
Mean	25.88	93.66	194.05	20	0.05
Minimum	-	-	-	-	-
Maximum	175.45	868.57	478.78	19	0.10
Area of visible land (km^2)					
Mean	20.03	33.80	15.74	1	0.05
Minimum	0.86	8.35	0.32	1	0.05
Maximum	63.45	127.68	71.42	2	0.10
Ratio of sea area to land area					
Mean	0.98	17.78	78.58	20	0.05

Table 7.34: Comparisons of visible areas for all promontory sites in Co. Donegal (m = 32, n = 19).

Number of sites with visibility of a location (**a**)	1	2	3	4	5	6	7	Weighted average
Area visible from **a** archaeological sites/km^2	2331.80	806.69	359.61	71.28	265.24	-	-	1.73
Minimum area visible from **a** random sites/km^2	1188.80	87.69	5.92	0.08	0.0004	-	-	1.07
Maximum area visible from **a** random sites/km^2	2516.80	398.10	129.74	6.75	1.97	0.13	0.0010	1.33
Number of random groups with values of **a**	19	19	19	19	19	12	2	
Rank	19	20	20	20	20	-	-	20
Significance	0.10	0.05	0.05	0.05	0.05	-	-	0.05

Table 7.35: Areas of the study area, which are visible from multiple promontory sites in Co. Donegal and multiple random sets of locations (m = 32, n = 19).

Conclusions

Visibility results indicate that the locations of several site types were influenced by particular vistas. The CSB sites illustrate small viewsheds and possible foci on the small bays in the south-western sector of the study area. The pattern depicted by the CSA sites illustrates locations with large vistas, over the coastline and particular foci on Donegal Bay and the northern coastline. The distribution of the CSB sites is generally in the same locality as the CSA sites. This suggests that the CSA sites may have had control over areas of trade and communication, which non-local objects and ideas may have then passed down to the slightly inland CSB sites. The CSAEA sites have a similar distribution and viewshed results to the CSA sites and may indicate that these sites are variations of the same sites type.

The location of the CEB sites illustrates limited vistas over the surrounding area and a small group of sites overlooking Donegal Bay. The results depicted from this site type suggest that there were other variables that affected the locations of these sites. Visibility results from the CEA sites contrast greatly with the CEB sites. The CEA sites are located in areas with large vistas over both the sea- and landscape. A visibility focus on Donegal Bay is also apparent with these sites. A few sites illustrate large vistas over the northern coastline and Lough Foyle. A comparison of the viewshed results between the two site types illustrates a comparable pattern to the one depicted by the drystone counterparts, CSB and CSA sites. The intensity of CEA sites and their overlapping viewsheds around Donegal Bay indicates that this area is important and probably an area of frequent communication and contact. The number of CEA sites located inland with large vistas also suggest these sites are in prominent locations to view a wide expanse of the surrounding area and also to be observed from a distance. This suggests that the CEA sites are engaged in both outside contact from the sea and inter-site communication.

Results from the promontory sites suggest these sites may have functioned as landmarks or watchtowers and focus on the surrounding seascape. These sites are located in areas with large vistas over the sea and limited visibility of the immediate landscape. Their dispersed distribution along the coastline areas of possible contact, depicted by the curvilinear site types, may support this function. Rectilinear and irregular sites are few in numbers and may have other variables affecting their distribution. The irregular sites do illustrate areas of foci that may suggest these sites are part of a larger group that focuses on the same areas.

7.3 Discussion

Four hypotheses are tested to investigate the affect of visibility on site location by typology. Viewshed data on the areas visible from both archaeological sites and random locations are calculated through the Monte Carlo statistical test. Results from this test indicate whether the visibility from archaeological locations is significantly different from the visibility from random locations. Statistical analyses of the hypotheses are testing whether archaeology sites are located in areas with a large degree of visibility, in areas with a large degree of visibility of the sea, in areas that have larger visible sea areas than land and visually focus on the same areas as other archaeological sites.

The CSB structures indicate two varying patterns of location with regards to visibility throughout the study region. In Argyll, visibilities from these sites overlook the majority of the coastline, especially the section between the west coast of Kintyre and the east coasts of Jura and Islay. The majority of these sites have large degrees of visibility and prefer views of the water. Visibility results on the other side of the Channel are only discernible for the CSB sites in Co. Donegal, in which they do not appear to have relatively large vistas. The visual coverage of coastline illustrated by the CSB sites in Argyll is also not apparent in Co. Donegal. Relatively few sites in Co. Donegal demonstrate a large degree of visibility overlooking the sea, concentrating at Donegal Bay. However, these sites may be representing a small subgroup and are separate from the overall pattern of the classification as a whole. The visibility results imply that the CSB sites in Co. Donegal are not located in areas that maximise visibility, whereas the locations of these sites in Argyll appear to have been strongly influenced by the degree of visibility and views of the sea. This suggests that the factors influencing CSB sites differ from Argyll to Co. Donegal. Sites in Argyll are more focused on looking towards to the sea, along places of possible contact or a major sea route, whereas sites in Co. Donegal are located slightly inland and do not focus on the sea or coastline. This may indicate that these sites embodied varying roles within the structure of their respective societies.

Conversely the CSA sites demonstrate a similar pattern between visibility and site location in both Argyll and Co. Donegal, but not for Northern Ireland. Sites in both Argyll and Co. Donegal prefer locations with large vistas, especially towards particular beaches and bays along the coastline. These include Machhrihanish Bay, Loch Crinan and Loch Melfort in Argyll and Donegal Bay, Trawbreaga Bay, Sheep Haven and Ballyhernan Bay in Co. Donegal. Sites in Northern Ireland did indicate a preference for sea visibilities as opposed to land, however this finding may be skewed by the viewshed from a single site, considering none of the other sites had extremely large vistas. These results may indicate control over areas of port for contact in Argyll and Co. Donegal. The geographical distributions of these sites differ, where sites in Argyll are located slightly inland and sites in Co. Donegal are located along the coastline.

Sites classed as CSAEA demonstrate that visibility is not an influential factor for site locations in Argyll and Northern Ireland, but affects site location in Co. Donegal. The three sites in Argyll may actually be representatives of a larger classification group, due to the large viewsheds produced from these sites. The distribution of these sites in Northern Ireland may reflect other underlying factors, which would differentiate them from the sites in Co. Donegal. The site locations in Co. Donegal have similar associations with visibility as those observed with the drystone constructed sites and may reflect a further extension of the drystone site type. The visibility results for all three sets indicate different patterns; however the sites in Argyll and Co. Donegal may in actuality be part of a broader classification group.

The earth-constructed sites in Co. Donegal and Northern Ireland demonstrate different relationships with visibility. The CEA sites in Northern Ireland demonstrate that the degree of visibility has no affect on site location, but rather sites are positioned in the landscape to view specific areas, particularly large sea lochs and the northern coastline. Sites in Co. Donegal appear to be located in areas with large vistas, especially of the sea and are also positioned in areas to view specific locations in the landscape. Examination of the distribution of sites and the corresponding viewsheds implies that the visibility of sites along the coasts in Co. Donegal and Northern Ireland appear to focus on similar landscape settings, the coastline and large bays or sea lochs. This may indicate places of communication and contact that the coastal CEA sites controlled. Both study areas also illustrated high frequencies of this site type located inland. This suggests a scenario where the inhabitants of the coastal sites managed contact from the sea and trade and ideas filtered inland.

The visibility results for RSA sites in all three areas do not give conclusive evidence that these sites are linked. Only the sites in Argyll indicate that visibility is an influential factor for site location. These sites prefer locations with large degrees of visibility, particularly of the sea, with coincidentally small amounts of visible land. Results for sites in Co. Donegal did indicate that two of the sites had extremely large degrees of visibility of the sea, however the distribution of these sites do not provide any evidence for association with the Argyll examples. Sites in Northern Ireland are too few in numbers to state any conclusive assumptions.

The irregular shaped sites in all three areas demonstrate varying results regarding site location and visibility. Three of the subclasses of irregular shaped sites in Argyll, ICSA, IRSA and IISA, indicate visibility is influential on site location, but not for smaller sized subclasses. Irregular sites in Co. Donegal and Northern Ireland are few in numbers, in which subclasses are examined as a single irregular-shaped category. Analyses on sites in Co. Donegal indicate these sites are possibly located to view specific areas of the landscape. Sites in Northern Ireland are found to be located in positions with a large visibility range, particularly over the sea. These results suggest that in Northern Ireland site locations are strongly influenced by degree of visibility, whereas in Co. Donegal sites are located in areas that view specific portions of the landscape. The sites in Argyll demonstrate both of these traits.

The promontory sites in all three areas demonstrate the influence of visibility on site location. Visibility from sites in Argyll appear to cover the coastlines and the surrounding sea around the islands of Islay, Jura, Colonsay and Mull, resembling a 'buffer' around this particular part of Argyll. Sites in Northern Ireland demonstrate views across the northern and north-eastern coastlines, where as the visibility from sites in Co. Donegal view particular sections of the coastline. These results may indicate site locations are influenced by the degree of visibility over specific sections of the coastline for purposes of visual control over areas or as landmarks for sea travellers. The promontory sites in all three study areas demonstrated dispersed distributions, particularly along the coastlines, which may further support this point.

The visibility results in Argyll demonstrate that AFCB sites are located in areas with large degrees of visibility, particular of the sea. The AFCA sites, however, tend to be located in positions with larger visible land areas. Visibility results for sites with architectural features in Co. Donegal and Northern Ireland are too few in numbers to discern conclusive assumptions on links between all three areas in regards to location and visibility.

Overall, the viewshed analyses demonstrate the locations of particular site classifications are influenced by the degree of visibility and the desire to view specific areas in the landscape. Comparable patterns are discernible in the CSA sites in Argyll and Co. Donegal, CEA sites in Northern Ireland and Co. Donegal and promontory sites in all three study areas. Localised patterns in regard to site location and visibility are also detected for particular site classifications. These included CSB sites and all large irregular site variations in Argyll. Results also suggest the settlement pattern are more complex and additional factors are affecting their distributions.

Chapter 8: Settlement and Seaways: discussions and conclusion

8.1 Introduction

The analyses conducted in this research were employed to investigate the settlement patterns in the North Channel region in order to determine the intensity of communication between groups during the 1st millennium BC and AD. Popular texts imply that either a population or a single dynasty of Scots emigrated from Northern Ireland into Argyll (Duncan 1992; Laing 2006; Macdonald 1950; Marshall 1998; Ó Cróinín 1995). Many, however, have indicated that the archaeological evidence fails to support this Irish origin of the Dalriadic kingdom in Argyll (Alcock 1970, 1972; Ritchie 1997a; Campbell 1999). The focus of this research was not on the migration theories, but rather to investigate cross-channel influences and contacts through settlement evidence. Three aims were employed to achieve this objective. The first considered the morphology of sites and applied a common classification scheme to all three study areas. Comparability between sites across the channel was then aptly assessed. Several sites across the study areas suggested shared traditions or exchange of architectural traits, whereas unrelated sites suggested more localised development. The second aim investigated the level of influence specific environmental variables had on the location of each site type. The intention was to determine whether there were similar distributions among comparable site classifications between the areas. The results indicated that site typologies in Co. Donegal reflect comparable patterns to the equivalent site types in Argyll but varied slightly from those in Northern Ireland. Settlement distributions in Argyll and Northern Ireland demonstrated distinct patterns. The third aim examined the relationship between site classifications and factors of visibility discerned from those locations. Factors included the degree of visibility, amount of land- or seascape within the visibility range and areas of visual focus from multiple sites. Investigations of these factors helped determine whether comparable site types had similar vistas and to establish important sea routes or ports in the maritime environment. Results indicated areas of interest possibly associated with contact along the coastlines, probable sea routes overlooked by contemporary site types and variations in the vistas between comparable site type locations between the study areas.

8.2 Patterns of contact

Results from the analyses demonstrate evidence of communication and the exchange of ideas between Scotland and Ireland with stronger affiliations apparent between Co. Donegal and Argyll than with Northern Ireland. The general pattern in the North Channel area indicates that during the 1st millennium BC sites in Co. Donegal and Argyll are comparable and located in areas of contact, assuming the majority of curvilinear drystone sites would have been in occupation at this time. The results of curvilinear sites by size, however, suggest different societal organizations in the two areas. By the end of the 1st millennium BC, climatic decline may have affected agricultural limits and restricted the amount of sustainable land for habitation across the entire study region. Settlements located at higher altitudes may have subsequently been abandoned. Societies began to retract and focus on localised networks and concentrated on land routes. Trade and communication across the North Channel may have reduced. The landscape of Northern Ireland encompasses large areas of fertile soil in the lowlands. The population in Co. Donegal may have taken advantage of these opportunities and relocated further east. The settlement structure may have been affected through the changing environment and population movements. This may have sparked the development in Northern Ireland of the large rampart enclosures of earth or stone and earth construction. A change in the morphology of structures and the re-organization of the society are apparent in Argyll during the 1st millennium AD, perhaps caused by decreased contact with Co. Donegal and the climatic conditions. Later in the 1st millennium AD, climatic conditions improved and Northern Ireland became more populated. Areas in Co. Donegal were re-inhabited. Large curvilinear earthen enclosure sites began appearing and the higher elevations were re-populated. Coastal trade and communications possibly expanded again, in which sites in Co. Donegal (e.g. Drumboghill (DN-130)) have comparable architectural features to Early Historic sites in Argyll (e.g. Kildonan Bay (AR-073)).

Patterns of contact interpreted in the study region indicate that sites in Northern Ireland demonstrate broadly shared traditions with sites in Co. Donegal, observed in the distributions of the large curvilinear earthen enclosure sites. The patterns between Northern Ireland and Argyll contrast greatly, suggesting there was minimal communication between these two areas. The Northern Irish communities may have had more affiliations with the settlements across the Irish Sea in Galloway and to the west with Co. Donegal. The distribution of comparable sites and the visibility evidence from sites in coastal areas suggest these sites in Co. Donegal looked towards the sea and had connections to the north with Argyll, to the south with western Ireland as well as to Northern Ireland in the east. Figure 8.1 illustrates the potential sea routes discussed for this region.

Several important patterns are deduced from the results. Firstly, there are broad comparisons between the sites in Argyll and Co. Donegal during the 1st millennium BC. Around the turn of the millennium, an event or series of events caused a dramatic change in the settlement structure throughout the study region. This is reflected in the appearance of rectilinear and irregular sites in Argyll and the introduction of the large earthen enclosure in the northern part of Ireland. During the 1st millennium AD communication links are evident between sites in Co. Donegal and Argyll. Sites in Co. Donegal also demonstrate some affiliations to sites in Northern Ireland during the 1st millennium AD, possibly as a result of population movement. The overall settlement patterns in Northern Ireland are very different from those in Argyll and Co. Donegal, in which evidence from a few known sites suggest communication with areas outside of the study region, possibly eastwards across the Irish Sea towards Galloway.

8.3 The drystone curvilinear sites: geological phenomenon or shared tradition

As discussed in Chapter 4, the smaller curvilinear drystone sites (CSB) represent the settlement evidence typical during the 1st millennium BC. The evidence recovered at excavated sites in Argyll suggests that smaller, simple, circular drystone sites appeared during the 1st millennium BC (e.g. Rahoy (AR-149)). Unfortunately, 1st millennium BC evidence from sites in Ireland is generally sparse. A number of the drystone sites in the west, however imply probable origins in the mid- to late 1st millennium BC (Gilmour 2000; Henderson 2000b). Excavations on the larger hilltop curvilinear drystone sites demonstrate occupation during the 1st millennium BC in Argyll and to an extent in Ireland, though none have been excavated in Co. Donegal (e.g. Duntroon (AR-700) and Eilean an Duin (AR-894) in Argyll, Mooghaun (Co. Clare) and Rathgall (Co. Wicklow)).

Chapter 4 discussed the differentiation of material used for the construction of a site (i.e. drystone, earthen or stone and earth rampart), which previously had been attributed to the local geology of Ireland rather than social or functional motives (Cotter 1993; Lacy 1983; Limbert 1996). Henderson (2000b) noted that the drystone sites are lacking in areas with a high concentration of earthen raths. This is supported by the distribution evidence in eastern area of Northern Ireland (Figure 8.2) (see also Buckley & Sweetman 1991). The earthen enclosures were often detected alongside the drystone sites in the west. This is particularly evident in the central and south-west areas of Co. Donegal. From this distributional pattern Henderson (2000b) suggested that these sites may not be contemporary and that the drystone examples may date earlier (*contra* to explanations using geology). He implied that the drystone oval domestic enclosures were an Atlantic west development. Most of the dating evidence for occupation dating to the 1st millennium BC was recovered in the west, which may support an earlier occupation for the drystone sites than their earthen counterparts.

As illustrated in Figure 8.2, the proportion of curvilinear drystone sites to earthen enclosures is highest in Argyll and the lowest in Northern Ireland, whereas the sites in Co. Donegal are almost divided in half. This may indicate a continuation of the drystone tradition in Argyll, which is supported by the excavated evidence (e.g. Rahoy (AR-149) and Duntroon (AR-700) in the 1st millennium BC and Kildonan Bay (AR-073) and Dùn Fhinn (AR-311) in the 1st millennium AD). The drystone sites in Co. Donegal possibly reflect a 1st millennium BC architectural tradition concurrent with the sites from western Ireland and Argyll. This may also be supported by the distribution of sites by size, where the proportion of CSB sites in Argyll are 71% of the total curvilinear sites and 21% of the curvilinear sites in Co. Donegal (Figure 8.3). Though this group is smaller in numbers, there are sites in Co. Donegal comparable to those in Argyll by shape, size and construction. There are also particular architectural features noted on several sites in Argyll and to a lesser extent in Co. Donegal.

These include 'guard chambers' off the entrance and intramural cells and passages observed at Doon Glebe (DO-118) and Gortnatraw South (DO-164) in Co. Donegal and at Druim an Duin (AR-103) and Dun Glashan (AR-169) in Argyll and may therefore indicate the exchange of architectural traits between the two areas.

Results from Chapter 6 demonstrate the correlation between the elevation variable and drystone sites. Argyll and Co. Donegal have comparable distributions, whereas sites in Northern Ireland reflect a distinct pattern. Only two CSB sites are detected in Northern Ireland; no pattern could be determined. Sites in Argyll and Co. Donegal illustrate comparable distributions across the elevation ranges where site locational preferences in Argyll are between sea level and 120m OD and sites in Co. Donegal are from 21m OD to 130m OD. This suggests that the preferred altitude range for CSB site locations are below 130m OD. The larger drystone enclosures (CSA) sites from Argyll and in Co. Donegal demonstrate a comparable pattern to those observed in the CSB sites. The majority of sites in Argyll are located in elevations between sea level and 120m OD and sites in Co. Donegal are distributed in the slightly narrow range from sea level to 100m OD. The distribution of CSA in Northern Ireland demonstrates a varied pattern, in which these sites are located at altitudes between 11m OD and 210m OD, but have significant distributions at higher altitudes between 81m OD and 130m OD. Sites in Argyll and Northern Ireland are also found to be significantly distributed on opposing aspects (i.e. southern and south-western hillsides in Argyll and north and north-eastern hillsides in Northern Ireland). This indicates that the locational rationale for drystone structures in Argyll and Co. Donegal had similar preferences concerning elevation, but higher altitudes were preferred for sites in Northern Ireland. Therefore, this suggests that drystone sites in Co. Donegal are more comparable to those in Argyll than in Northern Ireland regarding site type and distribution. Sites in Northern Ireland are demonstrating a distinct pattern, possibly indicating different influences than the ones that were affecting Co. Donegal and Argyll (further discussed under Section 8.3).

Results on visibility from CSB sites indicate that site locations in Argyll and Co. Donegal are influenced by different visibility features (see Chapter 7). The CSB sites in Argyll are typically located in areas with large vistas, particularly of the sea. These sites are not found to have a focus on specific areas in the landscape, the illustration of their combined viewsheds depict widespread visual coverage over a large area (Figure 8.4). The most significant focuses appears along the Atlantic Ocean up through Loch Linnhe to the start of the Great Glen and around the western side of the islands. This possibly indicates a network of sites that visually overlook and are linked by major sea routes. Several sites along the coastline are located on easily accessible locations at the edges of sandy bays, particularly those along the narrow strip of good arable land on the western coast of Kintyre, for example at Machrihanish and Bellochanty Bay. A cluster of sites on the fertile land of Lismore provide dominance over the seascape leading into the entrance of the Great Glen. In other areas in the northern section of the study area where the coastline is rocky and docking areas are limited, sites are found to be overlooking the coastlines from cliff edges, rock stacks and rocky knolls, such as sites in the Crinan area, along Loch Sween and on Mull. The location of sites in areas of large vistas and easy access to the sea may reflect a society that is part of a wider communication network along major sea routes and beyond. Sites with architectural features may further support this by their distribution spread throughout Argyll as opposed to concentrating in a particular area. A number of sites along the coastlines of the islands demonstrate large viewsheds that also imply a desire to focus on the sea. This may indicate secondary sea routes along the western edges of the Argyll study area and illustrate traffic sailing towards the Outer Hebrides to the north (refer to Figure 8.1).

The visibility results from CSB sites in Co. Donegal demonstrate a different scenario than that observed in Argyll and are possibly skewed by the small concentration of sites and their large vistas near Donegal Bay. The results indicate these sites are located in areas that had visibility of particular focal points in the landscape. The visibility from several of these sites is small and did not appear to look towards the surrounding seascape or features in the landscape. Most of these sites are located slightly inland or along inlets and on easily accessible locations such as undulating land, hillsides or small knolls, in which visibility may be restricted by the surrounding topography. Surprisingly, a small cluster of sites on the northern coastline did not exhibit large views, nor did the views extend north towards the sea. The distribution of these sites and their associated viewsheds may imply a small isolated community, in which contact is limited to sites within the immediate vicinity rather than across the sea. A number of the larger CSA sites are distributed in this area, which may be contemporary with these smaller sites (*infra*). The remaining CSB sites, littered around the coast of the western-most point of the study area, demonstrate larger degrees of visibility, but not to the same extent of those in Argyll. These sites are also surrounded by the larger drystone enclosures. The CSB sites are located slightly inland, in which trade and exchange from the sea may have reached the CSB sites from the larger CSA. This may be indicating a very different social organization of the settlements in Co. Donegal to those in Argyll.

The majority of CSA sites in Co. Donegal are distributed along the northern and western coastlines. The visibility results implied that the CSA sites are located in positions that looked outward towards the sea and focused on the easily accessible coastal bays. This suggested that the sites in Co. Donegal are located in areas of access for trade and communication both to the north towards Argyll and to the south towards western Ireland (Figure 8.5). CSA sites along the north coast around Fanad are located within easy access of sandy bays and had large vistas over these areas (e.g. Downies (DON-120), Breughy (DO-59) and Munroe (DO-215)). These sites may have been controlling coastal communication and contact rather than the CSB sites. The exchange of ideas and architectural traits may have filtered through the CSA sites to the CSB sites. The comparable architectural features observed on several sites may also support these north coast connections with Argyll. The location of the site Doon Glebe (DO-118), in the valley of the River Swilly, illustrates the movement of architectural features inland. This site is comparable in construction and architecture to sites in Argyll (e.g. Loch Glashan (AR-169)). A similar scenario to the sites in the Fanad area is found in the Donegal Bay area, where the CSA sites are near the coast and the CSB sites are further inland. Sites are visibly lacking in the north-west section of Co. Donegal, where blanket bog with little soil cover may have greatly inhibited agriculture sustenance.

CSA sites in Argyll have large vistas, frequently of the sea and focus on particular areas in the landscape. Figure 8.5 illustrates the largest focus on the area between Kintyre and the islands, Islay and Jura. These sites are located further inland than their smaller counterparts and appear to overlook areas where contact occurred, such as Machrihanish Bay and the area around Crinan (e.g. Largiemore (AR-859) and Duntroon (AR-700) respectively). This may suggest that areas, in which the CSB sites along the coastline are points of contact of important ports. Sites that are in conspicuous locations within the landscape may have been landmarks for sea travellers or defensive positions designed as watchtowers (e.g. An Dun, Islay (AR-164) and Dun Skeig (AR-838)).

The rectilinear and irregular drystone sites in Argyll are generally dated to the 1st millennium AD, which supports a continuation of drystone construction tradition in this area (e.g. Dùn Fhinn (AR-311), Ugadale Point (AR-074), Kildonan Bay (AR-073) and Eilean Righ I (AR-230). Irregular and rectilinear drystone sites are apparent in both Co. Donegal and Northern Ireland, however none of these sites has been dated. Broad similarities are observed in architectural features on irregular sites between Co. Donegal and Argyll (e.g. Drumboghill (DO-130) in Co. Donegal and Kildonan Bay (AR-073) in Argyll. The coastal distribution of these sites in Co. Donegal suggested they might be a product of interactions between Scotland and Ireland during the 1st millennium AD. Similar to their distribution in Northern Ireland, the sites are too few to indicate comparable patterns to those in Argyll. This would indicate that these site types are not the primary structure type during the 1st millennium AD, contra to Argyll.

8.4 The northern part of Ireland during the 1st millennia

Chapter 3 reviewed the paleoenvironmental evidence, which suggests a climatic decline around the end of the 1st millennium BC that lasted through the first few centuries of the 1st millennium AD. The decline in climate would have affected agricultural subsistence and upland areas would have become increasingly marginal (Askew *et al*. 1985). Sites located at higher altitudes may have been abandoned or switched from arable subsistence to pastoral. Drystone curvilinear sites at higher altitudes in Co. Donegal are generally located in the valleys of the Swilly and Foyle rivers that are well suited for agriculture. During the period of climatic decline, several of these sites may have been abandoned for locations at lower altitudes. Populations may have opted for less marginal soils in the lowland areas lying to the east, in Northern Ireland. The distribution of drystone curvilinear sites in Co. Down, along the eastern end of the Drumlin Belt, may have also witnessed an influx of populations from more western areas along this belt. The complex at Navan, Co. Armagh (Chapter 4, Section 4.4.1) may also support this settlement restructuring, in which the site may have changed from an elite domestic place to a 'royal' centre for trade, during the period of climatic decline at the turn of the millennium.

The drystone settlement evidence in Northern Ireland was briefly discussed in the preceding section and suggested settlement patterns distinct from those observed in Argyll and Co. Donegal. Only two out of the thirty-seven drystone curvilinear sites measure below 180m² internally, which is a very low proportion compared to the 1118 earthen enclosures in Northern Ireland. This further illustrates the difference in site construction type between Northern Ireland and the other two study areas, suggesting less contact with settlements of drystone building tradition in Argyll. The larger drystone enclosure sites in Northern Ireland demonstrate a distribution pattern inconsistent to both Argyll and Co. Donegal. These sites are located in greater proportion at altitudes higher than those observed in the other study areas. Only eight of these sites are located within the viewshed test area, in which visibility is not a significant factor for site location. The architectural features observed on sites in Argyll and Co. Donegal are absent in most sites. One of the most well-known sites, Altagore (NI-055), near the north-eastern coastline of Co. Antrim, has an intramural passage and a line of stones protruding from the interior wall face acting as steps leading up to the top of the wall. This stone step feature is not known on any of the sites in Argyll and Co. Donegal. The site Castle Haven, Borgue, Dumfries and Galloway (NX54NE 3) incorporates both intramural passages and similarly placed stone steps (Figure 8.6) (RCAHMS 1914). It can also be noted that several sites typified as 'homesteads' in Galloway also demonstrate comparable features to those in Northern Ireland (cf. Stout 2000 and Henderson 2000b). In the context of Galloway, the term 'homestead' is used to describe small defended settlements typically measuring 17m to 24m internally and constructed of both earthen ramparts and drystone walls (Cavers 2005). For example, the site Airyolland I, Mochrum, Dumfries and Galloway (NX34NW 14), consists of an enclosure constructed of earth and stone and is 24m in internal diameter. This site is in a non-defensive location and is comparable to the 'ringfort' sites in Northern Ireland (G. Cavers pers. comm.). Contact between Ireland and Galloway has been suggested due to the number of place-names of Irish origin on the Galloway peninsula (Cunliffe 2001; Nicolaisen 1976). These connections suggest that the communities in Northern Ireland were more affiliated with areas across the Irish Sea to the south-east rather than to the north-east, in which influences in architecture may be coming from Galloway rather than from population movements from the west Ireland.

The highest proportion of sites in both Co. Donegal and Northern Ireland are the larger curvilinear earthen enclosure (CEA) sites. Debates on whether activity associated with the enclosing bank at these sites solely date to the later half of the 1st millennium AD have proved irresolvable (cf. Henderson 2000b; Hirons & Sheridan 1986; Lynn 1983; O'Sullivan 1998; Stout 2000). Excavations have demonstrated that the majority of material evidence recovered from several of these sites suggests occupation during this time. However, excavation evidence, e.g. artefacts and structural foundation gullies, has also indicated earlier activity at a few of these sites (Chapter 4). This may suggest a transition between CSA sites and their CEA counterparts occurring around the beginning of the 1st millennium AD contemporary to the period of climatic improvement.

Though the CEA are similar in size, shape and construction, their distribution patterns demonstrated variations between Co. Donegal and Northern Ireland. Results from Chapter 6 indicated that site locations in both study areas were affected by elevation and slope aspect. A significant number of sites are detected on northern and north-western facing slopes though their distribution throughout the elevation variable varied. Sites in Co. Donegal illustrate a slightly larger distribution from 11m OD up to 130m OD, similar to the CSA sites (sea level to 100m OD). A significant number of sites in Northern Ireland are found in a narrower distribution at elevations between 51m OD and 120m OD fairly similar to the CSA sites in this area (81m OD to 130m OD). Two points can be made from these elevation distribution observations. The first suggests that the location rationale of earthen enclosures is more influenced by their immediate neighbours, the (possibly) earlier drystone sites and prefer similar locations; such as lower elevations in Co. Donegal and higher elevations in Northern Ireland. The second reiterates Henderson's (2000b) findings that earthen enclosures are found alongside the drystone sites. If geology was the underlying factor of construction material choice, then the expected frequencies of earthen enclosures in Northern Ireland should be much higher on lower altitudes. The distribution of the larger earthen enclosures with preferences for the similar altitudes as the drystone sites in Northern Ireland suggest geology might not influence the choice of construction material.

The location of CEA in Co. Donegal and Northern Ireland are both influenced by the visibility features of the landscape, but also demonstrate varying patterns. Several of the site locations in Northern Ireland have large vistas, however there are other locations in the landscape that have more expansive views. Results from Chapter 7 indicated that these site locations are chosen in order to view particular areas in the landscape rather than to view large areas of the surrounding landscape (Figure 8.7). The highest concentration is on the western coastline along Belfast Lough. A number of these sites along the northern coastline of Northern Ireland illustrate large vistas over the mouth of the River Bann and over Lough Foyle. This suggests that the sites along the eastern coast may be located in areas to observe sea traffic from the east, travelling through Belfast Lough. Sites along the northern coastline may be looking outward to the Atlantic to observe traffic coming through the River Bann. This may also indicate that the location of these northern sites were either influenced by earlier drystone inhabitants from Co. Donegal and Argyll or that several of these earthen enclosures may date earlier.

In Co. Donegal, areas with larger views of the surrounding land and seascape influence the locations of CEA sites (Chapter 7). Figure 8.7 also illustrates an extremely high concentration of sites with views focusing on Donegal Bay. This is the western end of the drumlin belt, where a high number of the earthen enclosures are located. Several of these CEA sites are located within a couple of kilometres of the coastline and most have views over large parts of the bay. This suggests that the coastline and beaches around Donegal Bay is an important area of interest on the south-west coast, indicating an area of frequent contact. The northern section of the study area illustrates two patterns between visibility and site locations. A group of sites located along the eastern coastline of the Inishowen peninsula overlooking Lough Foyle may illustrate a network with the sites from Northern Ireland. This suggests these sites are affiliated by a desire to visually oversee and control this body of water and contact with sea travellers using this route. The second pattern is observed in the small number of earthen enclosures along the northern coastline, particularly around Horn Head and Fanad, where high frequencies of drystone sites are located. This suggests that contact over the Atlantic to the north has possibly decreased, in which sites are located more inland or that some of the drystone sites were re-inhabited at this time. Excavations at Rinnaraw (DO-221) do suggest activity dating to both late 1st millennium BC and late 1st millennium AD.

The number of CEA sites and the excavation evidence in the northern part of Ireland suggests this type of structure was the principal occupation dwelling during the 1st

millennium AD. As discussed in the previous section, rectilinear and irregular sites are detected in both Co. Donegal and Northern Ireland, but are too few in number to detect comparable patterns between Scotland and Ireland. Similar architectural features are noted between sites in Co. Donegal and Argyll, such as the characteristic V-formation double staircase observed at Drumboghill (DO-130) and Grianán Ailech (DO-018) in Co. Donegal and at Kildonan Bay, Argyll (AR-073). Other comparisons are observed in the intramural guard-cell with a stepped entrance in the sites main entrance passage at both Drumboghill, Co. Donegal and Ardifuar 1 (AR-401), Argyll. This suggests that there is an exchange of architectural ideas between the two areas, however the structural representation of society represented through the morphology of the site varied greatly. Contact between Co. Donegal and Argyll during the 1st millennium AD is apparent, however the settlement evidence suggests localised rather than shared patterns between the two areas.

8.5 Landmarks for sea travellers and warning systems for settlements

As discussed under Section 8.2, a few of the CSA sites located at the higher altitudes may represent watchtowers or landmarks for travellers along the sea. The locations of the promontory sites throughout the study region also suggest their use as watchtowers or landmarks. The majority of these sites are distributed along the coastlines with a few examples located inland. Promontory sites have large internal spaces in all three areas. Smaller sized examples in Argyll and Co. Donegal are of comparable sizes measuring internally below 300m^2, however there are a number of sites in the latter area that encompass areas larger than 1000m^2 unlike the site in Argyll. Excavation evidence recovered from these sites also indicates intermittent periods of activity over a long span of time during the 1st millennium BC and AD.

These sites are located on relatively low altitudes but generally in prominent positions. Statistical testing demonstrates significant relationships between the larger promontory sites in Argyll and Co. Donegal and elevation, but not for Northern Ireland (Chapter 6). The sites in Co. Donegal are located preferentially at altitudes between sea level and 20m OD. Correlations are found between the larger promontory sites and all three environmental variables in Argyll. The location rationale for these sites illustrates a preference for a slightly broader elevation range, from sea level up to 50m OD. This suggests that elevation influenced the locations of promontory sites in both Co. Donegal and Argyll, whereas site locations in Argyll are also affected by slope and aspect. These results indicate that the influence of altitude ranges influenced the location of these sites similarly in both study areas.

The viewshed results indicate that visibility is a strong influence over the location of this site type in all three study areas (Chapter 7). Considering these sites are classed as promontory enclosures and are mostly located on headlands, these results are to be expected. In general, locational choices for these sites preferred areas with large vistas, particularly of the sea and are in positions that had direct views over specific areas. As a group, these sites illustrate visibilities that covered most of the inhabited coastlines, for each respective study area. Figure 8.8 illustrates the cumulative viewsheds in each region. In all three areas the large promontory sites are situated along the coastlines in locations that provided overlapping views of the surrounding sea. These sites appear to form a buffer around each study area, where every section of the coastline and the surrounding waters that have easy access to other coastal sites and might provide safe harbourage have visual contact with the promontory sites. Along the coastlines of Co. Donegal and on the islands in Argyll these sites are either located in isolation or near other drystone sites, including curvilinear, rectilinear and irregular. This suggests the promontory sites in these areas may have a correlation with the drystone sites and provided a visual warning system, similar to beacons, for the sites further inland (e.g. near the Fanad area in Co. Donegal and around the coastline of Islay). Sites located in isolations may have provided landmarks or lighthouse-like purposes for sailors travelling around areas that were less inhabited, such as the north-western point of Co. Donegal or the northern coastline of Northern Ireland. Sites in Northern Ireland are more widely dispersed than the other two study areas. Most are located along the northern coastline. Three visually overlook the area where the River Bann flowed into the Atlantic, which may suggest a watchtower-like effect over an area of sea traffic leading inland. The area of Kintyre in Argyll is distinctly void of promontory sites, however is highly populated by drystone sites. The promontory sites across the water on Islay may have provided warning for the sites on Kintyre.

Sites in Northern Ireland illustrate less overlapping viewsheds and have a widely dispersed distribution along the northern and north-eastern coastline, possibly suggesting less of a reliance for utilising this site type as watchtowers. In Co. Donegal, the distribution of sites and their corresponding viewsheds are more comparable to the pattern observed in Argyll. Tight clusters of sites on the coastline noted in Argyll and Co. Donegal may highlight certain areas of importance for sea travel. The widely dispersed distribution of sites in Northern Ireland may have reflected their use as landmarks along the high coastal cliffs for sea travellers.

8.6 Conclusions

Patterns demonstrated by the drystone curvilinear sites suggest the societies of Argyll and Co. Donegal were in contact, but were structured very differently. In Argyll, the CSB sites are located at points of contact and communication and illustrate large views over the coastlines. The CSA sites also exhibit large vistas and focus on particular areas, but are located further inland or on locations with difficult access to the shore. This suggests that the CSA sites contemporary with CSB sites may have represented places of communal gatherings, in which the purpose of these sites were more related to the immediate community rather than outside contact. Trade and architectural traits from across the sea would have been brought to the CSA sites from the inhabitants of coastal CSB sites. In Co. Donegal the pattern is reversed, in which the visibility from the CSB sites is much smaller and focuses on the immediate landscape compared to the large viewsheds and seascape foci from the CSA sites. The number of CSA sites is much larger than that of the CSB sites and are located within easy access of the shore, which suggests this is where contact from across the sea occurred. The inhabitants of the CSA sites would have brought trade and architectural ideas to the sites further inland. This may also suggest that a high number of CSA sites were in occupation during the 1st millennium BC and reflected the domestic structures for a large social group, therefore indicating varying societal organisations between the two areas.

The appearance of the earthen enclosure in the northern part of Ireland as the primary occupation dwelling was probably during 1st millennium AD, possibly affected by climatic changes. This contrasts with the rectilinear and irregular shaped drystone sites in Argyll. Comparable architectural features and interpretations of the visual foci from sites during this period suggest communication between Argyll and Co. Donegal. The evidence from promontory sites suggests possible watchtowers and landmarks for sea travellers, which may have been utilised through the 1st millennia. The evidence from Northern Ireland indicates this was at a lesser extent.

The evidence interpreted from the analyses does indicate communication and contact between Scotland and Ireland. However, stronger affiliations appear to have formed between Argyll and Co. Donegal rather than with Northern Ireland, particularly during the 1st millennium BC. This perhaps involved years of intermarriages between the two areas, which led to the later claims of Irish ancestry for the royal dynasties of Argyll. The alleged migration of the Scots was during a period of climatic decline and societal re-organization. This migration was also 'recorded' centuries after the event. During the establishment of the Dál Riata in Argyll, societies were flourishing, supported by the presence of high status objects. At this time the kinglists and genealogies were created, perhaps to substantiate claims of royal ancestry and referenced old communication links with Ireland that were actually with Co. Donegal rather than Co. Antrim.

8.7 Future Research

The statistical and GIS approaches incorporated into this research have demonstrated an appropriate utilisation of these tools for the investigation of prehistoric and Early Historic settlement patterns. Meaningful interpretations have been demonstrated from the analyses results. The inclusion of both environmental and cultural variables has provided a broader picture of the settlement patterns in each of the study areas. The analyses have demonstrated that several of the site classifications are affected by both environmental and visual variables and others were not. Future work may highlight other underlying locational influences that may explain outlier sites and site classifications that were not affected by the variables investigated in this research. These might include distances to water or soil coverage. Investigation into the settlement patterns in areas outside the study region may also provide further insights. The distribution of site in Galloway may further compliment those observed in Northern Ireland.

Bibliography

Admiralty Chart. 1886. *Scotland: West coast.* Number 2635.

Alcock, L. 1970. "Was there an Irish Sea Culture-province in the Dark Ages?" in D. Moore (ed.) *The Irish Sea Province in Archaeology and History.* Cardiff: Cambridge Archaeological Association. pp 55-65.

Alcock, L. 1972. "The Irish Sea Zone in the Pre-Roman Age." in C. Thomas (ed.) *The Iron Age in the Irish Sea Province.* London: Council for British Archaeology. pp 99-112.

Alcock, L. 1993. *The neighbours of the Picts: Angles, Britons & Scots at war and at home.* Groam House Museum Trust.

Alcock, L. 2003. *Kings and Warriors, Craftsmen and Priests in Northern Britain AD 550-850*. Edinburgh: Society of Antiquaries of Scotland, Monograph Series.

Alcock, L. & E.A. Alcock. 1987. "Reconnaissance excavations on Early Historic fortifications and other royal sites in Scotland, 1974-84: 2, Excavations at Dunollie Castle, Oban, Argyll, 1978". *Proceedings of the Society of Antiquaries of Scotland,* **117**: 119-147.

Aldenderfer, M. & H.D.G. Maschner. (eds.) 1996. *Anthropology, Space and Geographic Information Systems.* Oxford: University Press.

Allen, K.M.S., S.W. Green, & E.B.W. Zubrow (eds). 1990. *Interpreting Space: GIS and Archaeology.* London: Taylor and Francis.

Ambos, E.L. & D.O. Larson. 2002. "Verification of virtual excavation using multiple geophysical methods: Case studies from Navan Fort, County Armagh, Northern lreland". *The Society for American Archaeology Record* **2:** 32-38.

Anderson, J. 1878. "Notes on the Structure, Distribution, and Contents of the Brochs, with special reference to the question of their Celtic or Norwegian Origin". *Proceedings of the Society of Antiquaries of Scotland,* **12**: 314-355.

Anderson, M.O. 1980. *Kings and Kingship in Early Scotland*. Edinburgh & London: Scottish Academic Press, 2nd ed.

Anderson, A.O. & M.O. Anderson. (ed. And transl.) 1991. *Adomnan's Life of Columba.* 2nd ed, Oxford.

Andresen, J., T. Madsen & I. Scollar (eds.) 1993. *CAA92 Computer Applications and Quantitative Methods in Archaeology*, Aarhus University Press.

Armit, I. (ed.) 1990a. *Beyond the Brochs: Changing Perspectives on the Atlantic Scottish Iron Age*, Edinburgh.

Armit, I. 1990b. Broch Building in Northern Scotland: the context of innovation. *World Archaeology*. **21 (3)**: 435-445.

Armit, I. 1991. "The Atlantic Scottish Iron Age: five levels of chronology," *Proceedings of the Society of Antiquaries of Scotland* **121**: 181-214.

Armit, I. 1992. *The Later Prehistory of the Western Isles of Scotland*, British Archaeological Reports (British Series) **221**, Oxford.

Askew, G.P., R.W. Payton & R.S. Shiel. 1985. "Upland soils and land clearance in Britain during the second millennium BC". in D. Spratt & C. Burgess (eds) *Upland Settlement in Britain: the Second Millennium BC and After*. Oxford: BAR British Series, No. **143**, pp. 5-33.

ASNI (Archaeological Survey of Northern Ireland). 1966. *An Archaeological Survey of County Down.* Belfast: HMSO.

Baillie, M.G.L. 1992. "Dendrochronoology and past environmental change". *Proceedings of the British Academy.* **77:** 5-23.

Baillie, M.G.L. 1995. *A Slice through Time: dendrochronology and precision dating*. London: Batsford.

Bannerman, J. 1974. *Studies in The History of the Dalriada*. Edinburgh & London: Scottish Academic Press.

Baoill, C.Ó. and N.R. McGuire (eds). 2002. *Rannsachadh na Gáidhlig 2000: Papers read at the Conference Scottish Gaelic Studies 2000 held at the University of Aberdeen 2-4 August 2000.* Obar Dheathain : An Clo Gaidhealach.

Barber, K.E. 1982. "Peat-bog stratigraphy as a proxy climate record". in A.F.Harding (ed.) *Climatic change in later prehistory*. Edinburgh: Edinburgh University Press, pp 103-113.

Barrett, G.F. 1980. "A field survey and morphological study of ring-forts in southern County Donegal". *Ulster Journal of Archaeology* **43:** 39-51.

Barrett, J.C. 1981. "Aspects of the Iron Age in Atlantic Scotland. A case study in the problems of archaeological interpretation". *Proceedings of the Society of Antiquaries of Scotland.* **111**: 205-219.

Barry, T.B. 1981. "Archaeological excavation at Dunbeg promontory fort, Co. Kerry". *Proceedings of the Royal Irish Academy.* **81C:** 295-329.

Bede. *Historia ecclesiastica gentis Anglorum*; L. Sherley-Price (trans.) 1903. *The Ecclesiastical History of the English People with Bede's letter to Egbert and Cuthbert's Letter on the Death of Bede*. introduction by D. Farmer, revised by R.E. Latham, Penguin Books 1968.

Bennet, I. & E. Grogan. 1994. "Excavations at Mooghaun South, Co. Clare. Interim report 1". *Discovery Programme Reports* **1:** 39-43.

Bernard, W. 1870-9. "Exploration and Restoration of The Ruin of the Grianan of Aileach". *Proceedings of the Royal Irish Academy*. Ser. 2 Vol. 1, pp. 139-140.

Betts, U.V.G. 1969. "An Dun, Glen Lonan, Taynuilt". *Discovery and Excavation in Scotland*, Council for Scottish Archaeology. 9.

Bevan, A. & J. Conolly. 2002. "GIS, Archaeological Survey, and Landscape Archaeology on the Island of Kythera, Greece". *Journal of Field Archaeology*, Vol. 29, No. 1/2, pp. 123-138.

Beveridge, E. 1903. *Coll and Tiree: their prehistoric forts and eccliastical antiquities, with notices of the ancient remains in the Treshnish Isles.* 2nd ed 2001, Edinburgh: Birlinn.

Bibby, J.S., G. Hudson & D.J. Henderson. 1982. *Soil and Land Capability for Agriculture: Western Scotland (Sheet 4)*. Macaulay Soil Institue, Aberdeen.

Bigwood, W.F.L. 1964. "Dun at Glenramskill, Campbeltown". *Discovery and Excavation in Scotland*, Council for Scottish Archaeology. 18-19.

Bigwood, W. 1966. "Dùn Fhinn, Campletown," *Discovery and Excavation in Scotland*, Council for Scottish Archaeology. 11-12.

Birks, H.H. 1975. "Studies in the vegetational history of Scotland. IV. Pine stumps in Scottish blanket peats". *Philosophical Transactions of the Royal Society B.* **270**: 181-226.

Birks, H.J.B. B.J. & Madsen. 1979. "Flandrian vegetational history at Little Loch Roag, Isle of Lewis, Scotland". *Journal of Ecology.* **67:** 825-842.

Bowen, E.G. 1970. "Britain and the British Seas". in D. Moore (ed.) *The Irish Sea Province in Archaeology and History.* Cardiff: Cambridge Archaeological Association. pp 13-28.

Bowen, E.G. 1972. *Britain and the Western Seaways*, Thames and Hudson, London.

Bowen, E.G. 1977. *Saints, seaways and settlements.* Cardiff: University of Wales Press.

Brady, N. 1994. "Labour and agriculture in Early Medieval Ireland: The evidence from the sources". in A.J. Frantzen & D. Moffett (eds.) *The work of work: Servitude, slavery and labour in Medieval England.* Glasgow: Cruithne Press.

Brannon, N.F. 1981-2. "A Rescue Excavation at Lisdoo Fort, Lisnaskea, County Fermanagh". *Ulster Journal of Archaeology*. **44-45:** 53-59.

Breeze, D.J. 1982. *The Northern Frontiers of Roman Britain*. London: Batsford Academic and Educational.

Bridge, M.C., B.A. Haggart & J.J. Lowe. 1990. "The history and palaeoclimatic significance of subfossil remains of *Pinus sylvestris* in blanket peats from Scotland". *Journal of Ecology*. **78:** 77-99.

Bronk Ramsey, C. 2005. *OxCal v. 3.10.* Available at http://www.rlaha.ox.ac.uk/oxcal/oxcal.htm.

Brown, M. & T. Cowie. 1987. "A Dun on Eilean Righ, Loch Craignish". *Glasgow Archaeological Journal.* **14**: 58- 62.

Bryne, F.J. 1973. *Irish Kings and High-Kings.* London.

Buck, C., V. Cummings, C. Henley, S. Mills and S. Trick (eds). 2000. *Proceedings of the UK Chapter of Computer Applications and Quantitative Methods in Archaeology 1999*. Oxford: BAR British Series, No. **844**.

Buckley, V.M. and P.D. Sweetman. 1991. *An Archaeological Survey of County Louth.* Dublin: Office of Public Works.

Buxton, L.H.D. (ed) 1936. *Custon is King: Essays presented to R.R. Marett on his seventieth birthday*. London: Hutchinson's Scientific and Technical Publications.

Campbell, E. 1999. *Saints and Sea-Kings. The First Kingdom of the Scots*. Edinburgh: Canongate with Historical Scotland.

Campbell, E. 2001. "Were the Scots Irish?" *Antiquity* **75:** 285-292.

Carter, R.W.G. 1993. "Geology, hydrology and land-use of Lough Neagh and its catchment". in R.B. Wood & R.V. Smith (eds) *Lough Neagh: the Ecology of a multipurpose Water Resource.* London: Kluwer Academy, pp. 11-34.

Caulfield, S. 1977. "Quern Replacement and the Origin of Brochs". *Proceedings of the Society of Antiquaries of Scotland.* **109**: 129-39.

Caulfield, S. 1981. "Celtic Problems in the Irish Iron Age". In D. Ó Corráin (ed.) *Irish Antiquity. Essays and Studies presented to Professor M.J. O'Kelly.* Cork: Tower Books, pp. 205-215.

Cavers, M.G. 2005. *Crannogs and Later Prehistoric Settlement in Western Scotland: With particular reference to Dumfries and Galloway and Argyll and Bute.* unpublished PhD, University of Nottingham, Department of Archaeology.

Champion, T. 1982. "The Myth of Iron Age Invasions in Ireland". in B.G. Scott (ed.) *Studies on Early Ireland, Essays in Honour of M.V.Duignan.* Belfast, 39-44.

Childe, V.G. 1940. *Prehistoric Communities of the British Isles.* London: Chambers.

Childe, V.G. & W. Thorneycroft. 1938. "The vitrified fort at Rahoy, Morvern, Argyll'". *Proceedings of the Society of Antiquaries of Scotland.* **72**: 23-43.

Chorley, R.J. & P. Haggett (eds.) 1967. *Models in Geography.* London: Methuen.

Christison, D. 1889. "The duns and forts of Lorne, Nether Lochaber, and the Neighbourhood". *Proceedings of the Society of Antiquaries of Scotland.* **23**: 368-432.

Christison, D. 1891. "Excavation of the fort "Suidhe Chennaidh" Loch Awe: and description of some Argyleshire cairns". *Proceedings of the Society of Antiquaries of Scotland.* **25**: 118-27.

Christison, D. 1904. "The Forts of Kilmarton, Kilmichael Glassary and North Knapdale, Argyle". *Proceedings of the Society of Antiquaries of Scotland.* **38**: 205-251.

Christison, D. 1905. "Report on the Society's excavations of forts on the Poltalloch Estate, Argyll, in 1904-5". *Proceedings of the Society of Antiquaries of Scotland.* **39**: 259-70.

Christison, D., J. Anderson & T. Ross. 1905. "Report on the Society's excavations of forts on the Poltalloch Estate, Argyll, in 1904-5". *Proceedings of the Society of Antiquaries of Scotland.* **39**: 270-85.

Christopherson, G.L. & D.P. Guertin. 1996. Visibility Analysis and Ancient Settlement Strategies in the Region of Tall al-Umayri, Jordan. Paper presented at the Annual Meeting of American Schools of Oriental Research, New Orleans, Louisiana. http://www.casa.arizona.edu/MPP/viewshed/vspaper.html

Clark, J.G.D. 1966. "The Invasion Hypothesis in British Archaeology". *Antiquity* **40**: 172-189.

Clark, P. 2004. *The Dover Bronze Age boat in context: society and water transport in prehistoric Europe.* Oxford: Oxbow.

Clarke, D. (ed). 1972. *Models in archaeology.* London: Methuen.

Clough, T.H.McK. & W.A. Cummins. 1988. *Stone axe studies, volume 2: the petrology of prehistoric stone implements from the British Isles*. London: Council for British Archaeology Research Report **67**.

Cohen, L. & M. Holliday. 1996. *Practical Statistics for Students.* Paul Chapman Publishing Ltd.: London.

Colby, Col. T.F. 1837. *Ordnance Survey of the County of Londonderry*. *Volume 1.* Dublin.

Coles, J.M. 1962. "Scottish Late Bronze Age metalwork: typology, distribution and chronology". *Proceedings of the Society of Antiquaries of Scotland*. **93:** 16-134.

Coles, G., M. Church & P. Milburn. 1999. *An Assessment Survey of the Paleoecological Record of the Eastern Angus and adjacent South Aberdeenshire Ploughlands*, Centre for Field Archaeology, University of Edinburgh, unpublished report no. 471.

Collins, A.E.P. 1966. "Excavations at Dressogagh rath, Co. Armagh". *Ulster Journal of Archaeology*. **29:** 117-129.

Comber, M. 2006. "Tom Fanning's excavations at Rinnaraw Cashel, Portnablagh, Co. Donegal". *Proceedings of the Royal Irish Academy*. **106C:** 67-124.

Conolly, J. & M. Lake. 2006. *Geographical Information Systems in Archaeology*. Cambridge: Cambridge University Press.

Cooney, G. & E. Grogan. 1991. "An archaeological solution to the 'Irish' problem?" *Emania*. **9:** 33-43.

Coppock, J.T. 1976. *An Agricultural Atlas of Scotland.* Edinburgh.

Cottam, B. & A. Small. 1974. "The Distribution of Settlement in Southern Pictland." *Medieval Archaeology*. **18:**43-65.

Cotter, C. 1993. "Western Stone Fort Project. Interim Report". *Discovery Programme Reports* **1:** 1-19.

Cotter, C. 1994. "Atlantic fortifications - the dúns of the Aran Islands". *Archaeology Ireland* vol. 8, No 1, Issue 27, pp 24-28.

Cotter, C. 1995. "Western Stone Fort Project. Interim Report". *Discovery Programme Reports* **2:** 1-11.

Cotter, C. 1996. "Western Stone Fort Project. Interim Report". *Discovery Programme Reports* **4:** 1-14.

Craig, G.Y. 1991. *The Geology of Scotland.* London: Geological Society.

Craw, J.H. 1930. "Excavations at Dunadd and at other sites on the Poltalloch Estates, Argyll". *Proceedings of the Society of Antiquaries of Scotland.* **63:** 111-146.

Crawford, H.E.W. (ed.). 1979. *Subterranean Britain: Aspects of Underground Archaeology*. New York: St. Martin's Press.

Crawford, O.G.S. 1912. "The distribution of Early Bronze Age Settlements in Britain". *The Geographic Journal*. **Vol 40, No. 2:** 184-197.

Crawford, O.G.S. 1936. "The Western Seaways". in L.H.D. Buxton (ed) *Custom is King: Essays presented to R.R. Marett on his seventieth birthday*. London: Hutchinson's Scientific and Technical Publications.

Crawford, R.M.M. 2000. "Ecological hazards of oceanic environments". *New Phytologist.* **147:** 257-281.

Croll, E. and D. Parkin (ed). 1992. *Bush base: forest farm - culture, environment and development*. London: Routledge.

Crone, B.A. 2000. *The History of a Scottish Lowland Crannog: Excavations at Buiston, Ayrshire, 1989-90.* STAR Monograph 4. AOC/Historic Scotland, Edinburgh.

Cunliffe, B. 2001. *Facing the Ocean: The Atlantic and its Peoples.* OUP Oxford.

Daly P. & T.L. Evans (eds). 2006. *Digital Archaeology: Bridging method and theory.* New York: Routledge.

Davidson, D.A. 1979. "Chapter II: The Orcadian Environment and Cairn Location," in A.C. Renfrew (ed) *Investigations in Orkney*, London: Reports of the Research Committee of the Society of Antiquaries of London **38**: 7-20.

Davidson, D.A, R.L. Jones & A.C. Renfrew. 1976. "Paleo-environmental reconstruction and evaluation: a case study from Orkney" *Transactions of the Institute of British Geographers.* **1:** 346-362.

Davies, M. 1946. "The diffusion and distribution pattern of the megalithic monuments of the Irish Sea and North Channel Coastlands". *Antiquaries Journal*. **26:** 38-60.

Digimap. 2001. *Land-Form Profile™ User Guide v4.0.* EDINA, Edinburgh.

Dumville, D.N. 1977. "Kingship, Genealogies and Regional Lists." in P.H. Sawyer and I.N. Wood (eds.) *Early Medieval Kinships*. Leeds, pp 72-104.

Dumville, D.N. 2002. "Ireland and North Britain in the Earlier Middle Ages: Contexts for *Míniugud Senchus Fher* nAlban." in C.Ó. Baoill and N.R. McGuire (eds) *Rannsachadh na Gáidhlig 2000: Papers read at the Conference Scottish Gaelic Studies 2000 held at the University of Aberdeen 2-4 August 2000.* Obar Dheathain : An Clo Gaidhealach, 185-211.

Duncan, A.A.M. 1992. *Scotland: The Making of the Kingdom.* Edinburgh. (1st ed 1975).

Duncan, R.B. & K.A. Beckman. 2000. "The application of GIS predictive site location models within Pennsylvania and West Virginia". in K.L. Westcott (ed). *Applications of GIS for archaeologists: A predictive modeling toolkit.* London: Taylor & Francis, pp. 33–56.

Edwards, N. 1990. *The Archaeology of Early Medieval Ireland.* B.T. Batsford Ltd: London.

Edwards, N. 2005. "The Archaeology of Early Medieval Ireland, *c*.400-1169: Settlement and Economy". in D. Ó Cróinín (ed.) *A New History of Ireland, Volume I: Prehistoric and Early Ireland*. Oxford: Oxford University Press, pp. 235-300.

ERM (Environmental Resource Management). 1996. *Landscape Assessment of Argyll and the Firth of Clyde.* Scottish Natural Heritage Review. **No. 78**.

Espa, G., R. Benedetti, A. De Meo, U. Ricci & S. Espa. 2006. "GIS based models and estimation methods for the probability of archaeological site location". *Journal of Cultural Heritage* **7:** 147-155.

ESRI. 2005. *Raster Data in ArcSDE 9.1*. ESRI: Redlands, CA. http://www.esri.com/library/whitepapers/pdfs/arcsde91-raster.pdf. Last Accessed August 14, 2006.

Evans, N.P. 1999. *A GIS Based Analysis of the Distribution of the 'Angus' Souterrain Group Within the 'NO' Mapsheet Region of Eastern Scotland,* University of Southampton: Unpublished MSc Dissertation.

Excavations. 1970-6. "Summary accounts of archaeological excavations in Ireland". Published annually by the Association of Young Irish Archaeologists, T.G. Delaney (ed.) Ulster Museum Belfast.

Fahy, E.M. 1969. *Historical geography of west Cork before the twelfth century A.D.* unpublished PhD, University College, Cork.

Fairhurst, H. 1939. "The Galleried Dùn at Kildonan Bay, Kintyre". *Proceedings of the Society of Antiquaries of Scotland.* **73**: 185-228.

Fairhurst, H. 1956. "The Stack Fort on Ugadale Point, Kintyre". *Proceedings of the Society of Antiquaries of Scotland.* **88:** 15-21.

Farrell, A.P. & S. Penny. 1975. "Broighter boast: a re-assessment". *Irish Archaeological Research Forum*. **2.2:** 15-26.

Feachem, R. 1963. *A Guide to Prehistoric Scotland*. London: B.T.Batsford Ltd.

Fedorko, E.J. 2005a. *An Accuracy Assessment of SAMB Elevation Data.* West Virginia GIS Technical Center website, SAMB Elevation Conversion Project Report April 2005. http://www.wvgis.wvu.edu/stateactivities/wvsamb/elevation/accuracy_assesment.pdf. Last Accessed: August 7, 2006.

Fedorko, E.J. 2005b. *Report: Comparison of Methods to Produce Digital Terrain Models.* West Virginia GIS Technical Center website, SAMB Elevation Conversion Project Report April 2005.
http://wvgis.wvu.edu/stateactivities/wvsamb/elevation/topogrid_vs_tin.pdf. Last Accessed: August 7, 2006.

FGDC (Federal Geographic Data Committee). 1998. *Geospatial Positioning Accuracy Standards, PART 3: National Standards for Spatial Data Accuracy.* Report FGDC-STD-007.3-1998.

Fisher, P. 1991. "First experiments in viewshed uncertainty: the accuracy of the viewshed area". *Photogrammetric Engineering and Remote Sensing,* **57(10):** 1321-1327.

Fisher, P., C. Farrelly, A. Maddocks & C. Ruggles 1997. "Spatial Analysis of Visible Areas from the Bronze Age Cairns of Mull". *Journal of Archaeological Science* **24**: 581-592.

Fojut, N. 1980. *The archaeology and geography of Shetland brochs,* unpublished PhD thesis, University of Glasgow.

Fossitt, J.A. 1990. *Holocene Vegetation History of the Western Isles, Scotland*, unpublished PhD, University of Cambridge.

Foster, S.M. 1996. *Picts, Gaels and Scots: Early Historic Scotland*, B.T. Batsford Ltd/ Historic Scotland.

Fox, C.F. 1932. *Personality of Britain: its influences on habitation and invader in prehistoric and early historic times.* Cardiff: National Museum of Wales and the Press Board of the University of Wales.

Frantzen, A.J. & D. Moffett (eds.) 1994. *The work of work: Servitude, slavery and labour in Medieval England.* Glasgow: Cruithne Press.

Fraser, D. 1983. *Land and Society in Neolithic Orkney, Parts i-ii,* Oxford: BAR British Series, No. **117,** (i)-(ii).

Freeman, P. 2001. *Ireland and the Classical World*, University of Texas Press, Austin.

Gaffney, V. and Z. Stanĉiĉ. 1991. *GIS Approaches to Regional Analysis: A Case Study of the Island of Hvar,* Ljubljana: Znanstveni institute Filozofske Fakultete, University of Ljubljana, London.

Gaffney, V. and Z. Stanĉiĉ. 1992. "Diodorus siculus and the island of Hvar, Dalmatia: testing the text with GIS." in G. Lock and J. Moffett (eds). *Computer Applications and Quantitative Methods in Archaeology 1991.* Oxford: Tempvs Reparatvm, pp 113-126.

Gaffney, V. and P. M. van Leusen. 1995. "Postscript - GIS, Environmental Determinism and Archaeology." in G. Lock and Z. Stanĉiĉ (eds.) *Archaeology and Geographical Information Systems: A European Perspective*, London: Taylor and Francis pp. 367-382.

Gaffney, V., Z. Stanĉiĉ and H. Watson. 1995. "The Impact of GIS on Archaeology: A Personal Perspective." in G. Lock and Z. Stanĉiĉ (eds.) *Archaeology and Geographical Information Systems: A European Perspective*, London: Taylor and Francis pp. 211-229.

Gaffney, V., Z. Stanĉiĉ and H. Watson. 1996. "Moving from catchments to cognition: tentative steps towards a larger archaeological context for GIS." in M. Aldendefer and H. Maschner (eds) *Anthropology, Space and Geographical Information Systems*, Oxford: Oxford University Press, pp. 123-154.

Gillings, M. and G. T. Goodrick. 1996. "Sensuous and Reflexive GIS: Exploring Visualization and VRML." *Internet Archaeology* 1. http://intarch.ac.uk/journal/issue1/gillings_toc.html

Gilmour, S.M.D. 1994. *Iron Age Structures in Argyll*. unpublished M.A. Dissertation, Edinburgh University, Department of Archaeology.

Gilmour, S.M.D. 2000. *Later Prehistoric and Early Historic Settlement Archaeology of the Western Seaways: A Study of the Western Settlement Record from Shetland to Brittany in the First Millennia BC and AD*. unpublished PhD, University of Edinburgh, Department of Archaeology.

Green, M.J. (ed.) 1995. *The Celtic World*. London: Routledge.

Grogan, E. 1995. "Excavations at Mooghaun South, 1993. Interim report". *Discovery Programme Reports* **2:** 57-61.

Grogan, E. 1996. "Excavations at Mooghaun South, 1994. Interim report". *Discovery Programme Reports* **4:** 47-57.

Grogan, E. & T. Condit. 1994. "New hillfort date gives clue to the Bronze Age". *Archaeology Ireland* **8(2):** 7.

Grogan, E. & G. Eogan. 1987. "Lough Gur excavations by Seán P Ó Riordáin: further Neolithic and Beaker habitations on Knockadoon". *Proceedings of the Royal Irish Academy* **87**C: 299-506.

Gwynn, L. (ed & tr). 1912a. "De Shíl Chonairi Móir." *Ériu* **6**:130-143.

Gwynn, L. (ed & tr). 1912b. “De Maccaib Conaire.” *Ériu* **6**:144-153.

Haggett, P. 1965. *Locational Analysis in Human Geography.* New York: John Wiley & Sons.

Hall, V.A. 1990. “ Recent landscape history from a Co. Down deposit”. *New Phytologist.* **115:** 377-383.

Hall, V.A. 2000. “The documentary and pollen analytical records of the vegetational history of the Irish landscape AD 200-1650”. *Peritia: Journal of the Medieval Academy of Ireland.* **14:** 342-369.

Hamlin, A. & C.J. Lynn. 1988. *Pieces of the Past*. Belfast: HMSO.

Harding A.F. (ed.) 1982. *Climatic change in later prehistory*. Edinburgh: Edinburgh University Press.

Harding, D.W. 1984. “The Function and Classification of Brochs and Duns,” in R. Miket and C. Burgess (eds.) *Between and Beyond the Walls: essays on the prehistory and history of Northern Britain in honour of George Jobey,* Edinburgh, pp. 206-220.

Harding, D.W. 1997. “Forts, Duns, Brochs and Crannogs: Iron Age Settlements in Argyll,” in G. Ritchie (ed.) *The Archaeology of Argyll*, RCAHMS and Edinburgh University Press, 118-140.

Harding, D.W. 2006. “Redefining the Northern British Iron Age”. *Oxford Journal of Archaeology.* **25(1):** 61-82.

Harris, J. 1984. “A Preliminary survey of hut-circles and field systems in South-east Perthshire.” *Proc. Soc. Antiq. Scot.* **114**: 199-216.

Harris, T.M., and G.R. Lock. 1992. “Toward a regional GIS site information retrieval system: The Oxfordshire sites and monuments record (SMR) prototype.” in C. Larsen (ed.). *Sites and Monuments: National Archaeological Records*. Copenhagen: The National Museum of Denmark, pp. 185–199.

Harris, T.M. and G.R. Lock. 1995. "Toward an evaluation of GIS- in European archaeology: the past, present and future of theory and applications." in G. Lock and Z. Stanĉiĉ (eds.) *Archaeology and Geographical Information Systems: A European Perspective*, London: Taylor and Francis pp. 349-60.

Haughton, J.P. 2005. "The Physical Environment". in D.Ó. Cróinín (ed) *A New History of Ireland.* Oxford University Press: Oxford, pp. 32-48.

Henderson, J.C. (ed). 2000a. *The Prehistory and Early History of Atlantic Europe, Paper from a session held at the European Association of Archaeologists Fourth Annual Meeting in Göteborg 1998*, British Archaeological Reports (International Series) 861.

Henderson, J.C. 2000b. "Shared Traditions? The Drystone Settlement Records of Atlantic Scotland and Ireland 700BC-AD 200,"in J.C. Henderson (ed.) *The Prehistory and Early History of Atlantic Europe, Paper from a session held at the European Association of Archaeologists Fourth Annual Meeting in Göteborg 1998*, British Archaeological Reports (International Series) 861: 117-154.

Hencken, H.O.N. 1938. *Cahercommaun: a stone fort in County Clare.* Dublin: The Royal Society of the Antiquaries of Ireland.

Henry, F. 1965. *Irish Art in the Early Christian Period to A.D. 800*. London: Methuen.

Herity, M. & G. Eogan. 1977. *Ireland in Prehistory.* London: Ruotledge & Kegan Paul.

Higuchi, T. 1989. *The Visual and Spatial Structure of Landscapes,* Mass. Cambridge: MIT Press.

Hingley, R. 1992. "Society in Scotland from 700BC to AD200". *Proceedings of the Society of Antiquaries of Scotland.* **122**: 7-53.

Hirons, K.R. 1983. “Percentage Accumulation Rate Pollen Diagrams from East County Tyrone”. in T. Reeves-Smyth & F. Hamond (eds.) *Landscape Archaeology in Ireland*. Oxford: BAR British Series, No. **116**, pp. 253-267.

Hirons, K.R. 1984. *Palaeoenvironmental investigations in east Co. Tyrone, Northern Ireland.* unpublished Ph.D. thesis, Queen’s University, Belfast.

Hirons, K.R. & A. Sheridan. 1986. “An Introduction to Prehistoric and Early Christian Settlement in Southwest County Down”. in A.M. McCabe & K.R. Hirons (eds.) *Field guide to the Quanternary Deposits of southeast Ulster*. Cambridge : Quaternary Research Association and Irish Association for Quaternary Studies, pp. 62-113.

Hirsch, E. 1995. “Landscape: Between Place and Space.” in E. Hirsch, and M. O'Hanlon, (eds.) *The Anthropology of Landscape: Perspectives on Place and Space.* Oxford: Clarendon Press, pp 1-30.

Hirsch, E. and M. O'Hanlon, (eds.) 1995. *The Anthropology of Landscape: Perspectives on Place and Space.* Oxford: Clarendon Press.

Hodder, I. And C. Orton. 1976. *Spatial Analysis in Archaeology.* Cambridge: Cambridge University Press

Hope, A.C.A. 1968. “A simplified Monte Carlo significance test procedure”. *Journal of the Royal Statistical Society.* **B30:** 582-598.

Huggett, J. and N. Ryan (eds.) 1995. *Computer Applications and Quantitative Methods in Archaeology, 1994*. Oxford: BAR International Series, No. **600**.

Hughes, K. 1972. *Early Christian Ireland: Introduction to the Sources*. The Sources of History Limited in association with Hodder and Stoughton Limited.

Huntley, B., M.G.L. Baillie, J.M. Grove, C.U. Hammer, S.P. Harrsion, and S. Jacomet. 2002. "Holocene palaeoenvironmental changes in North-West Europe: Climatic implications and the human dimension". In G. Wefer, W. Berger, K.E. Behre & E. Jansen (eds.) *Climatic development and history of the North Atlantic realm.* Berlin/Heidelberg/New York: Springer-Verlag, pp. 259-298.

Ingold, T. (ed). 1986a. *The Appropriation of Nature: Essays on Human Ecology and Social Relations*. Manchester: MUP.

Ingold, T. 1986b. "Territoriality and tenure: the appropriation of space in hunting and gathering societies." in T. Ingold (ed) *The Appropriation of Nature: Essays on Human Ecology and Social Relations*. Manchester: MUP, pp. 130-164.

Ingold, T. 1992. "Culture and the perception of the environment." in E. Croll and D. Parkin (ed) *Bush base: forest farm - culture, environment and development*. London: Routledge, pp. 39-56.

Jöckel, K.-H. 1986. "Finite Sample Properties and Asymptotic Efficiency of Monte Carlo Tests". *The Annals of Statistics.* **Vol 14, No. 1:** 336-347.

Kelleher, J.V. 1963. "Early Irish History and Pseudo-History." *Studia Hibernica* **3:** 113-127.

Kelly, E.P. 1974. "Aughinish Island". In T.G. Delaney (ed.) *Excavations 1974 Summary accounts of archaeological work in Ireland.* pp. 20-21.

Koch, J.T. 1991. "Erin, Alba and Letha: when was a language ancestral to Gaelic first spoken in Ireland?" *Emania* **9:** 17-27.

Kvamme, K. 1990a. "One-sample tests in regional archaeological analysis: new possibilities through computer technology." *American Antiquity* **55(2)**: 367-381.

Kvamme, K. 1990b. "The fundamental principles and practice of predictive archaeological modelling." in A. Voorrips (ed.) *Mathematics and Information Science in Archaeology: A Flexible Framework.* Studies in Modern Archaeology 3. Bonn: Holos-Verlag, pp 257-295.

Kvamme, K. 1992. "Geographical Information Systems and archaeology." in G. Lock & J. Moffett (eds.) *CAA91: Computer Applications and Quantitative Methods in Archaeology: 1991*, Oxford: BAR International Series, No. **577**, pp. 77-84.

Kvamme, K. 1996. "A proton magnetometry survey at Navan Fort". *Emania* **14:** 83-8.

Kvamme, K. 1997. "Ranter's Corner -- Bringing the Camps Together: GIS and ED." *Archaeological Computing Newsletter* **47**:1-5.

Kvamme, K. 1999. "Recent Directions and Developments in Geographical Information Systems." *Journal of Archaeological Research* **Vol 7, No. 2**: 153-201.

Lacy, B. (ed.) 1983. *Archaeological Survey of County Donegal: A description of the field antiquities of the County from the Mesolithic Period to the 17th century A.D.* Lifford: Donegal County Council.

Laing, L. 2006. *The Archaeology of Celtic Britain and Ireland c.AD 400-1200*. Cambridge: Cambridge University Press.

Laing, L. and J. Laing. 1990. *Celtic Britain and Ireland, AD 200-800: The Myth of the Dark Ages.* Dublin: Irish Academic Press.

Laing, L. and J. Laing. 2001. *The Picts and the Scots.* Gloucestershire: Sutton Publishing.

Lake, M.W. and P.E. Woodman. 2000. "Viewshed analysis of site location on Islay." in S.J. Mithen (ed) *Hunter-Gatherer Landscape Archaeology: The Southern Hebrides Mesolithic Project 1988-98,* Vol. 2, *Archaeological Fieldwork on Colonsay, Computer Modelling, Experimental Archaeology and Final Interpretations,* Cambridge: The McDonald Institute for Archaeological Research, pp. 497-503.

Lake, M.W, P.E. Woodman and S.J. Mithen 1998. "Tailoring GIS Software for Archaeological Applications: An Example Concerning Viewshed Analysis." *Journal of Archaeological Science* **25:** 27-38.

Lane, A.M. 1987. "English Migrants in the Hebrides: 'Atlantic Second B' revisited". *Proceedings of the Society of Antiquaries of Scotland.* **117:** 47-66.

Lane, A. & E. Campbell. 2000. *Dunadd: An Early Dalriadic Capital.* Oxford: Oxbow Books.

Langdon, P.G. & K.E. Barber. 2005. "The climate of Scotland over the last 5000 years inferred from multiproxy peatland records: inter-site correlations and regional variability". *Journal of Quaternary Science.* **20:** 549–566.

Larsen, C. (ed.). 1992. *Sites and Monuments: National Archaeological Records*. Copenhagen: The National Museum of Denmark.

Legg, R.J. & D. Taylor. 2006. "Modeling Environmental Influences on the Locations of Irish Early Medieval Ringforts." *Geoarchaeology* **Vol 21, Issue 3:** 201-220.

Limbert, D. 1996. "Irish Ringforts: A Review of their Origins," *Archaeological Journal* **153:** 243-289.

Liversage, G.B. 1968. "Excavations at Dalkey Island, Co Dublin, 1956-1959". *Proceedings of the Royal Irish Academy.* **66C:** 53-233.

Llobera, M. 1996. "Exploring the topography of the mind: GIS, social space and archaeology." *Antiquity* **70:** 612-622.

Llobera, M. 1999. *Landscapes of Experiences in Stone: Notes on a Humanistic Use of a GIS to Study Ancient Landscapes,* Unpublished DPhil Thesis, Oxford: Oxford University.

Llobera, M. 2001. "Building Past Landscape Perception with GIS: Understanding Topographic Prominence." *Journal of Archaeological Science* **28:** 1005-1014.

Llobera, M. 2003. "Extending GIS-based visual analysis: the concept of *visualscapes*." *International Journal of Geographical Information Science* **17(1):** 25-48.

Llobera, M., D. Wheatley, T.J.M. Steele, S. Cox & O. Parchment. 2004. "Calculating the inherent visual structure of a landscape ('total viewshed') using a high-throughput computing". In *XXXII International Conference – Computer Applications in Archaeology 2004- Computer Applications and Quantitative Methods in Archaeology, Beyond the Artifact: Digital Interpretation of the Past, Prato, Italy, 13-17 April, 2004.* (In Press). http://eprints.soton.ac.uk/43036/01/Lobera CAA2004 WithGraphics.pdf

Lock, G. 1991. "An introduction to statistics for archaeologists." in S.Ross, J.Moffett & J.Henderson (eds.) *Computing for Archaeologists.* Oxford: Oxford University Committee for Archaeology, pp. 57-95.

Lock, G. 1995. "Archaeological computing, archaeological theory and moves toward contextualism." in J. Huggett and N. Ryan (eds.) *Computer Applications and Quantitative Methods in Archaeology, 1994*. Oxford: BAR International Series, No. **600**, pp. 13–18.

Lock, G. (ed). 2000. *Beyond the Map: Archaeology and spatial technologies.* Amsterdam: etc: IOS Press.

Lock, G. and T. Harris. 1996. "Danebury Revisited: an English Iron Age hillfort in a digital landscape." in M. Aldenderfer and H.D.G. Maschner (eds.) *Anthropology, Space and Geographic Information Systems.* Oxford: University Press, pp. 214-240.

Lock, G. and J. Moffett (eds). 1992. *Computer Applications and Quantitative Methods in Archaeology 1991.* Oxford: Tempvs Reparatvm.

Lock, G. and Z. Stanĉiĉ (eds.) 1995. *Archaeology and Geographical Information Systems: A European Perspective*, London: Taylor and Francis.

Lynch, A. 1981. *Man and environment in south-west Ireland.* British Archaeological Reports (British Series) **85** Oxford.

Lynn C.J. 1975. "The medieval ringfort: an archaeological chimera." *Irish Archaeological Research Forum*. **2.1:** 29-36.

Lynn, C.J. 1978. "Early Christian period domestic structures: a change from round to rectangular". *Irish Archaeological Research Forum*. **5:** 29-45.

Lynn, C.J. 1982. "Excavation at Rathmullan, A Raised Rath and Motte in County Down". *Ulster Journal of Archaeology*. **44 and 45:** 65-171.

Lynn, C.J. 1983. "Some 'Early' Ring-forts and Crannogs," *The Journal of Irish Archaeology* **1:** 47-58.

Lynn, C.J. 1986. "The Excavation of Rathmullan, County Down: Addenda". *Ulster Journal of Archaeology*. **48:** 130-132.

Lynn, C.J. 1988a. "The Iron Age gates of Ulster?: The Dorsey, Co. Armagh". in C.J. Lynn & A. Hamlin (eds.) *Pieces of the Past: Archaeological Excavations by the Department of the Environment for Northern Ireland 1970-1986.* Belfast: HMSO, pp. 21-24.

Lynn, C.J. 1988b. "Ulster's oldest wooden houses: Deer Park Farms, Flenarm, Co. Antrim". in C.J. Lynn & A. Hamlin (eds.) *Pieces of the Past: Archaeological Excavations by the Department of the Environment for Northern Ireland 1970-1986.* Belfast: HMSO, pp. 44-47.

Lynn, C.J. 1994. "Houses in rural Ireland, A.D. 500-1000". *Ulster Journal of Archaeology*. **57:** 81-94.

Lynn, C.J. 1997. "Excavation of site A". in D.M. Waterman *Excavations at Navan Fort 1961-71*. Completed and edited by C.J. Lynn, Northern Ireland Archaeological Monographs: No **3**, Belfast: The Stationary Office, pp. 127-146.

Lynn, C.J. 2003. "Ireland in the Iron Age: A basket case?" *Archaeology Ireland* vol. 8, No 2. pp 20-23.

Lynn, C.J. & A. Hamlin (eds.) 1988. *Pieces of the Past: Archaeological Excavations by the Department of the Environment for Northern Ireland 1970-1986.* Belfast: HMSO.

Lynn, C.J., D. Flanagan & D.M. Waterman. 1997. "Introduction to the excavation at Navan Fort". in D.M. Waterman *Excavations at Navan Fort 1961-71*. Completed and edited by C.J. Lynn, Northern Ireland Archaeological Monographs: No **3**, Belfast: The Stationary Office, pp. 1-11.

Macalister, R.A.S. 1928. *The Archaeology of Ireland.* London: Methuen.

Macdonald, C.M. 1950. *The History of Argyll: up to the beginning of the sixteenth century*. Glasgow: W. & R. Holmes (Books) Ltd.

MacKie, E.W. 1974. *Dun Mor Vaul: an iron age broch on Tiree*. Glasgow: University of Glasgow Press.

MacKie, E.W. 1992. "The Iron Age semibrochs of Atlantic Scotland: a case study in the problems of deductive reasoning." *Archaeology* **148:** 149-181.

MacKie, E.W. 1997. "Dun Mor Vaul revisited: fact and theory in the reappraisal of the Scottish Atlantic Iron Age". In G. Ritchie (ed.) *The archaeology of Argyll*. Edinburgh: Edinburgh University Press. 141-180.

Mackinder, H.J. 1902. *British and the British Seas*. New York: D. Appleton and Co.

Macklin, M.G., C. Bonsall, F.M. Davies & M.R. Robinson. 2000. "Human-environment interactions during the Holocene: new data and interpretations from the Oban area, Argyll, Scotland". *The Holocene*. **Vol 10, Issue 1:** 109-121.

Madry S.L.H. & C.L. Crumley. 1990. "An application of remote sensing and GIS in a regional
archaeological settlement pattern analysis: the Arroux River Valley, Burgundy, France." in K.M.S. Allen, S.W. Green, and E.B.W. Zubrow (eds.). *Interpreting Space: GIS and Archaeology.* London: Taylor and Francis, pp 364-380.

Madry, S.L.H. & Rakos, L. 1996. "Line-of-Sight and Cost-Surface Techniques for Regional research in the Arroux River Valley." in H.D.G. Maschner (ed.). *New Methods, Old Problems: Geographic Information Systems in Modern Archaeological Research*. Southern Illinois University at Carbondale: Center for Archaeological Investigations Occ. Paper No. 23, pp 104-126.

Mallory, J.P. 1995. "Haughey's Fort and the Navan complex in the Late Bronze Age," in J. Waddell and E.S. Twohig (eds.) *Ireland in the Bronze Age. Proceedings of the Dublin conference, April 1995*, Dublin, 73-86.

Mallory, J.P. & B.N. Hartwell, 1997. "Down in prehistory," in L. Proudfoot and W. Nolan (eds.) *Down: history and society*. Dublin, 1-32.

Mallory, J.P. & C.J. Lynn. 2002. **"**Recent excavations and speculations on the Navan complex". *Antiquity* **76:** 532-541.

Mallory, J.P., D.M. Brown & M.J.L. Baillie. 1999. "Dating Navan Fort". *Antiquity* **73:** 427-431.

Mallory, J.P., D.G. Moore & L.J. Canning. 1996. "Excavations at Haughey's Fort 1991 and 1995". *Emania* **14:** 5-20.

Manning, C. 1986. "Archaeological excavation of a succession of enclosures at Millockstown, County Louth". *Proceedings of the Royal Irish Academy.* **86C:** 135-181.

Marshall, J.O.C. 1998 *Dalriada: A Guide around the Celtic Kingdom.* Glenariff Development Group.

Maschner, H.D.G. 1996a. "The politics of settlement choice on the Northwest coast: GIS, cognition and social landscapes." in M. Aldendefer and H. Maschner (eds) *Anthropology, Space and Geographical Information Systems*, Oxford: Oxford University Press, pp 175-89.

Maschner, H.D.G. 1996b. "Review of *Archaeology and Geographical Information Systems: A European perspective* [in G. Lock and Z. Stanĉiĉ (eds.) 1995. London: Taylor and Francis] *Geoarchaeology* **11:** 505-507.

Maschner, H.D.G. (ed.). 1996c. *New Methods, Old Problems: Geographic Information Systems in Modern Archaeological Research*. Southern Illinois University at Carbondale: Center for Archaeological Investigations Occ. Paper No. 23.

Maxwell, G. 1969. "Duns and Forts - A Note on Some Iron Age Monuments of the Atlantic Province," *Scottish Archaeological Forum* **1**: 41-46.

McCabe, A.M. & K.R. Hirons (eds.) 1986. *Field guide to the Quanternary Deposits of southeast Ulster*. Cambridge : Quaternary Research Association and Irish Association for Quaternary Studies.

McClung de Tapia, E. & H Tapia-Recillas. 1997. "Statistical Analysis Using GIS: Applications to the Study of Prehispanic Settlement Location in the Teotihuacan Region, Mexico", in I. Johnson & M. North (eds) *Archaeological Application of GIS: Proceedings of Colloquium II, UISPP XIIIth Congress, Eorli, Italy, September 1996,* Sidney University Archaeological Methods Series 5.

McCormick, F. 1995. "Cows, ringforts, and the origins of Early Christian Ireland". *Emania.* **13:** 33-37.

McDermott, F., D.P. Mattey & C. Hawlesworth. 2001. "Centennial-scale Holocene climate variability revealed by a high-resolution speleothem δ^{18} record from SW Ireland". *Science*. **294:** 1328-1331.

McGlade, J. 1995. "Archaeology and the ecodynamics of human-modified landscapes." *Antiquity* **69**: 113-132.

McGrail, S. 1978. *Logboats of England and Wales*. Oxford: BAR British Series, No. **51**.

McGrail, S. 1990a. "Boats and boatmanship in the late prehistoric southern North Sea and Channel region". in S. McGrail (ed.) *Maritime Celts, Frisians and Saxons*. Council for British Archaeology Research Report **71**: 32-48.

McGrail, S. (ed.) 1990b. *Maritime Celts, Frisians and Saxons*. London: Council for British Archaeology Research Report **71.**

McGrail, S. 1995. "Celtic seafaring and transport". in M.J. Green (ed.) *The Celtic World*. London: Routledge, pp. 254-284.

McNeill, T.E. 1992. "Excavation at Dunsilly, Co. Antrim". *Ulster Journal of Archaeology*. **54-55:** 78-112.

Miket, R. and C. Burgess (eds.) 1984. *Between and Beyond the Walls: essays on the prehistory and history of Northern Britain in honour of George Jobey*, Edinburgh.

Mitchell, F. & M. Ryan. 1998. *Reading the Irish Landscape.* Dublin: Town House.

Mithen, S.J. (ed). 2000. *Hunter-Gatherer Landscape Archaeology: The Southern Hebrides Mesolithic Project 1988-98,* Vol. 2, *Archaeological Fieldwork on Colonsay, Computer Modelling, Experimental Archaeology and Final Interpretations,* Cambridge: The McDonald Institute for Archaeological Research.

Molloy, K. 1997. "Prehistoric farming at Mooghaun – a new pollen diagram from Mooghaun Lough". *Archaeology Ireland*. **11(3):** 22-26.

Molloy, K. & M. O'Connell 1991. "Palaeoecological investigations towards the reconstruction of woodland and land-use history at Lough Sheeauns, Connemara, western Ireland". *Review of Palaeobotany and Palynology*. **67:** 75-113.

Moore, D. (ed.) 1970. *The Irish Sea Province in Archaeology and History.* Cardiff: Cambridge Archaeological Association.

Moore, M.J. 1987. *Archaeological inventory of County Meath.* Stationery Office.

Morgan, S. 2000. *An Investigation into the effects of environmental factors on settlement location in the Strath of Kildonan.* Geographical Information Science, Department of Geography, University of Edinburgh: Unpublished MSc Dissertation.

Mount, C. 1994. "From Knoxpark to Tír na nÓg". *Archaeology Ireland.* **8(3):** 22-23.

Mount, C. 2002. "The Promontory Fort, Inhumation Cemetery and sub-Rectangular Enclosure at Knoxspark, Co. Sligo". in M. Timoney (ed.) *A Celebration of Sligo – first essays for Sligo Field Club*. Sligo: Sligo Field Club, pp. 103-116.

Murphy, E.M. 2000. **"**Report on the osteological material from Site C, Navan Fort. Co. Annagh". *Emania* **18:** 17-29.

Mytum, H. 1992. *The Origins of Early Christian Ireland*. London: Routledge.

Nichols, H. 1967 "Vegetational change, shoreline displacement and the human factor in the late Quaternary history of south-west Scotland". *Transactions of the Royal Society of Edinburgh.* **67:** 145-187.

Nicolaisen, W.F.H. 1976. *Scottish Place-names: their study and significance*. London: Batsford.

Nieke, M.R. 1984. *Settlement Patterns in the Atlantic Province of Scotland in the first Millennium AD: A Study of Argyll*. (3 vols.) Unpublished PhD Thesis, University of Glasgow.

Nieke, M.R. 1985. “Eilean An Duin”. *Discovery and Excavation, Scotland,* Council for Scottish Archaeology, 34-35.

Nieke, M.R. 1990. “Fortifications in Argyll: Retrospect and Future Prospect,” in I. Armit (ed.) *Beyond the Brochs: Changing Perspectives on the Atlantic Scottish Iron Age,* Edinburgh, 131-142.

Nieke, M.R. & W.E. Boyd. 1987. “Eilean an Duin, Criagnish, Mid-Argyll”. *Glasgow Archaeological Journal.* **14**: 48-57.

Ó Corráin, D. (ed.) 1981. *Irish Antiquity. Essays and Studies presented to Professor M.J. O’Kelly.* Cork: Tower Books.

Ó Cróinín, D. 1995. *Early Medieval Ireland 400-1200.* London: Longmens.

Ó Cróinín, D. (ed.) 2005. *A New History of Ireland, Volume I: Prehistoric and Early Ireland*. Oxford: Oxford University Press.

Ó Ríordáin, S.P. 1943. *Antiquities of the Irish Countryside*. Cork.

O’Connell, M. 1980. “The development history of Scragh Bog, Co Westmeath, and the vegetational history of its hinterland”. *New Phytologist.* **85:** 301-319.

O’Connor, A. & D.V. Clarke (eds.) 1983. *From the Stone Age to the ‘Forty-Five: studies presented to R.B.K. Stevenson former Keeper National Museum of Antiquities of Scotland*. Edinburgh: John Donald Publishing Ltd.

O’Kelly, M.J. 1981. “An Early Bronze Age Ringfort at Carrigillhy, Co. Cork”. *Journal of the Cork Historical and Archaeological Society.* **56:** 69-86.

O’Rahilly, T.F. 1946. *Early Irish History and Mythology*. Dublin: Dublin Institute for Advanced Studies.

O'Sullivan, A. 1998. *The Archaeology of Lake Settlement in Ireland,* Discovery Programme Monograph No. **4**, Dublin: Royal Irish Academy.

Orpen, G. 1894. "Ptolemy's Map of Ireland." *Journal of the Royal society of Antiquaries of Ireland* **24:** 115-128.

Ozawa, K., T. Kato & H. Tsude. 1995. "Detection of beacon networks between ancient hillforts using a digital terrain model based GIS." in J. Huggett & N. Ryans (eds) *Computer Application and Quantitative Methods in Archaeology 1994,* Oxford: British Archaeological Reports (Int series) **600:** 157-162.

Parker Pearson, M. & N. Sharples with J. Mulville & H. Smith. 1999. *Between Land and Sea: Excavations at Dun Vulan, South Uist.* Sheffield Environmental and Archaeological Research Campaign in the Hebrides, Volume 3. Sheffield: Sheffield Academic Press.

Parry, M.L. 1975. "Secular climatic change and marginal agriculture". *Transactions, Institute of British Geographers* **64:** 1–13.

Parry, M.L. 1978. *Climatic Change, Agriculture and Settlement.* Folkestone.

Parry, M.L. 1985. "Upland settlement and climatic change: the medieval evidence". In D. Spratt and C. Burgess (eds.) *Upland Settlement in Britain: the Second Millennium BC and After.* Oxford: BAR British Series, No. **143**, pp. 35-49.

Paterson, R.C. 2001. *The Lords of the Isles*. Edinburgh: Birlinn Limited.

Pears, N.V. 1970. "Post-glacial tree-lines of the Cairngorm Mountains, Scotland: some modifications based on radiocarbon dating". *Transactions of the Botanical Society of Edinburgh.* **40:** 536-544.

Peltenburg, E.J. 1982. "Excavations at Balloch Hill, Argyll". *Proceedings of the Society of Antiquaries of Scotland.* **112**: 207-8.

Piggott, C.M. 1951. "Excavation at Dunan na Nighean, Colonsay". *Proceedings of the Society of Antiquaries of Scotland.* **83**: 232-233.

Pitcher, W.S. & A.R. Berger. 1972. *The geology of Donegal.* London:Wiley.

Plog, F. T, and J.N. Hill, 1971. "Explaining variability in the distribution of sites." in G.J. Gumerman (ed.). *The Distribution of Prehistoric Population Aggregates, Anthropological Reports.* No. 1, Prescott, AZ: Prescott College Press, pp. 7-36.

Proudfoot, V.B. 1970. "Irish raths and cashels: some notes on origin, chronology and survival". *Ulster Journal of Archaeology.* **33:** 37-48.

Proudfoot, L. and W. Nolan (eds.). 1997. *Down: history and society*. Dublin.

Proudfoot, V.B. & F.W. Boal. 1960. "Two soil maps of County Down". *The Geographical Journal* **126(1):** 60-66.

Proudfoot, V.B. & B. Wilson. 1961-2. "Further excavations at Larrybane promontory fort". *Ulster Journal of Archaeology*. **24**-**25**: 91-115.

Radford, C.A.R. 1966. "Cultural Relationships of the Celtic World". In *Proceedings of the Second International Congress of Celtic Studies: Cardiff*. Cardiff, pp. 3-30.

Raftery, B. 1971. "Rathgall, Co Wicklow: 1970 excavations". *Antiquity* **45:** 296-298.

Raftery, B. 1972. "Irish Hill-forts," in C. Thomas (ed.) *The Iron Age in the Irish Sea Province*, Council for British Archaeology Research Report **9**: 37-58.

Raftery, B. 1973. "Rathgall: a Late Bronze Age burial in Ireland". *Antiquity* **47:** 293-295.

Raftery, B. 1976. "Rathgall and Irish Hillfort Problems," in D.W. Harding (ed.) *Hillforts: Later Prehistoric Earthworks in Britain and Ireland*, Academic Press, 339-357.

Raftery, B. 1987. "The Loughnashade horns". *Emania* **2:** 21- 4.

Raftery, B. 1994. *Pagan Celtic Ireland, The Enigma of the Irish Iron Age.* London: Thames and Hudson Ltd.

Raftery, B. 2005. "Iron-age Ireland." in D.Ó. Cróinín (ed) *A New History of Ireland.* Oxford University Press: Oxford, pp 134-181.

Raftery, J. 1944. "The Turoe Stone and the Rath of Feerwore". *Journal of the Royal Society of Antiquaries Ireland*. **74:** 23-52.

Raftery, J. 1951. *Prehistoric Ireland*. London: Batsford.

Raftery, J. 1981. "Concerning chronology". In D. Ó Corráin (ed.) *Irish antiquity: essays and studies presented to Professor M.J. O'Kelly.* Cork: Tower Books, pp 82-92.

Ratcliffe, D.A. & D.B.A Thompson. 1988. "The British uplands: their ecological character and international significance". in M.B. Usher & D.B.A. Thompson (eds.) *Ecological Change in the Uplands: Special publication number 7 of the British Ecological Society.* Oxford: Blackwell Scientific Publications, pp. 9-36.

RCHME (Royal Commission on the Historical Monuments of England) 1970. *County Dorset, Volume 2, part 3 South-East,* London: HMSO.

RCAHMS (Royal Commission on the Ancient and Historical Monuments of Scotland). 1914. *The Royal Commission on Ancient and Historical Monuments of Scotland: Fifth Report and Inventory of Monuments and Constructions in Galloway, Vol II. County of the Stewartry of Kirkcudbright.* Edinburgh: HMSO.

RCAHMS. 1928. *Ninth report with inventory of monuments and constructions in the Outer Hebrides, Skye and the Small Isles.* Edinburgh: HMSO.

RCAHMS. 1971. *The Royal Commission on Ancient and Historical Monuments of Scotland: Argyll. An Inventory of the Ancient Monuments Volume 1: Kintyre*. Edinburgh: HMSO.

RCAHMS. 1975. *The Royal Commission on Ancient and Historical Monuments of Scotland: Argyll. An Inventory of the Ancient Monuments Volume 2: Lorn*. Edinburgh: HMSO.

RCAHMS. 1980. *The Royal Commission on Ancient and Historical Monuments of Scotland: Argyll. An Inventory of the Ancient Monuments Volume 3: Mull, Tiree, Coll and northern Argyll: excluding the early Medieval and later monuments of Iona*. Edinburgh: HMSO.

RCAHMS. 1984. *The Royal Commission on Ancient and Historical Monuments of Scotland: Argyll. An inventory of the monuments Volume 5: Islay, Jura, Colonsay and Oronsay*. Edinburgh: HMSO.

RCAHMS. 1988. *The Royal Commission on Ancient and Historical Monuments of Scotland: Argyll. An inventory of the monuments 6: Mid Argyll and Cowal, prehistoric and early historic monuments*. Edinburgh: HMSO.

RCAHMS. 1990. *North-east Perth: an archaeological landscape*. Edinburgh.

Reeves-Smyth, T. & F. Hamond (eds.) 1983. *Landscape Archaeology in Ireland*. Oxford: BAR British Series, No. **116.**

Rhodes, A.N., B.T. Rumsby & M.G. Macklin. 1992. "Gallanach Beg, Oban". in M.J.C. Walker, J.M. Gray & J.J. Lowe (eds.) *The South-west Scottish Highlands: Field Guide.* Cambridge: Quaternary Research Association, pp. 121-124.

Ripley, B.D. 1987. *Stochastic Simulation.* Wiley.

Ritchie, J.N.G. 1974. "Iron Age finds from Dun an Fheurain, Gallanach, Argyll". *Proceedings of the Society of Antiquaries of Scotland.* **103**: 100-112.

Ritchie, J.N.G. 1997a. "Early Settlement in Argyll". in J.N.G. Ritchie (ed.) *The Archaeology of Argyll*, RCAHMS and Edinburgh University Press, pp. 38-66.

Ritchie, J.N.G. (ed.) 1997b. *The Archaeology of Argyll*, RCAHMS and Edinburgh University Press.

Ritchie, J.N.G. & A.M. Lane. 1981. "Dun Cul Bhuirg, Iona, Argyll". *Proceedings of the Society of Antiquaries of Scotland.* **110**: 209-229.

Ritchie, W.A. 1979. "Machair development and chronology of the Uists and adjacent islands". *Proceedings of the Royal Society Edinburgh Section.* **77B**: 107-22.

Rivet, A.L.F. & C. Smith. 1979. *The Place-names of Roman Britain*. Princeton University Press.

Ross, S., J.Moffett & J.Henderson (eds.) 1991. *Computing for Archaeologists.* Oxford: Oxford University Committee for Archaeology.

Ruggles, C. and D.J. Medyckyj-Scott. 1996. "Site Location, Landscape Visibility, and Symbolic Astronomy: A Scottish Case Study." in H.D.G. Maschner (ed.). *New Methods, Old Problems: Geographic Information Systems in Modern Archaeological Research*. Southern Illinois University at Carbondale: Center for Archaeological Investigations Occ. Paper No. 23, pp 127-146.

Ruggles, C., D.J. Medyckyj-Scott & A. Gruffydd 1993. "Multiple viewshed analysis using GIS and its archaeological application: a case study in northern Mull." in J. Andresen, T. Madsen & I. Scollar (eds.) *CAA92 Computer Applications and Quantitative Methods in Archaeology*. Aarhus University Press, pp. 125-132.

Sawyer, P.H. and I.N. Wood (eds.). 1977. *Early Medieval Kinships*. Leeds.

Scott, B.G. (ed.) 1982. *Studies on Early Ireland, Essays in Honour of M.V.Duignan.* Belfast.

Shennan, S. 1997. *Quantifying Archaeology.* Edinburgh University Press.

Sheridan, J.A. 1986. "Porcellanite Artifacts: A new survey". *Ulster Journal of Archaeology*. **49:** 19-32.

Sheridan, A., G. Cooney & E. Grogan. 1992. "Stone axe studies in Ireland". *Proceedings of the Prehistoric Society*. **58:** 389-416.

Skene, W.F. 1837. *The Highlanders of Scotland*. London: John Murray, Vol. 1.

Skene, W.F. (ed.). 1867. *Chronicles of the Picts, chronicles of the Scots: and other memorials of Scottish history*. Edinburgh: H.M. General register house.

Skene, W.F. 1886. *Celtic Scotland: A History of Ancient Alban. Volume 1 History and Ethnography*. 2nd edition. Edinburgh: D. Douglas.

Smith, H. 1999. "The Plant Remains". in M. Parker Pearson & N. Sharples with J. Mulville & H. Smith. *Between Land and Sea: Excavations at Dun Vulan, South Uist.* Sheffield Environmental and Archaeological Research Campaign in the Hebrides, Volume 3. Sheffield: Sheffield Academic Press, pp. 297-336.

Snell, E. 1999. *Multivariate analysis for archaeological site prediction in the Highland Region of Scotland,* Geographical Information Science, Department of Geography, University of Edinburgh: Unpublished MSc. Dissertation.

Spratt, D. and C. Burgess (eds.) 1985. *Upland Settlement in Britain: the Second Millennium BC and After.* Oxford: BAR British Series, No. **143.**

Stenberger, M. 1966. "A ringfort at Raheennamadra, Knocklong, Co. Limerick. *Proceedings of the Royal Irish Academy*. **65C:** 37-54.

Stewart, M. & R.A. Stranchan. 1999. "Structure and early kiematic historyof the Great Glen Fault Zone, Scotland". *Tectontics.* **18(2):** 326-342.

Stokes, W. 1896. "The Annals of Tigernach, Third Fragment. A.D. 489-766." *Revue Celtique* **17**:79-223.

Stout, M. 2000. *The Irish Ringfort,* Irish Settlement Studies No. **5**, Four Courts Press.

Thomas, C. (ed.). 1972. *The Iron Age in the Irish Sea Province.* London: Council for British Archaeology Research Report **9**.

Thomas, F.W.L. 1890. "On Duns of the Outer Hebrides". *Archaeologica Scotica.* **5**: 365-432.

Thomas, F.W.L. 1879. "Dunadd, Glassary, Argyllshire; the place of inauguration of the Dalriadic kings". *Proceedings of the Society of Antiquaries of Scotland.* **13:** 28-47.

Thomas, D. H. & R.L. Bellinger. 1976. *Prehistoric Pinon Ecotone Settlements of the Upper Reese River Valley, Central Nevada.* Anthropological Papers, Vol. 53, No. 3. New York: American Museum of Natural History.

Tilley, C. 1994. *A Phenomenology of Landscape*. Oxford: Berg.

Tilley, C. 1996. "The Power of Rocks: Topography and Monument Construction on Bodmin Moor". *World Archaeology.* **Vol 28, No. 2:** 161-176.

Timoney, M. (ed.) 2002. *A Celebration of Sligo – first essays for Sligo Field Club*. Sligo: Sligo Field Club.

Tipping, R. 1994. "The form and fate of Scotland's woodlands". *Proceedings of the Society of Antiquaries of Scotland.* **124**: 1-54.

Tomlin, C.D. 1990. *Geographic Information Systems and Cartographic Modeling*. Englewood Cliffs, N.J.: Pretice-Hall.

Tuovinen, T. 2002. *The Burial Cairns and the Landscape in the Archipelago of Åboland, SW Finland, in the Bronze Age and the Iron Age,* Academc dissertation, Department of Art Studies and Anthropology, University of Oulu, Finland.

Usher, M.B. & D.B.A. Thompson (eds.) 1988. *Ecological Change in the Uplands: Special publication number 7 of the British Ecological Society.* Oxford: Blackwell Scientific Publications.

van Leusen P M, 1993. "Cartographic modelling in a cell-based GIS". in J Andresen, T Madsen, I Scollar (eds) *Computing the Past: Computer Applications and Quantitative Methods in Archaeology 1992.* Aarhus: Aarhus University Press, pp 105-123.

van Leusen, P.M. 2002. *Pattern to process: methodological investigations into the formation and interpretation of special patterns in archaeological landscapes.* unpublished PhD thesis, University of Groningen.

Veneziano, D. 2002. *Accuracy Evaluation of LIDAR-Derived Terrain Data for Highway Location*. Paper from the Transportation Scholars Conference 2002, Centre for Transportation Research and Education, Iowa State University.

Voorrips, A. (ed.) 1990. *Mathematics and Information Science in Archaeology: A Flexible Framework.* Studies in Modern Archaeology 3. Bonn: Holos-Verlag.

Waddell, J. 1978. "The Invasion Hypothesis in Irish Prehistory." *Antiquity* **52**: 121-128.

Waddell, J. 1998. *The Prehistoric Archaeology of Ireland.* Galway University Press.

Waddell, J. and E.S. Twohig (eds.). 1995. *Ireland in the Bronze Age. Proceedings of the Dublin conference, April 1995.* Dublin.

Wailes, B. 1990. "Dún Ailinne: a summary excavation report". *Emania* **7:** 10-21.

Wakeman, W.F. 1848. *Archæologica Hibernica. A hand-book of Irish antiquities, pagan and Christian: especially of such as are easy of access.* Dublin: James McGlashan.

Walker, M.J.C. & J.J. Lowe. 1985. "Flandrian environmental history of the Isle of Mull. I. Pollen-stratigraphic evidence and radiocarbon dates from Glen More, south-central Mull". *New Phytologist.* **99:** 587-610.

Walker, M.J.C., J.M. Gray & J.J. Lowe (eds.) 1992. *The South-west Scottish Highlands: Field Guide.* Cambridge: Quaternary Research Association.

Warner, R.B. 1979. "The Irish souterrains and their background". in H.E.W. Crawford (ed.) *Subterranean Britain: Aspects of Underground Archaeology*. New York: St. Martin's Press, pp. 100-144.

Warner, R.B. 1981. "Fortification: Observations on the beginnings of Fortification in Later Iron-Age Ireland". *Bulletin of the Ulster Place Name Society* (2nd series). **3**: 45-52.

Warner, R.B. 1983. "Ireland, Ulster and Scotland in the Earlier Iron Age". in A. O'Connor & D.V. Clarke (eds.) *From the Stone Age to the 'Forty-Five: studies presented to R.B.K. Stevenson former Keeper National Museum of Antiquities of Scotland*. Edinburgh: John Donald Publishing Ltd. pp 160-187.

Warner, R.B. 1997. "The radiocarbon chronology of the Navan excavation". in D.M. Ceremonial activity was suggested as the probable function of this structure, supported by evidence of deliberate destruction by fire (Murphy 2000). *Excavations at Navan Fort 1961-71*. Completed and edited by C.J. Lynn, Northern Ireland Archaeological Monographs: No **3**, Belfast: The Stationary Office, pp. 173-196.

Warren, R.E. & D.L. Asch. 2000. "A predictive model of archaeological site location in the Eastern Prairie Peninsula." in K.L. Westcott & R.J. Brandon (ed). *Practical Applications of GIS for archaeologists: A predictive modeling toolkit.* London: Taylor & Francis, pp. 5–32.

Waterman, D.M. 1956. "The Excavation of a House and Souterrain at White Fort, Drumaroad, Co Down" *Ulster Journal of Archaeology* **19:** 73-86.

Waterman, D.M. 1971. "A marshland habitation site near Larne, Co Antrim". *Ulster Journal of Archaeology*. **34:** 65-76.

Waterman, D.M. 1997a. *Excavations at Navan Fort 1961-71*. Completed and edited by C.J. Lynn, Northern Ireland Archaeological Monographs: No **3**, Belfast: The Stationary Office.

Waterman, D.M. 1997b. "Site B excavation: phase 1 Neolithic to phase 3(iii) Early Iron Age". in D.M. Waterman *Excavations at Navan Fort 1961-71*. Completed and edited by C.J. Lynn, Northern Ireland Archaeological Monographs: No **3**, Belfast: The Stationary Office, pp. 13-34.

Wefer, G., W. Berger, K.E. Behre & E. Jansen (eds.) 2002. *Climatic development and history of the North Atlantic realm.* Berlin/Heidelberg/New York: Springer-Verlag.

Weir, A.W. 1993. "Dark Ages and the pollen record". *Emania.* **11:** 21-30.

Weir, A.W. 1994. "A palynological study of landscape development in County Louth in the first millennium BC and the first millennium AD". *Discovery Programme Reports* **1:** 104-109.

Weir, A.W. 1995. "A palynological study of landscape development and agricultural development in County Louth from the second millennium BC to the first millennium AD". *Discovery Programme Reports* **2:** 77-126.

Weir, A.W. 1997. "The environment of Navan: an outline of vegetational history from *c.* 5500 cal. BC to 1000 cal. AD". in D.M. Waterman *Excavations at Navan Fort 1961-71*. Completed and edited by C.J. Lynn, Northern Ireland Archaeological Monographs: No **3**, Belfast: The Stationary Office.

Weir, D.A. 1989. "A radiocarbon date from the Navan Fort ditch". *Emania* **6:** 34-35.

Westcott, K.L. & R.J. Brandon (ed). 2000. *Practical Applications of GIS for archaeologists: A predictive modeling toolkit.* London: Taylor & Francis.

Westropp, T.J. 1901. "The ancient forts of Ireland: being a contribution towards our knowledge of their types, affinities and structural features". *Transactions of the Royal Irish Academy.* **31:** 579-730.

Wheatley, D. 1993. "Going over old ground: GIS Archaeological Theory and the act of perception." in J. Andresen, T. Madsen & I. Schollar (eds.) *CAA92 Computer Applications and Quantitative Methods in Archaeology*. Aarhus University Press, pp. 133-138.

Wheatley, D. 1995. "Cumulative viewshed analysis: a GIS-based method for investigating intervisibility, and its archaeological application." in G. Lock & Z. Stančič (eds.) *Archaeology and Geographical Information Systems: A European Perspective.* London: Taylor & Francis, pp. 170-185.

Wheatley, D. 1996. "The Use of GIS to Understand Regional Variation in earlier Neolithic Wessex." in H.D. Maschner (ed) *New Methods, Old Problems. Geographic Information Systems in Modern Archaeological Research.* Southern Illinois University Center for Archaeological Investigation Occasional Paper **23:** 75-103.

Wheatly, D. 2004. "Making space for an archaeology of place." *Internet Archaeology*. 15. http://intarch.ac.uk/journal/i...y_toc.html.

Wheatley, D. and M. Gillings. 2000. "Vision, Perception, and GIS: developing enriched approaches to the study of archaeological visibility." in G. Lock (ed) *Beyond the Map: Archaeology and spatial technologies.* Amsterdam, etc.: IOS Press, pp. 1-27.

Wheatley, D. and M. Gillings. 2002. *Spatial Technology and Archaeology: the archaeological applications of GIS.* London: Taylor and Francis.

Williams, B.B. 1984. "Excavations at Ballyutoag, County Antrim". *Ulster Journal of Archaeology* **47:** 37-49.

Wood, R.B. & R.V. Smith (eds). 1993. *Lough Neagh: the Ecology of a multipurpose Water Resource.* London: Kluwer Academy.

Woodman, P.E. 2000a. “Beyond significant patterning, towards past intentions: the location of Orcadian chambered tombs.” in C. Buck *et al.* (eds). *Proceedings of the UK Chapter of Computer Applications and Quantitative Methods in Archaeology 1999*. Oxford: BAR British Series, No. **844**, pp. 91-105.

Woodman, P.E. 2000b. “A predictive model for Mesolithic location on Islay using logistic regression and GIS.” In S.J. Mithen (ed.) *Hunter-Gatherer Landscape Archaeology: The Southern Hebrides Mesolithic Project 1988-98*. Vol. 2, *Archaeological Fieldwork on Colonsay, Computer Modelling, Experimental Archaeology, and Final Interpretations.* Cambridge: McDonald Institute for Archaeological Research, pp. 445-464.

Young, A. 1962. “Brochs and Duns”. *Proceedings of the Society of Antiquaries of Scotland* **95**: 171-198.

Zubrow, E.B.W. 2006. “Digital Archaeology: A historical context.” in P. Daly & T.L. Evans (eds). *Digital Archaeology: Bridging method and theory.* New York: Routledge, 10-31.

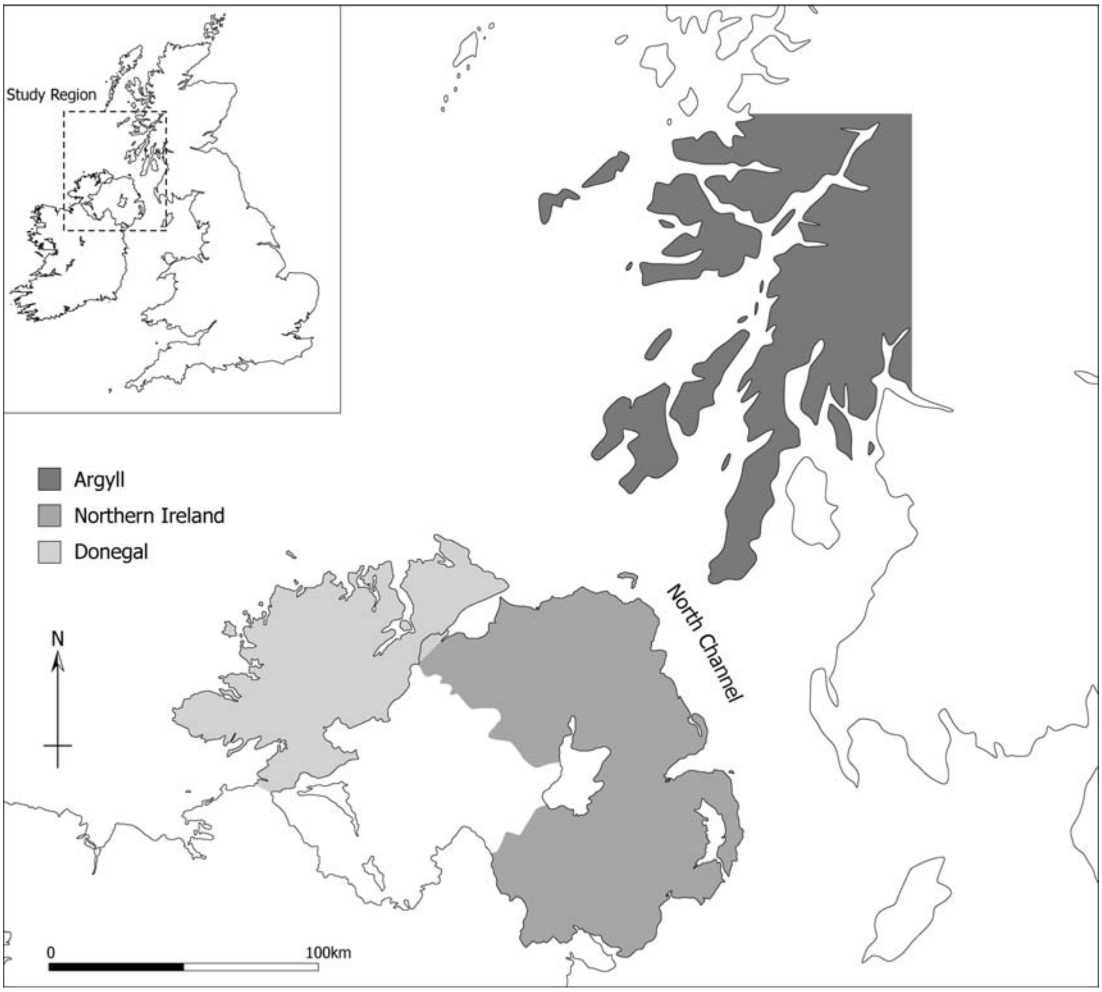


Figure 2.1: Map of study region. Shaded areas indicate study area boundaries.

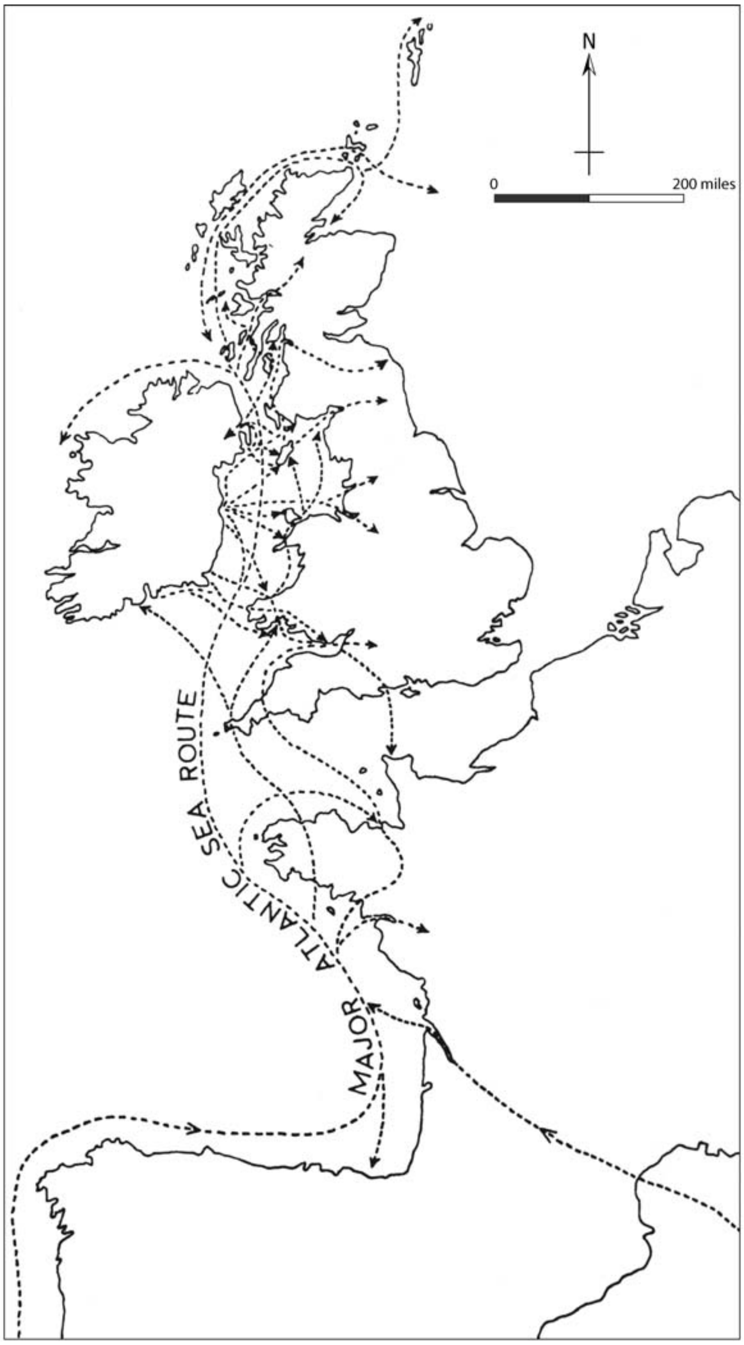


Figure 2.2: Map of hypothetical Atlantic Seaways during the prehistoric period (after Bowen 1977, fig 4)

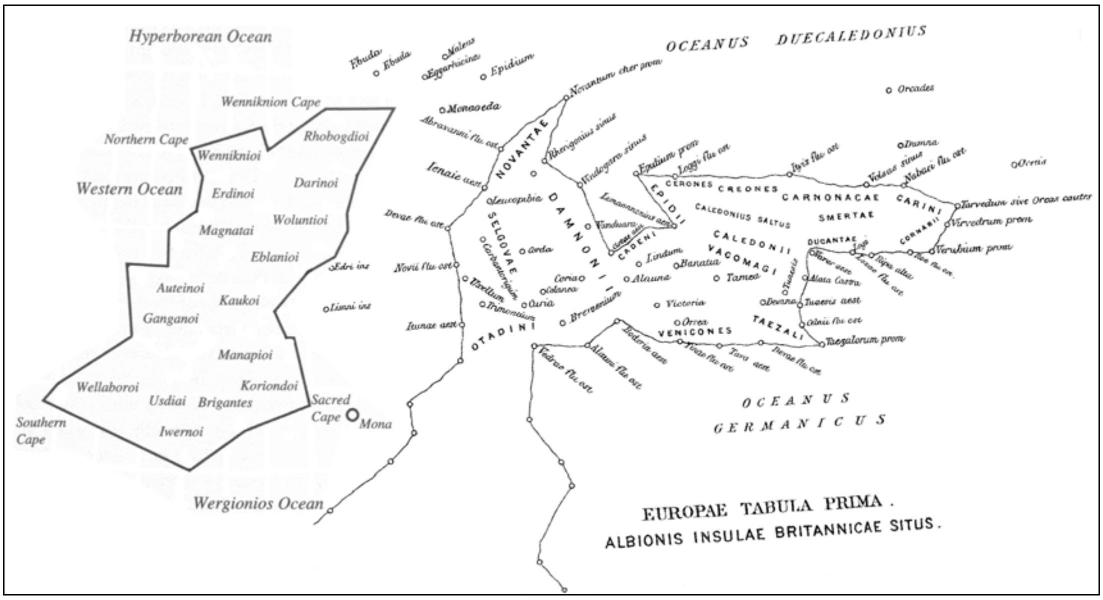


Figure 2.3: Ptolemy’s map of Ireland and Scotland (after Raftery 1994 and Breeze 1982).

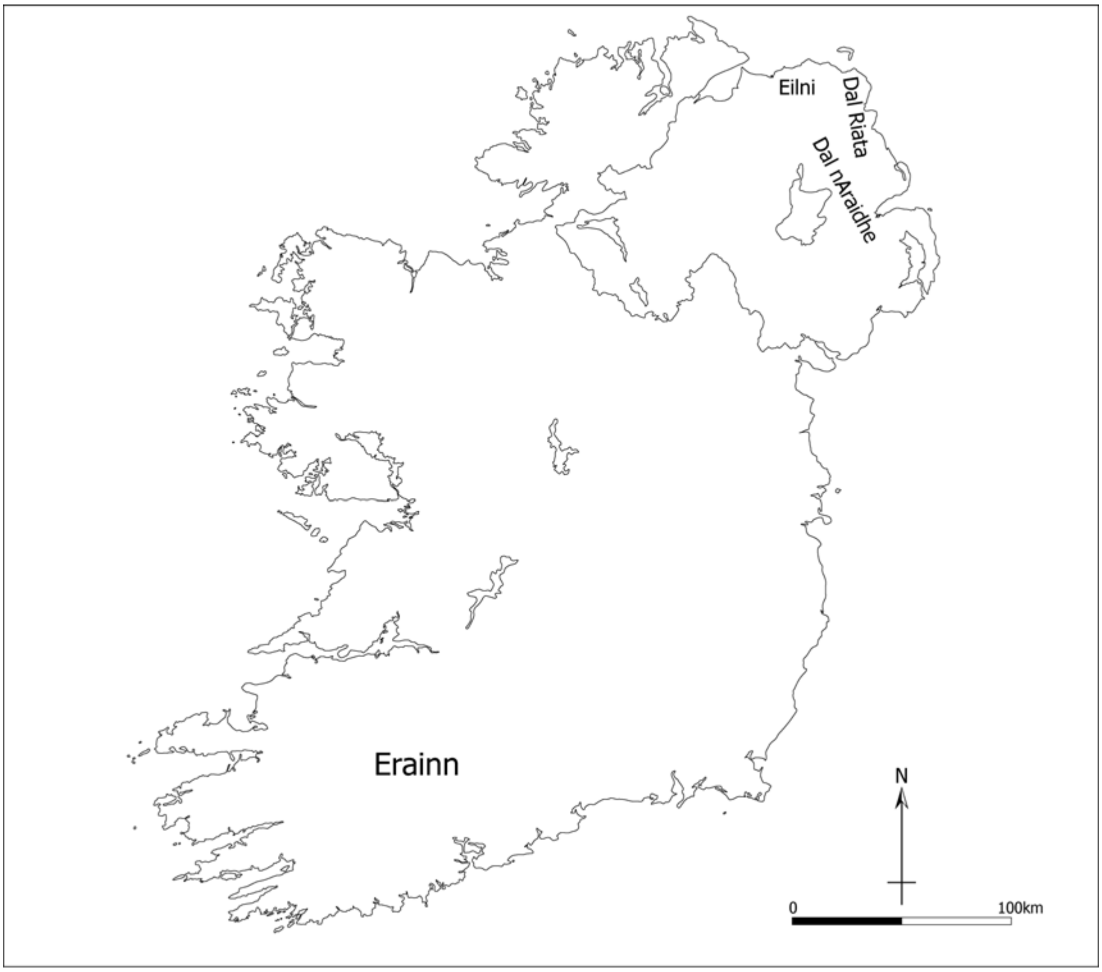


Figure 2.4: Map of tribal groups in Ireland.

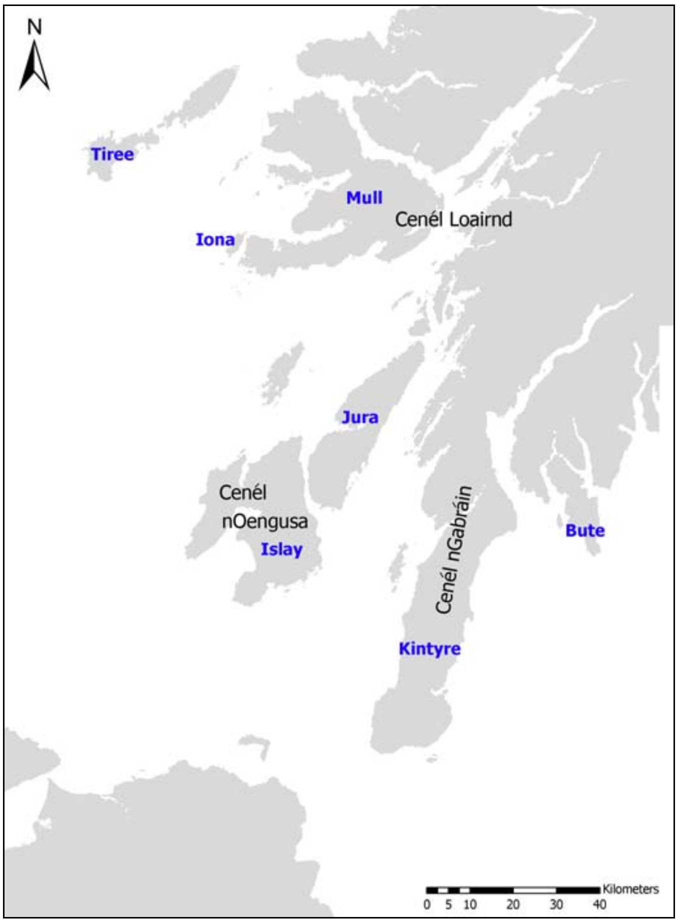


Figure 2.5: Map of Dál Riata and area controlled by the tribal groups (after Campbell 1999).

Figure 2.6: Mackinder's "Seas if the Oceanic Border" division of Atlantic Britain illustrating the potential of axes of contact (After Mackinder 1902, fig 14).

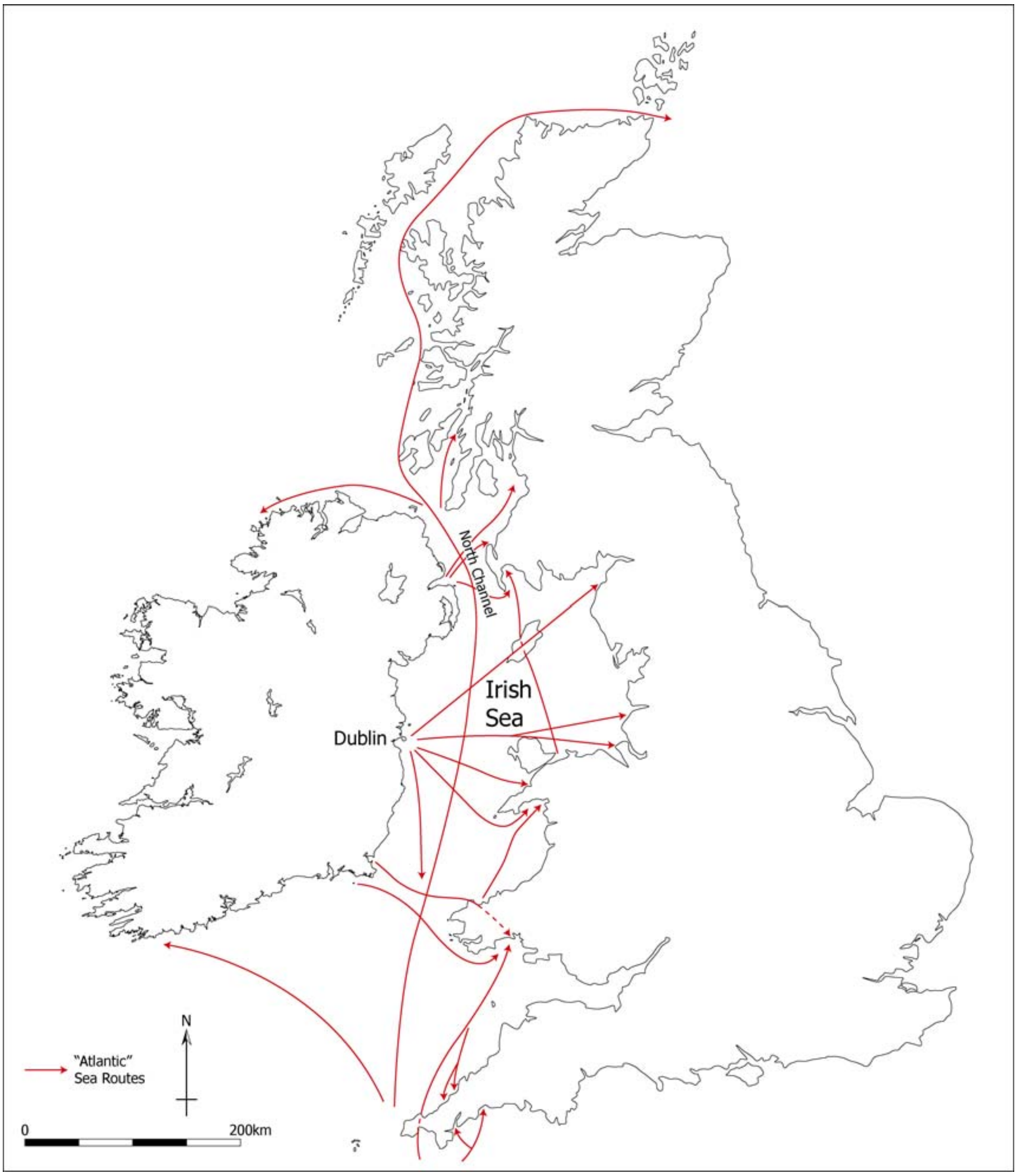


Figure 2.7: Sir Cyril Fox's western sea routes through Britain and Ireland (after Bowen 1970 fig 1).

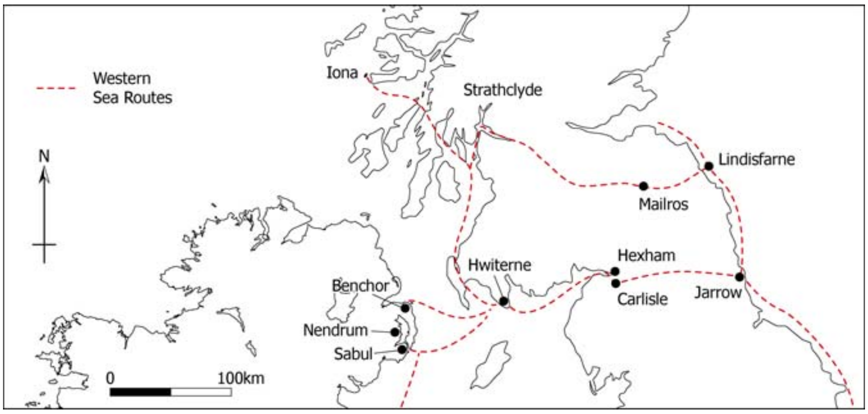


Figure 2.8: Crawford's (1936) western sea routes through Western Europe illustrating his variation through Northern Ireland and western Scotland (after Bowen 1977, fig 2).

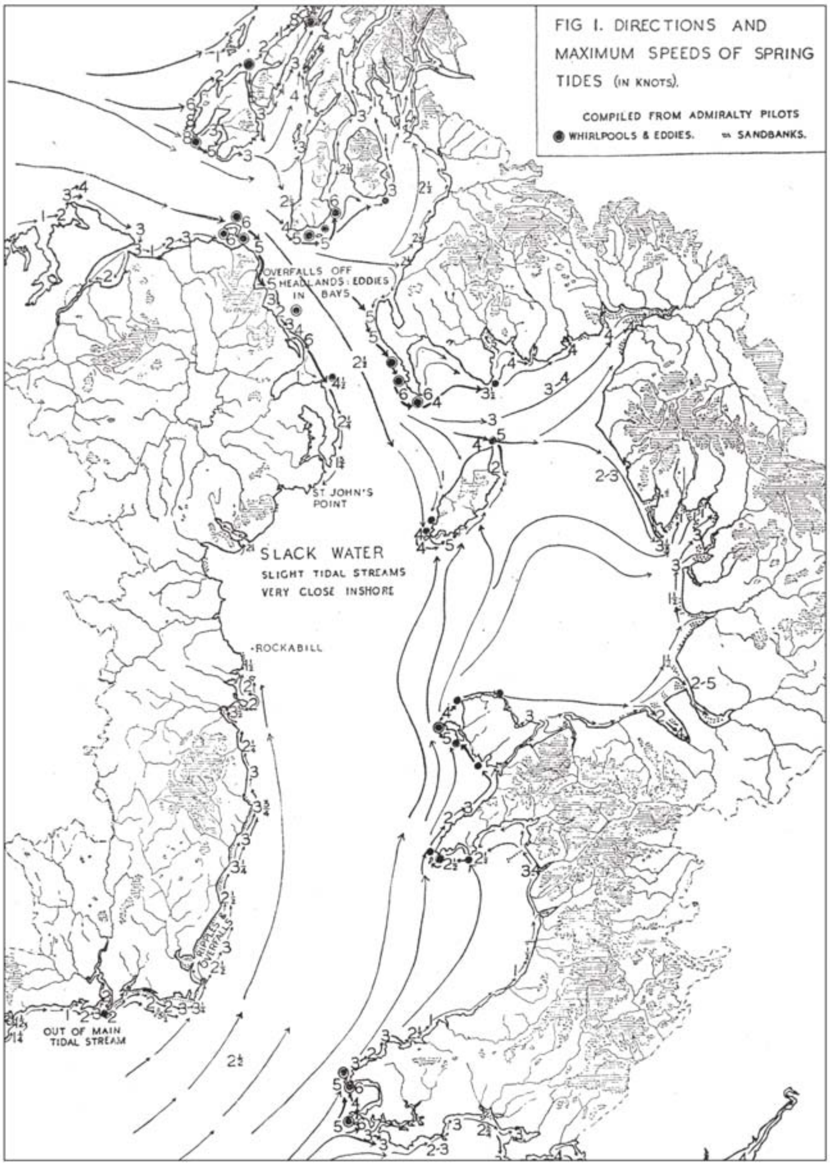


Figure 2.9: Directions and speeds of spring tides in knots and distribution of greater tidal eddies and whirlpools in the study region (after Davies 1946, fig 1).

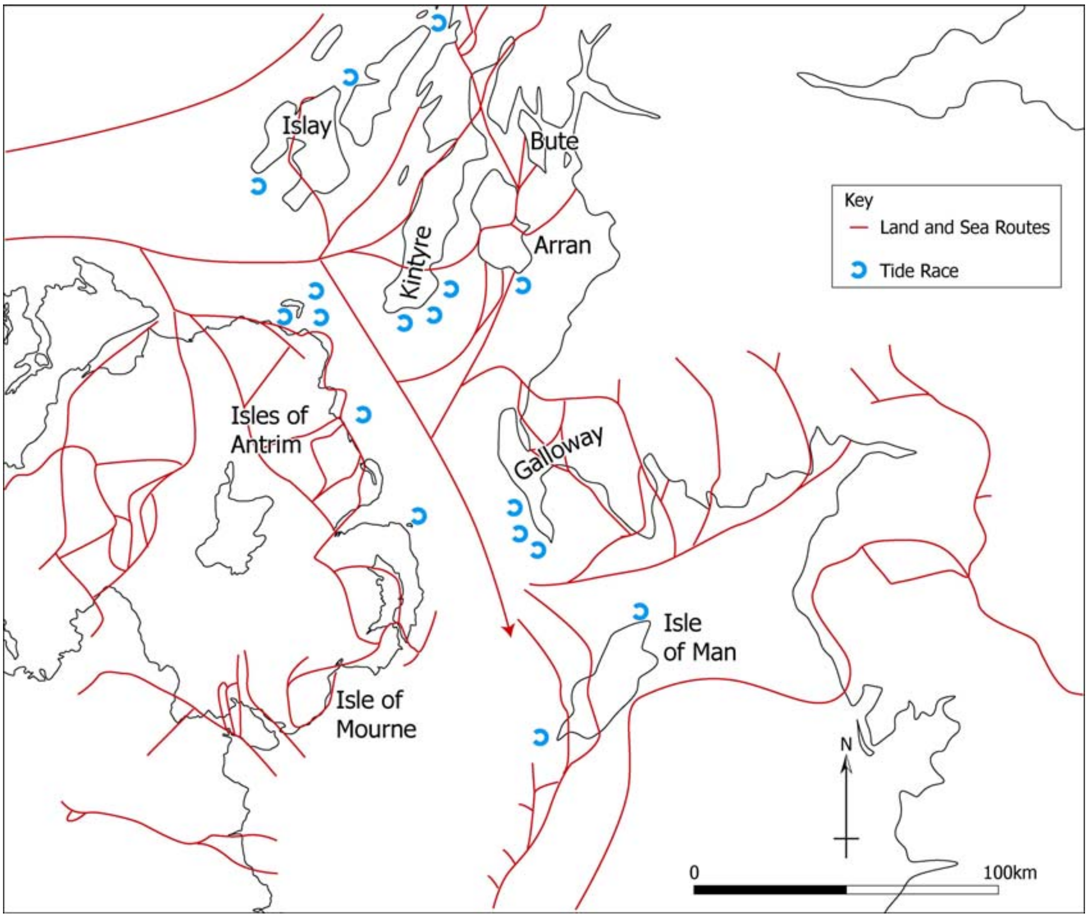


Figure 2.10: Davies' (1946) maritime and landward route ways (after Davies 1946, fig 2).

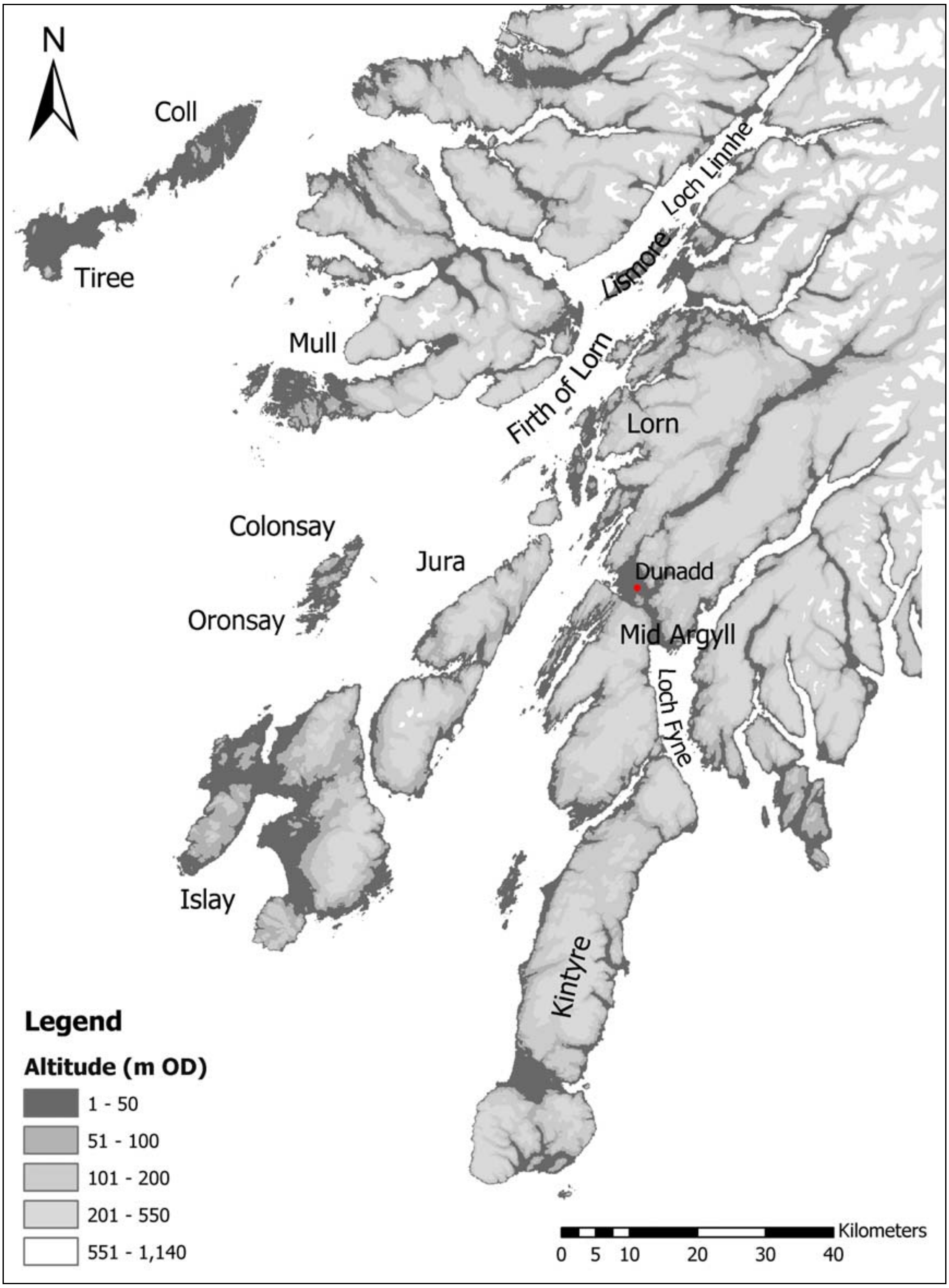


Figure 3.1: Elevation map of Argyll study area with place names.

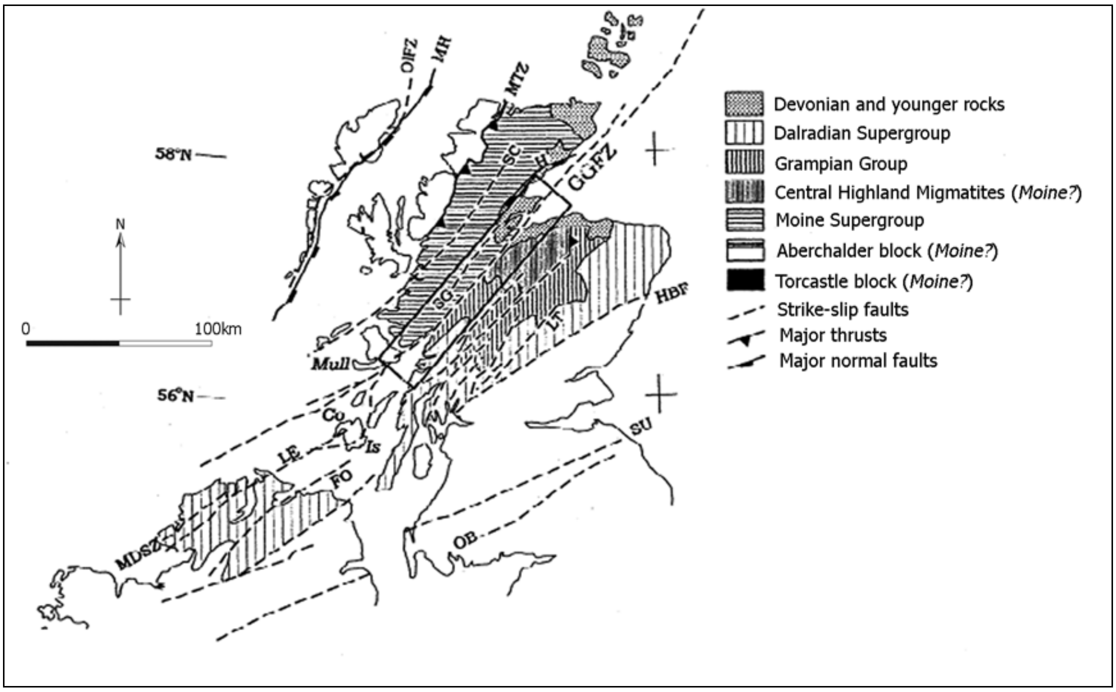


Figure 3.2: Map of study region illustrating the Great Glen Faultline (after Stewart & Strachan 1999, fig 1b).

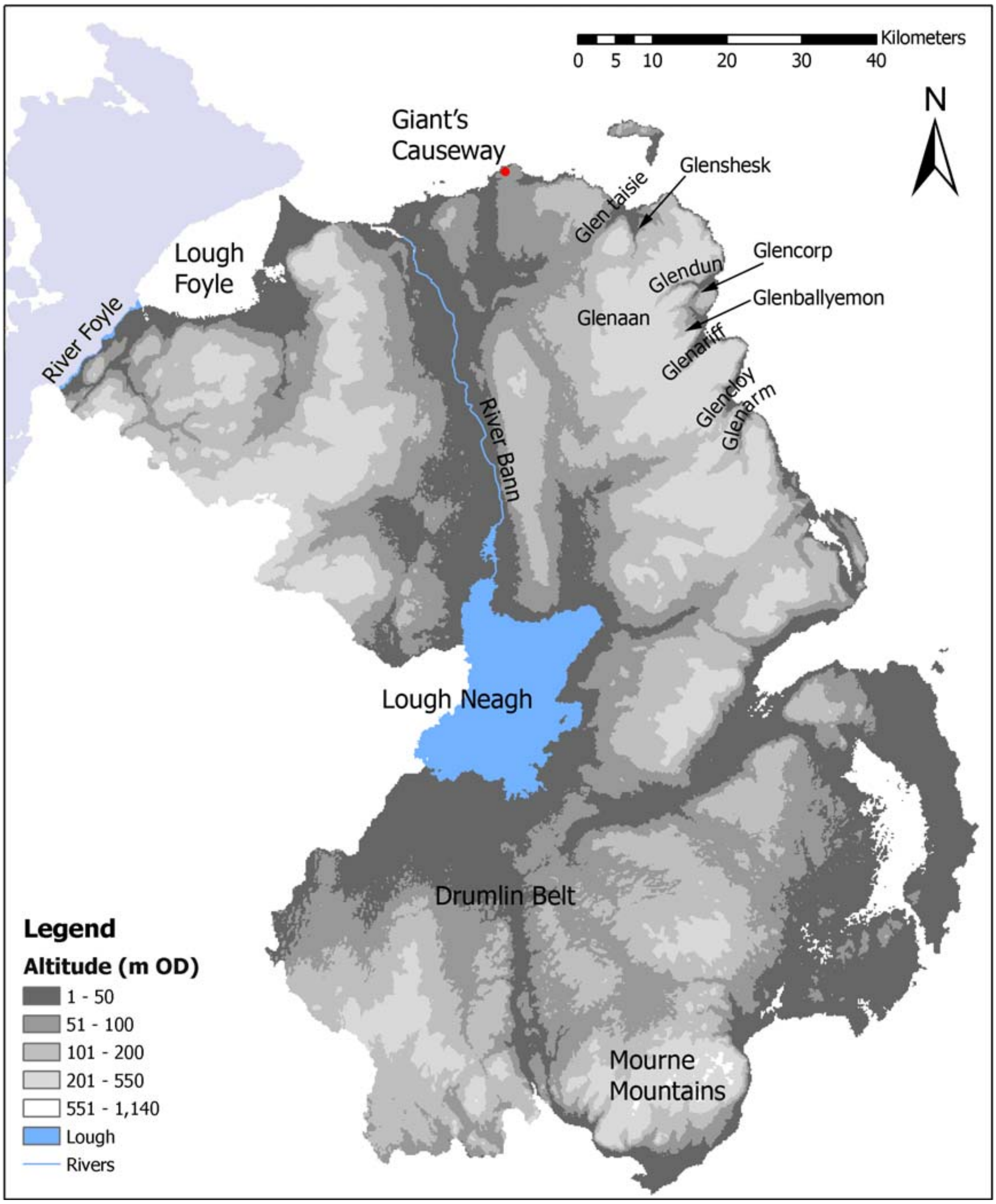


Figure 3.3: Elevation map of Northern Ireland study area with place names.

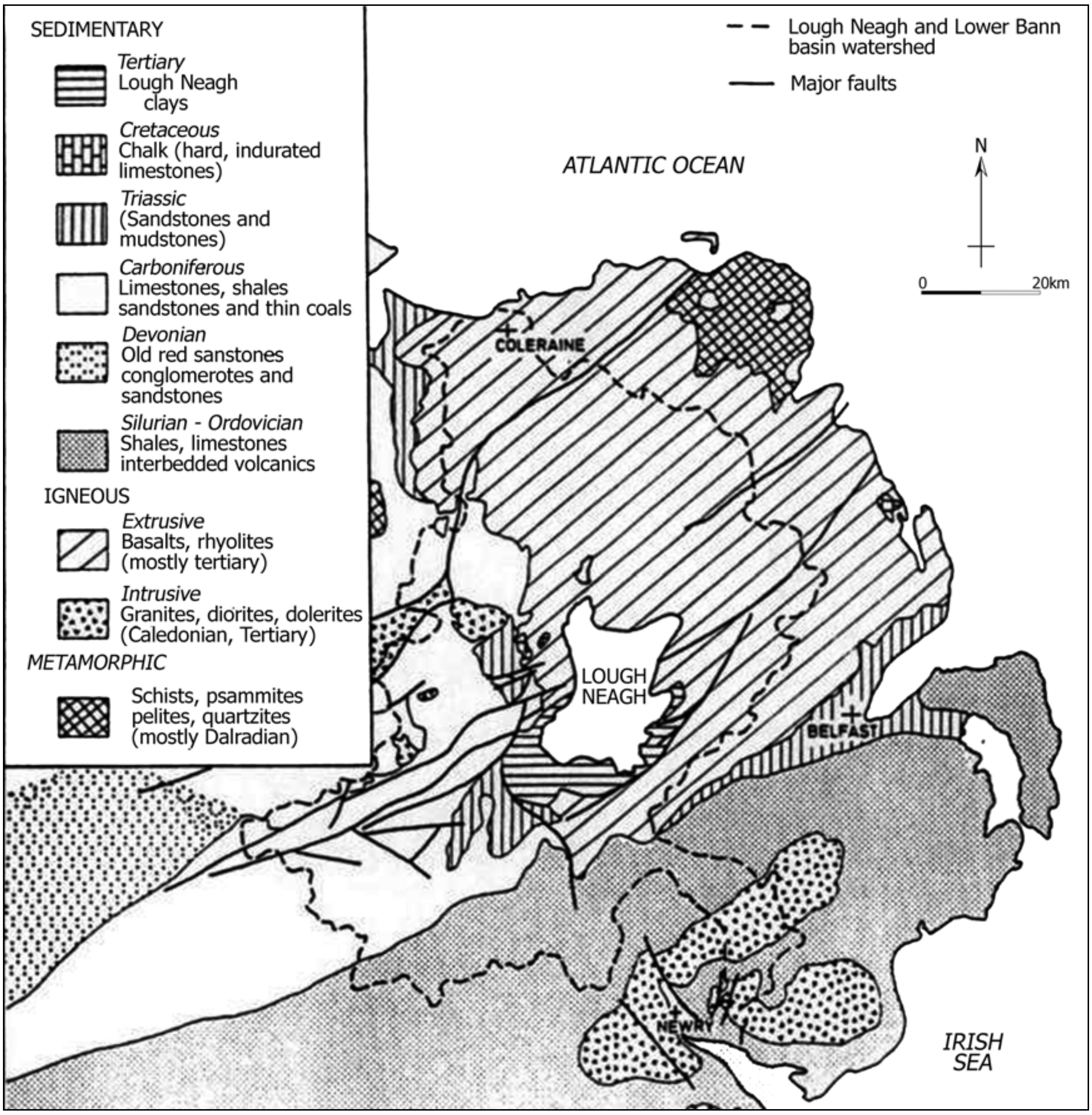


Figure 3.4: Geological map of Northern Ireland study area (after Carter 1993, fig 2.1).

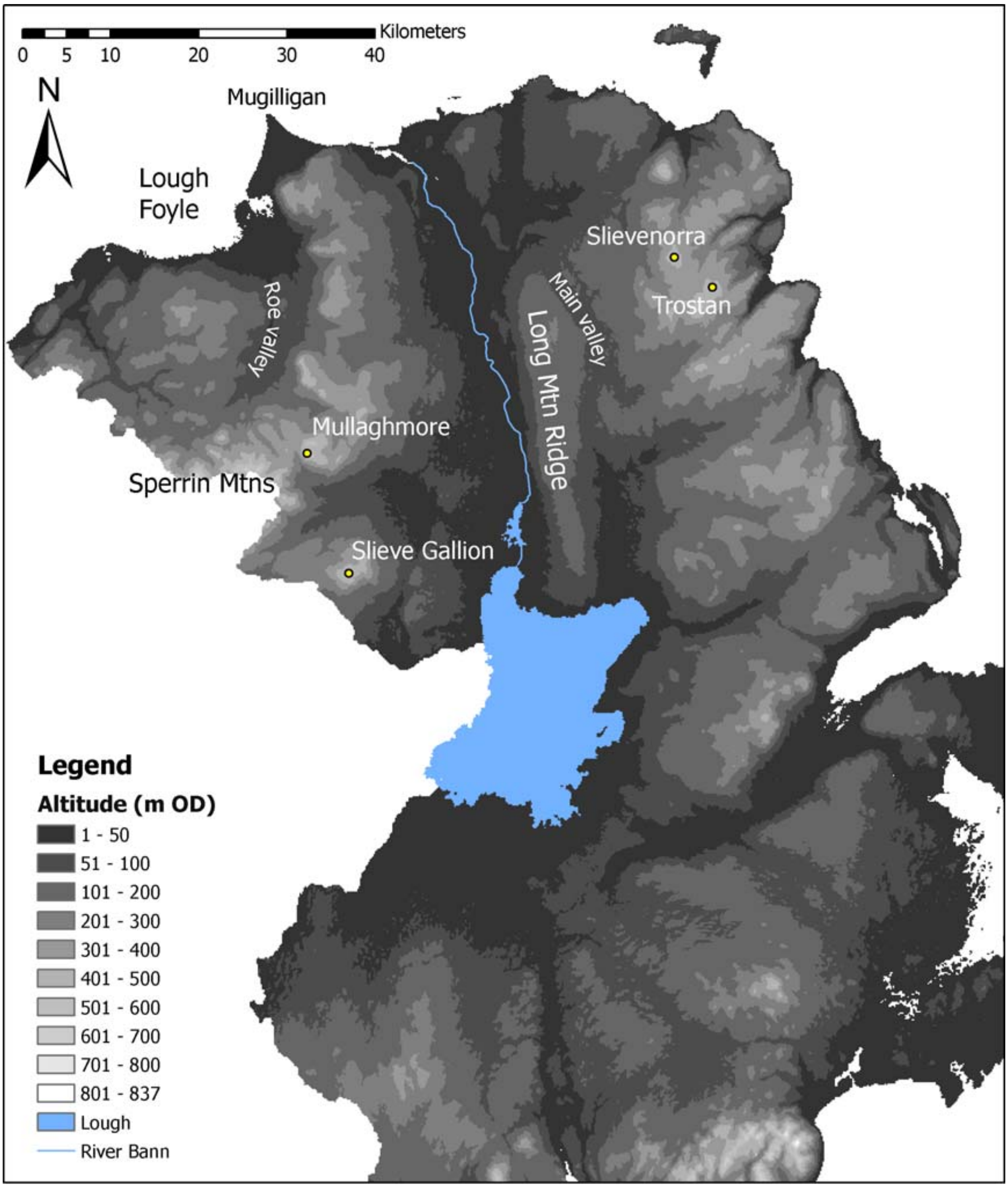


Figure 3.5: Detailed elevation map depicting topographical features in the northern half of the Northern Ireland study area.

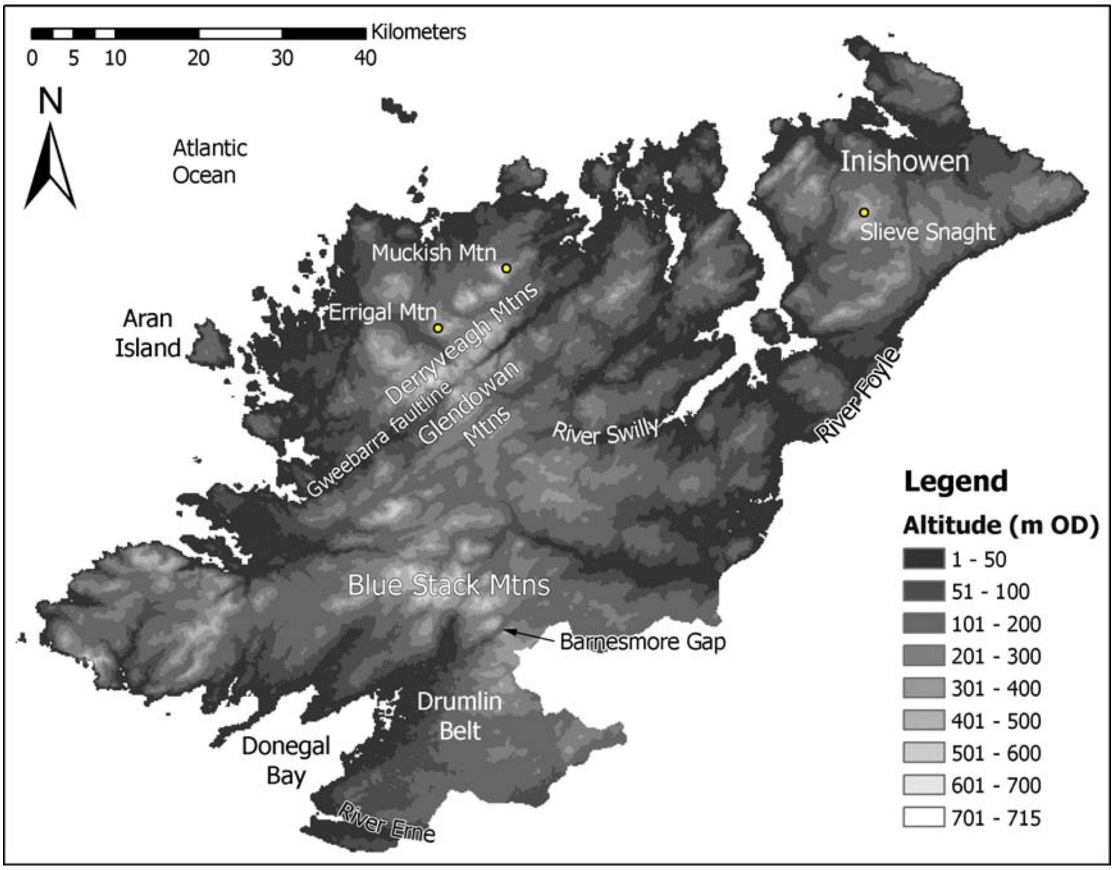


Figure 3.6: Elevation map of Co. Donegal study area with place names.

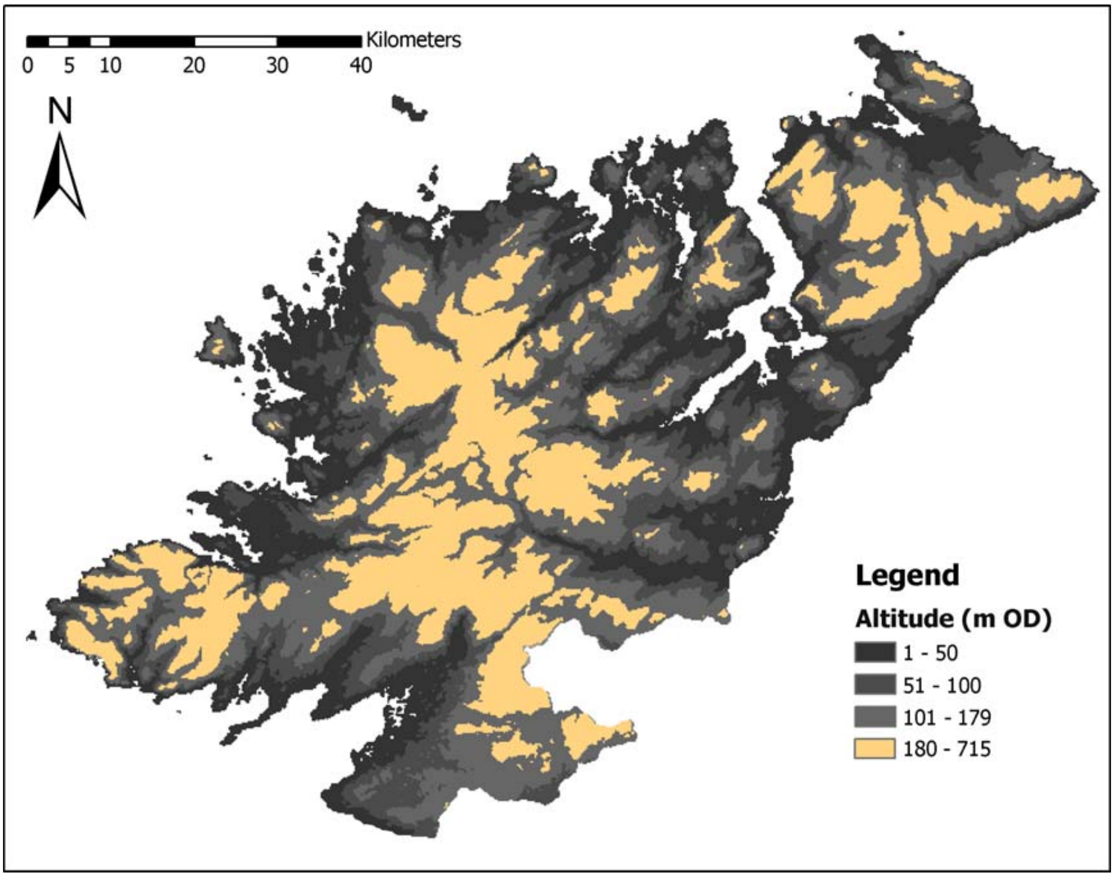


Figure 3.7: Elevation map of Co. Donegal highlighting altitudes above 180m OD.

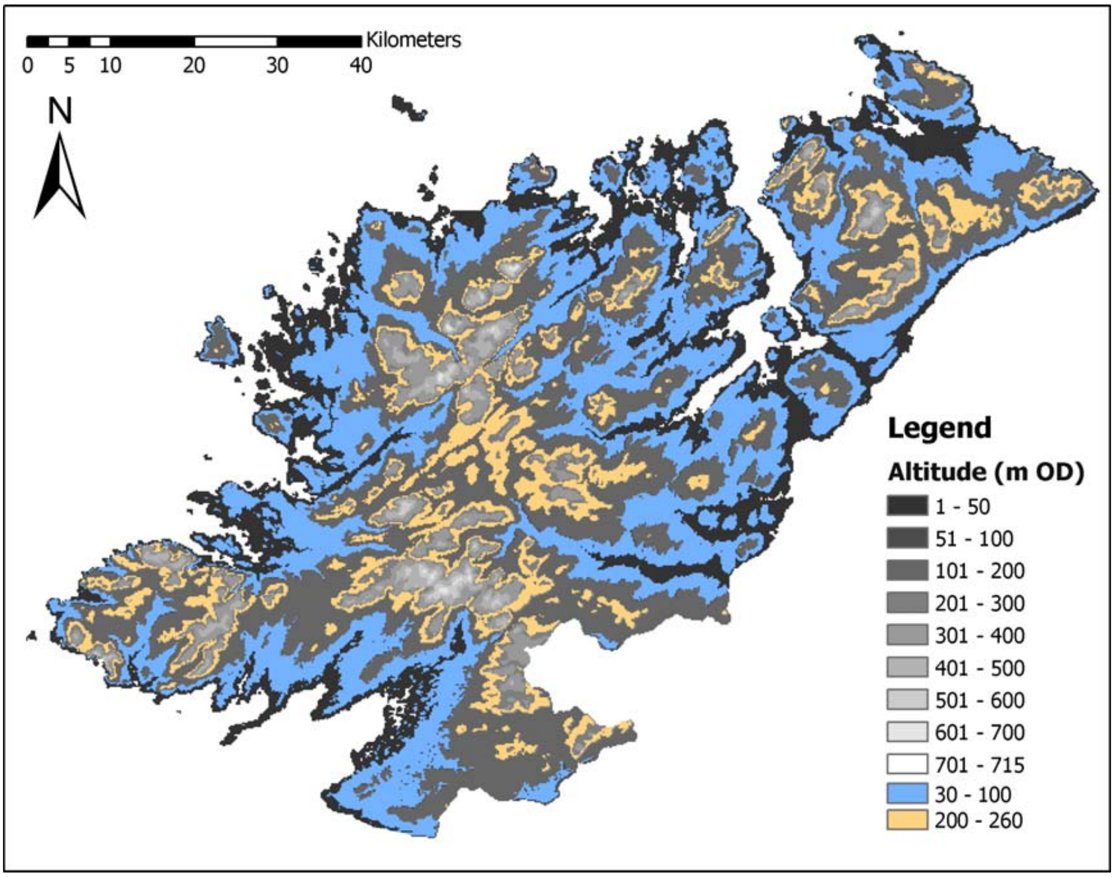


Figure 3.8: Elevation map of Co. Donegal highlighting altitude ranges between 30m OD – 100m OD and 200m OD – 260m OD.

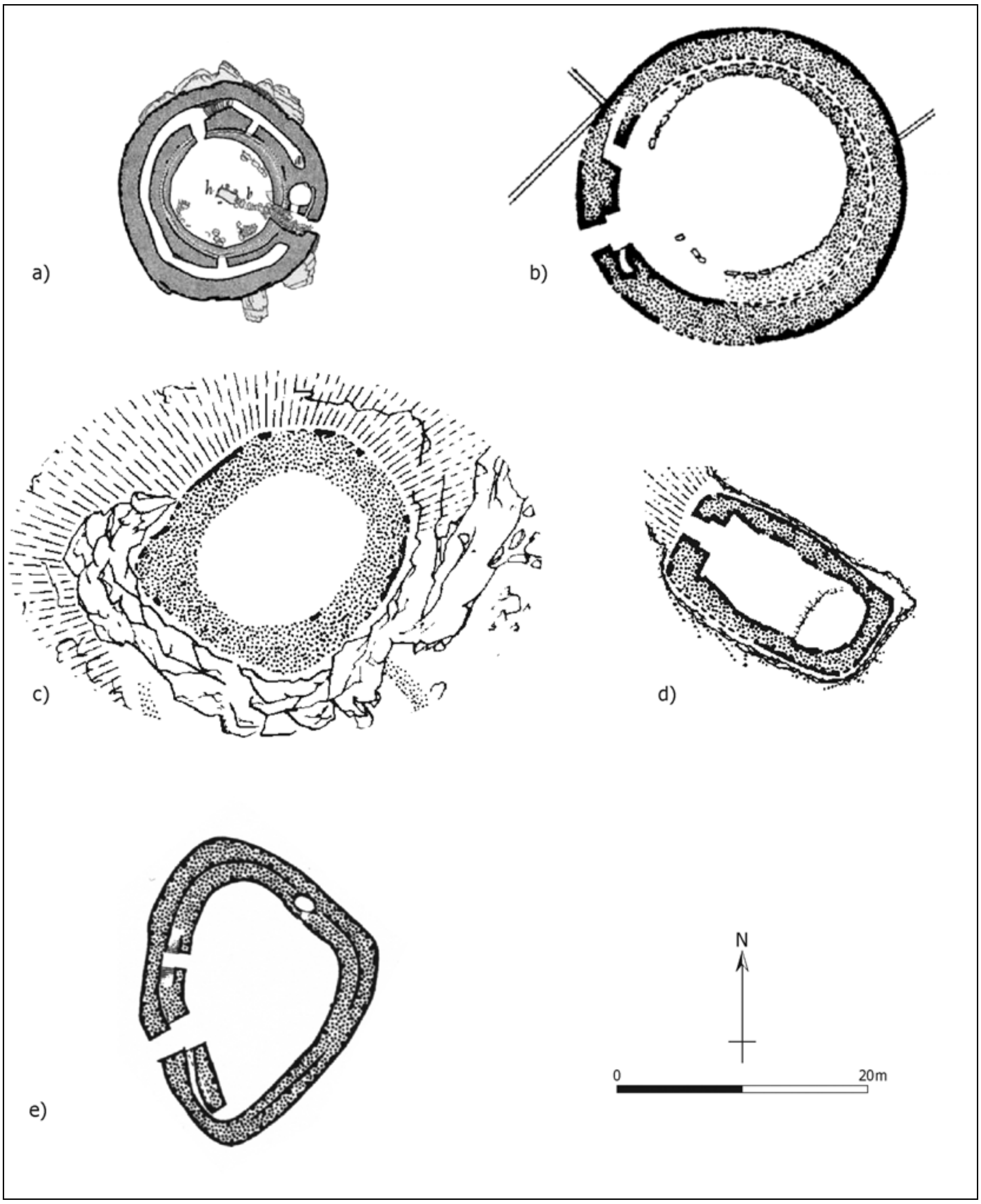


Figure 4.1: Example of a site classified as (a) 'broch': Dun Mor Vaul (AR-008); (b) 'dun', with broch style architectural details comprising of a guard cell in the entrance passage and an intramural staircase on the northwest: Ardifuir 1 (AR-401); (c) 'dun', a simple, solid walled sub-circular structure: Ardifuir 2 (AR-320); (d) 'dun' a simple, solid walled rectilinear-shaped structure: Dùn Fhinn (AR-311); (e) 'dun' a triangular-shaped structure with double stairs and intramural gallery: Kildonan Bay (AR-073) (Source: RCAHMS 1988).

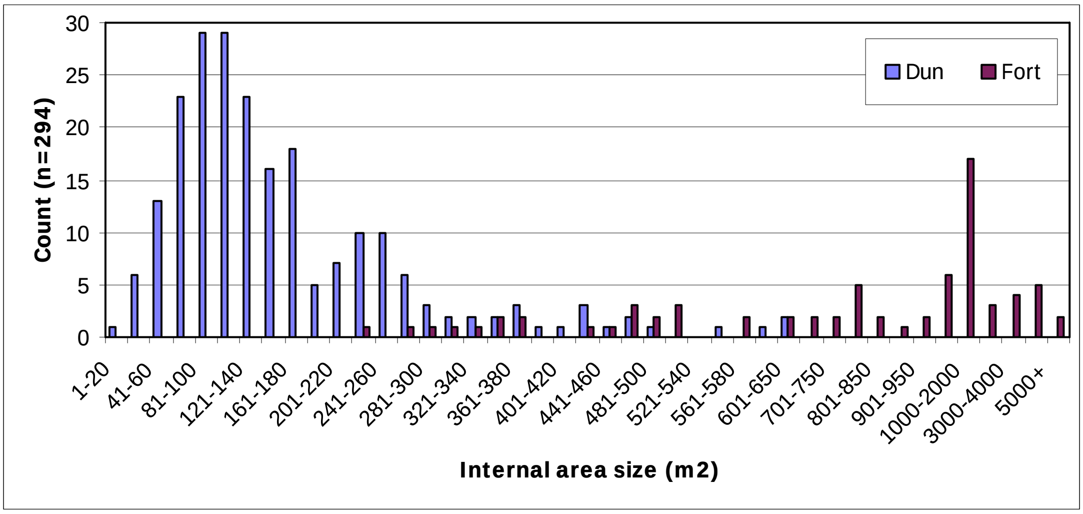


Figure 4.2: Internal area size of 'dun' and 'fort' sites that have documented measurements (RCAHMS). Overlapping of the two types occurs between 240m² and 700m².

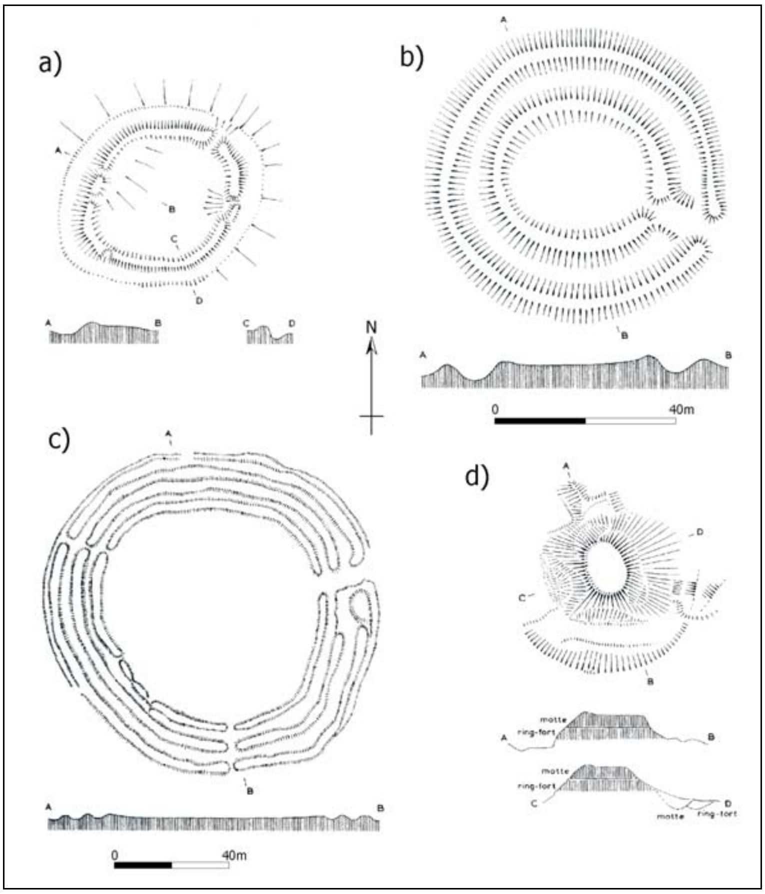


Figure 4.3: Examples of ringforts: (a).univallate rath at Killyliss, Co. Tyrone; (b).bivallate rath at Lisnageeha, Co. Tipperaru; (c).multivallate rath at Garranes, Co. Cork; (d). Raised rath at Rathmullan, Co. Down (Source: Edwards 2005).

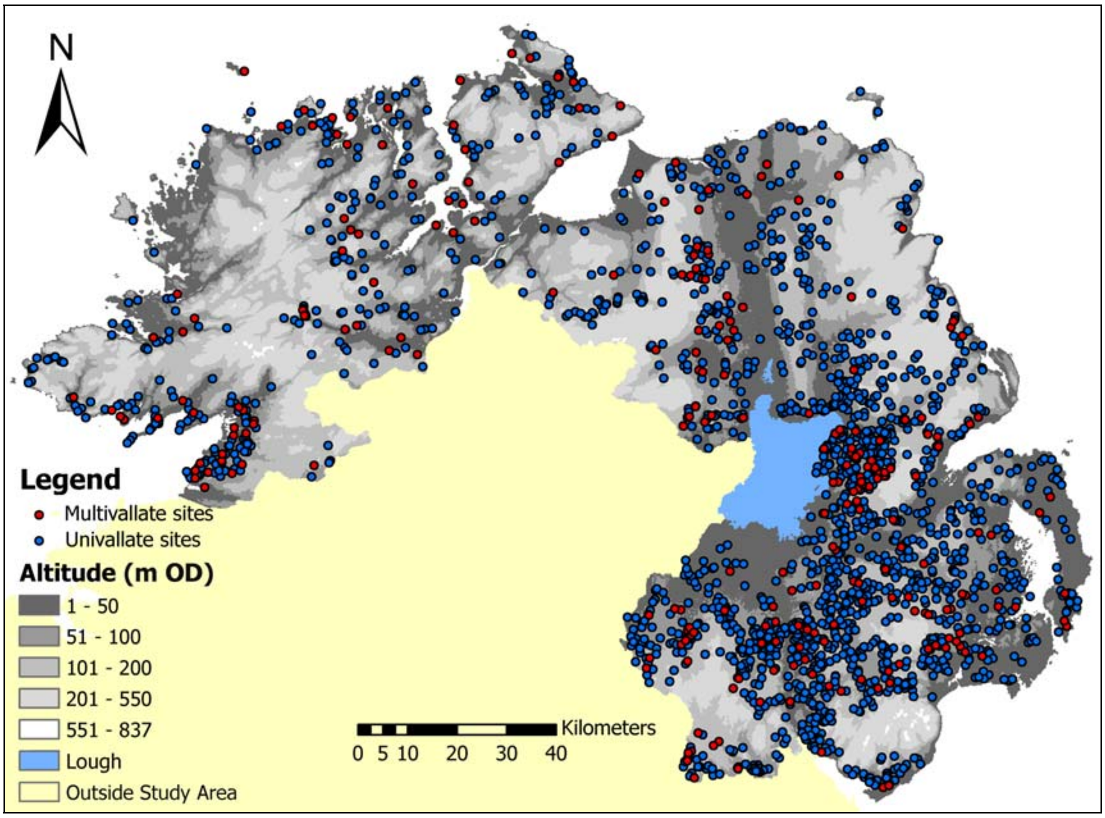


Figure 4.4: Distribution of univallate and multivallate sites in the study areas of Co. Donegal and Northern Ireland.

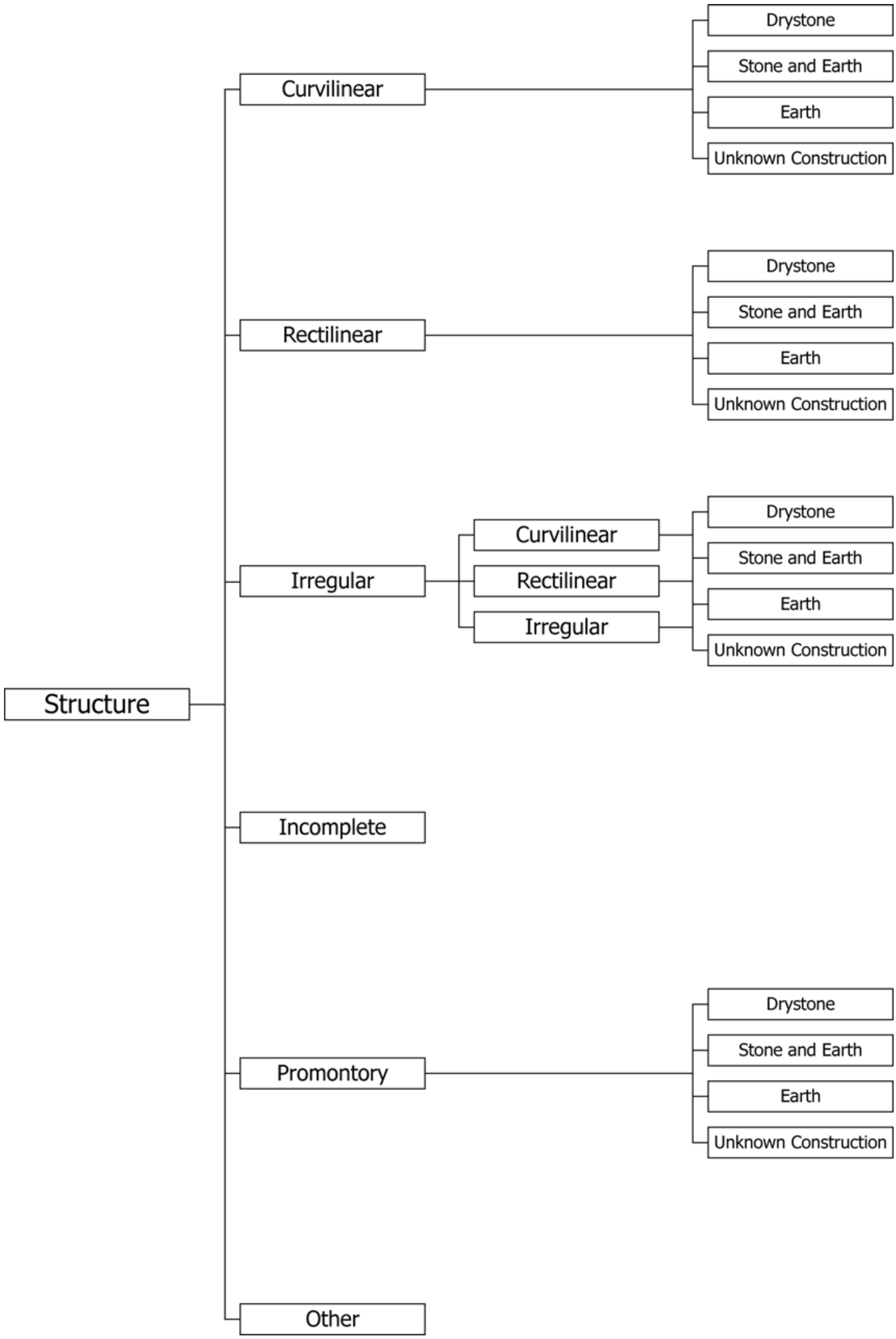


Figure 4.5: The classification schema used as a basis for categorising structures.

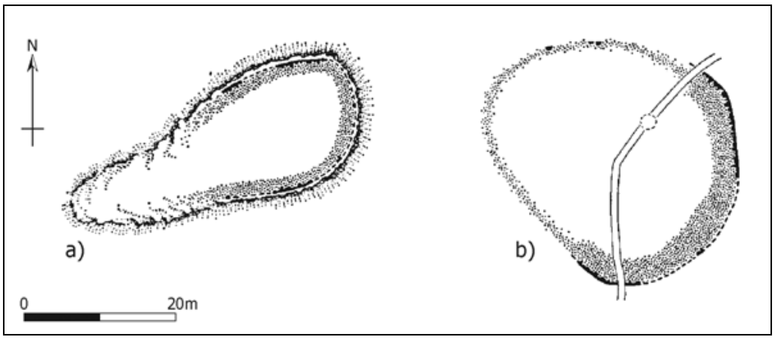


Figure 4.6: Examples of Irregular-Curvilinear sites: (a) Cnoc Eibhleach (AR-289); (b) Saddell House (AR-686) (Source: RCAHMS 1971).

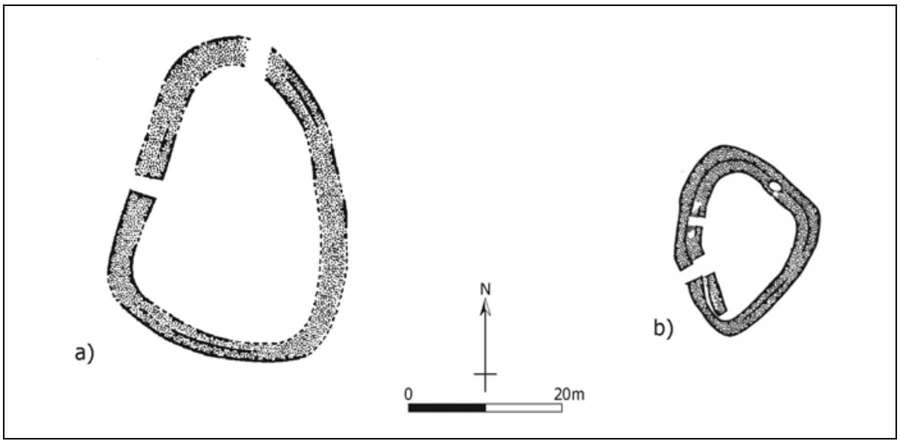


Figure 4.7: Example of Irregular-Rectilinear sites: (a).inner enclosure at Ranachan Hill (AR-827); (b) Kildonan Bay (AR-073) (Source: RCAHMS 1971).

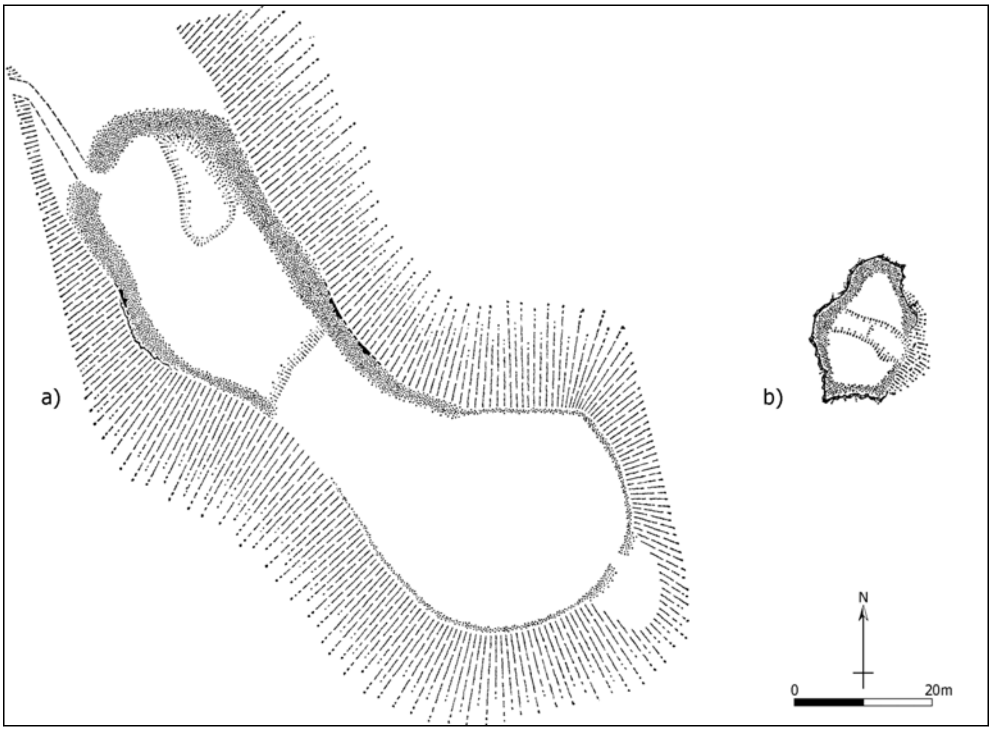


Figure 4.8: Example of Irregular-Irregular sites: (a) Achnaclach (AR-716) and (b) Eascairt (AR-279) (Source: RCAHMS 1971).

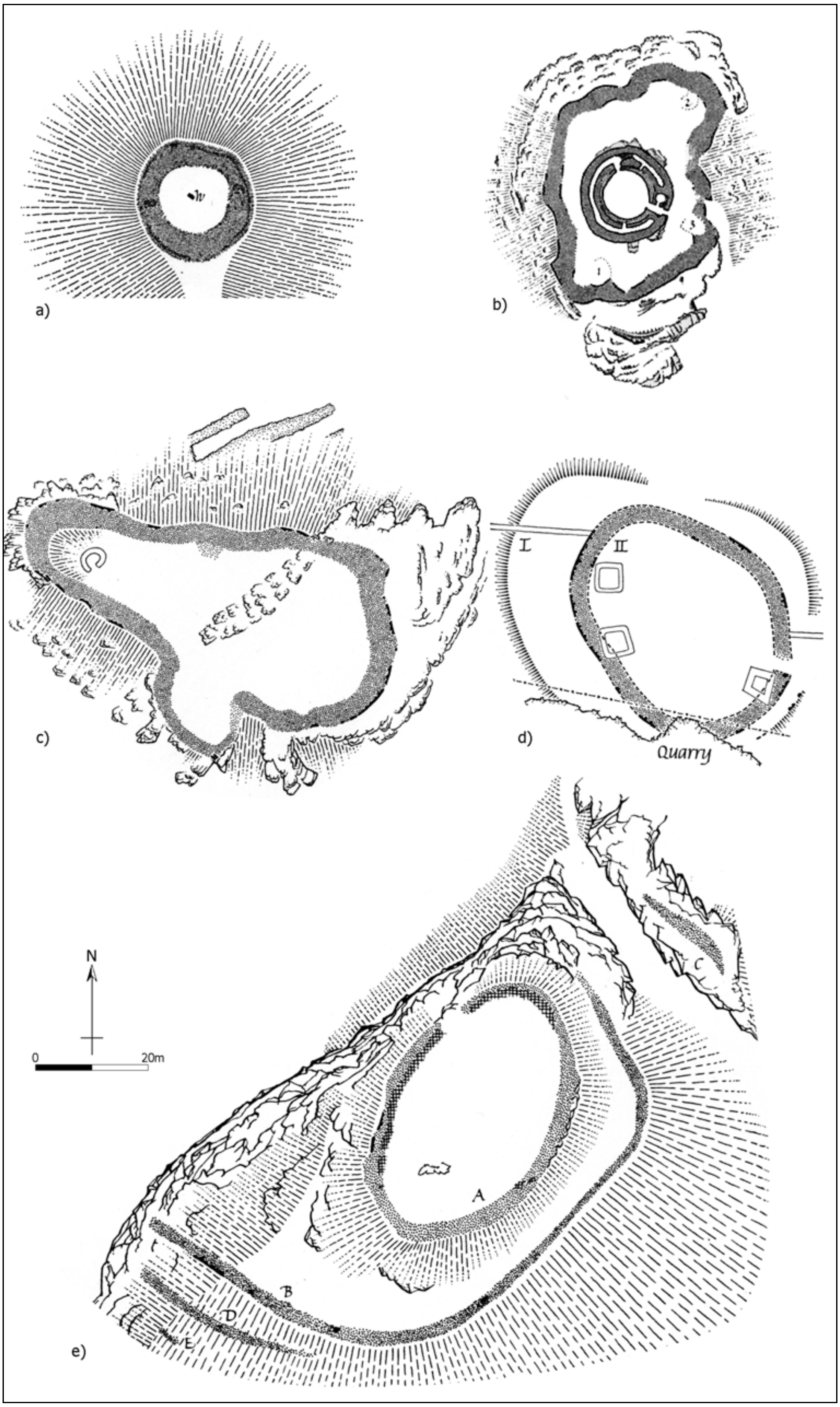


Figure 4.9: Site plans of drystone structures in Argyll dating to the 1st millennium BC: (a) Rahoy (AR-149) CSB; (b) Dun Mor Vaul (AR-008) AFCB; (c) Eilean an Duin (AR-894) ICSA; (d) Balloch Hill (AR-854) ICSA; (e) Duntroon (AR-700) CSA (Source: RCAHMS 1971; 1980; 1988).

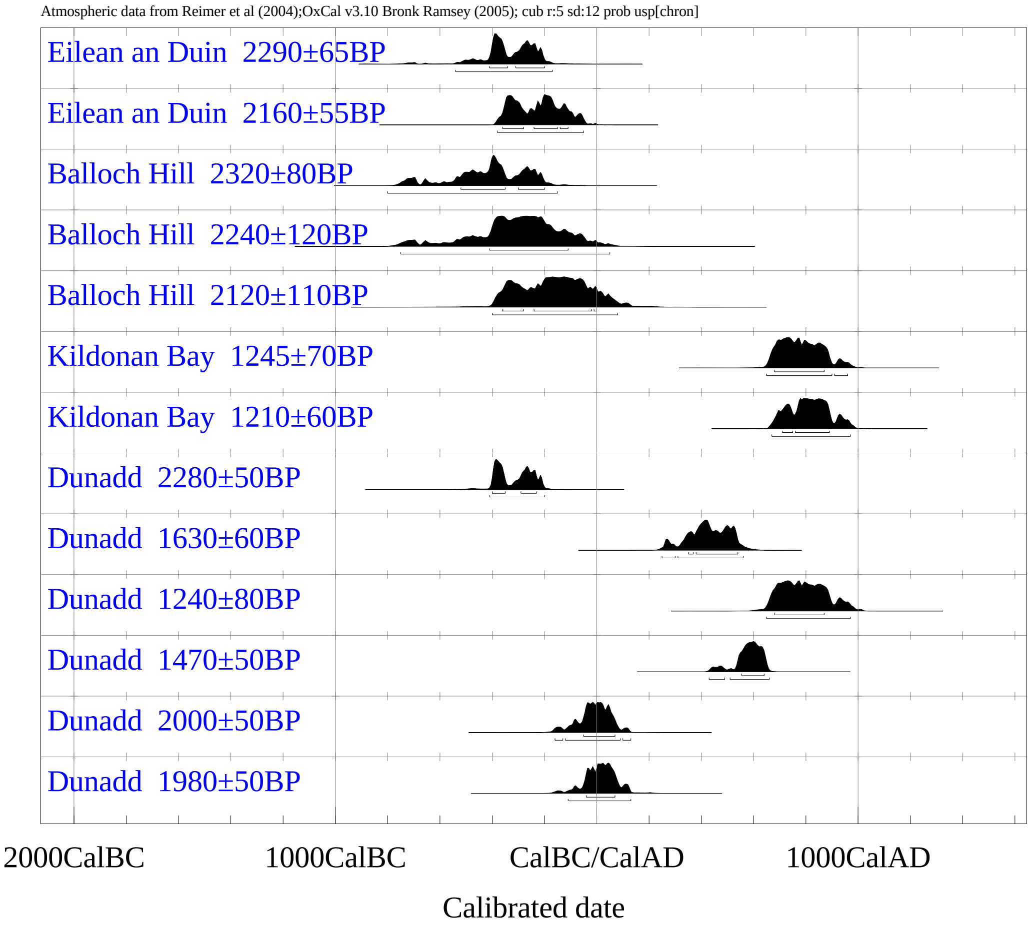


Figure 4.10: Table of radiocarbon dates discussed in the text from sites in Argyll.

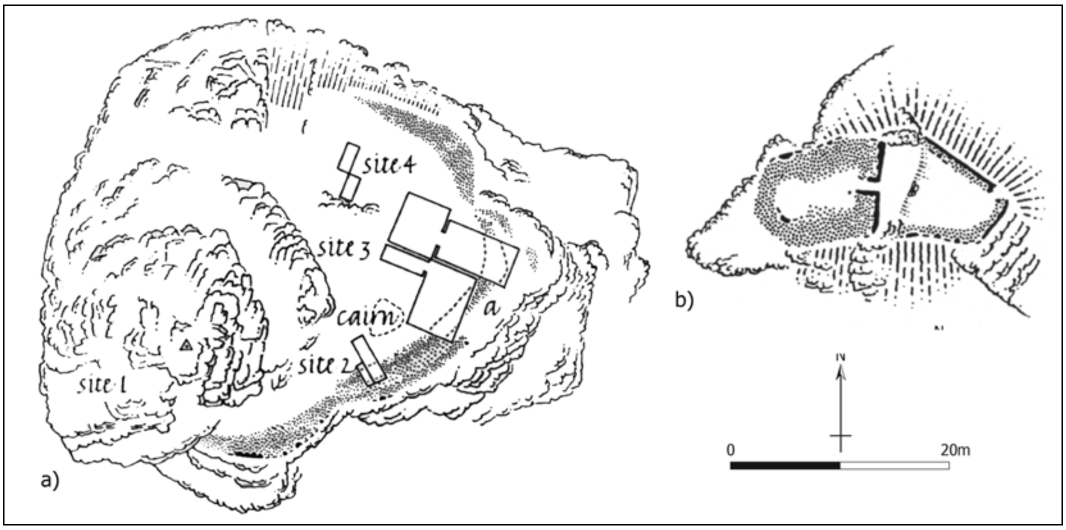


Figure 4.11: Site plans of drystone structures in Argyll dating to the turn of the millennium from BC to AD: (a) Dùn Cùl Bhuirg (AR-681) ICSA (Source: Ritchie & Lane 1980); (b) Dùnan nan Nighean (AR-136) RSB (Source: RCAHMS 1984).

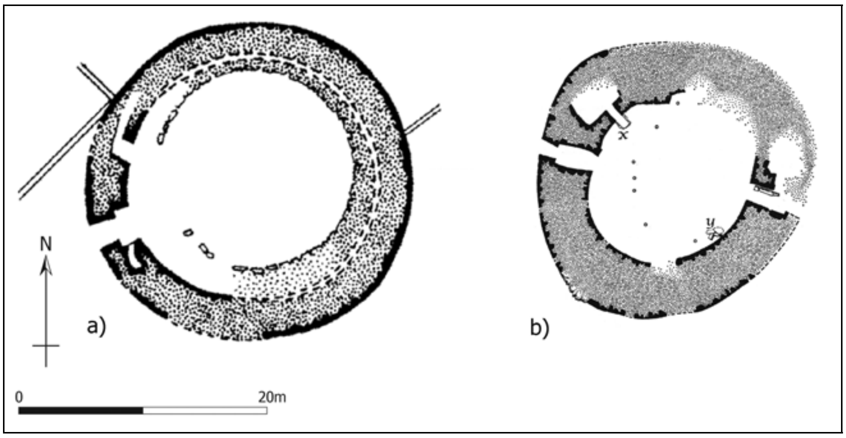


Figure 4.12: Site plans of drystone structures in Argyll dating to the 1st millennium AD with evidence of 1st millennium BC activity: (a) Ardifuar I (AR-401) AFCA; (b) Kildalloig (AR-413) AFCB (Source: RCAHMS 1971; 1988).

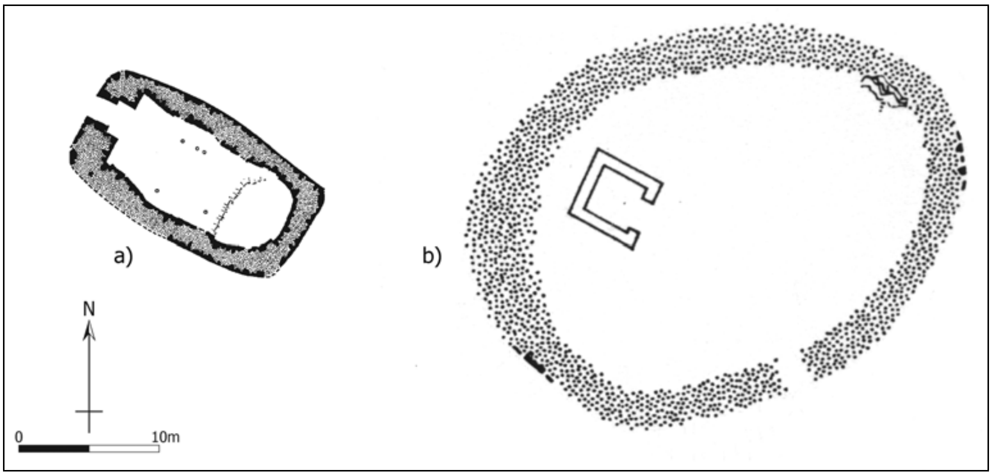


Figure 4.13: Site plans of drystone structures in Argyll dating to early 1st millennium AD: (a) Dùn Fhinn (AR-311) RSB; (b) An Dùn (AR-211) CSA (Source: RCAHMS 1975; 1984).

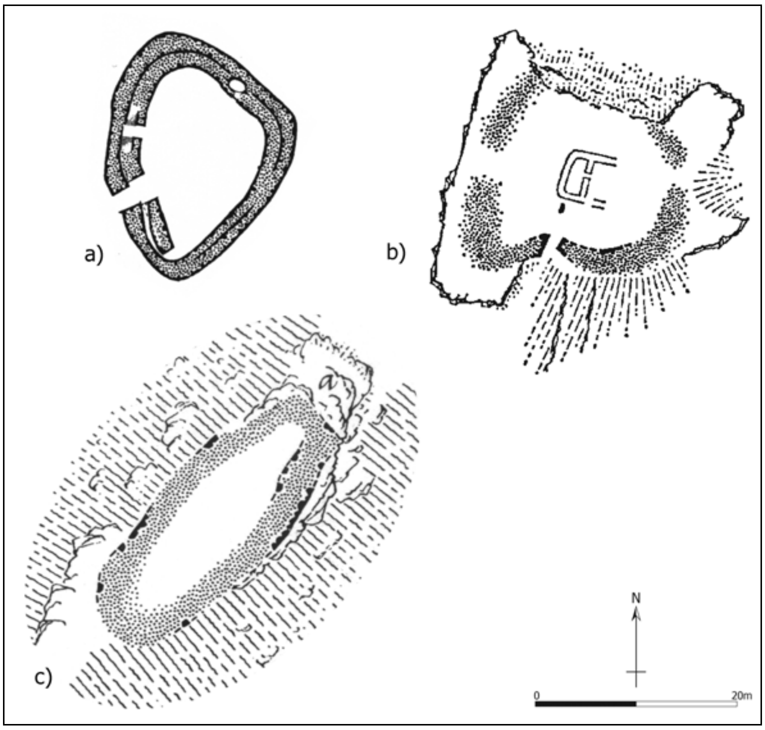


Figure 4.14: Site plans of drystone structures in Argyll dating to mid 1st millennium AD: (a) Kildonan Bay (AR-073) AFIR; (b) Ugadale Point (AR-074) RSA; (c) Eilean Righ I (AR-230) IRSA (Source: RCAHMS 1971; 1988).

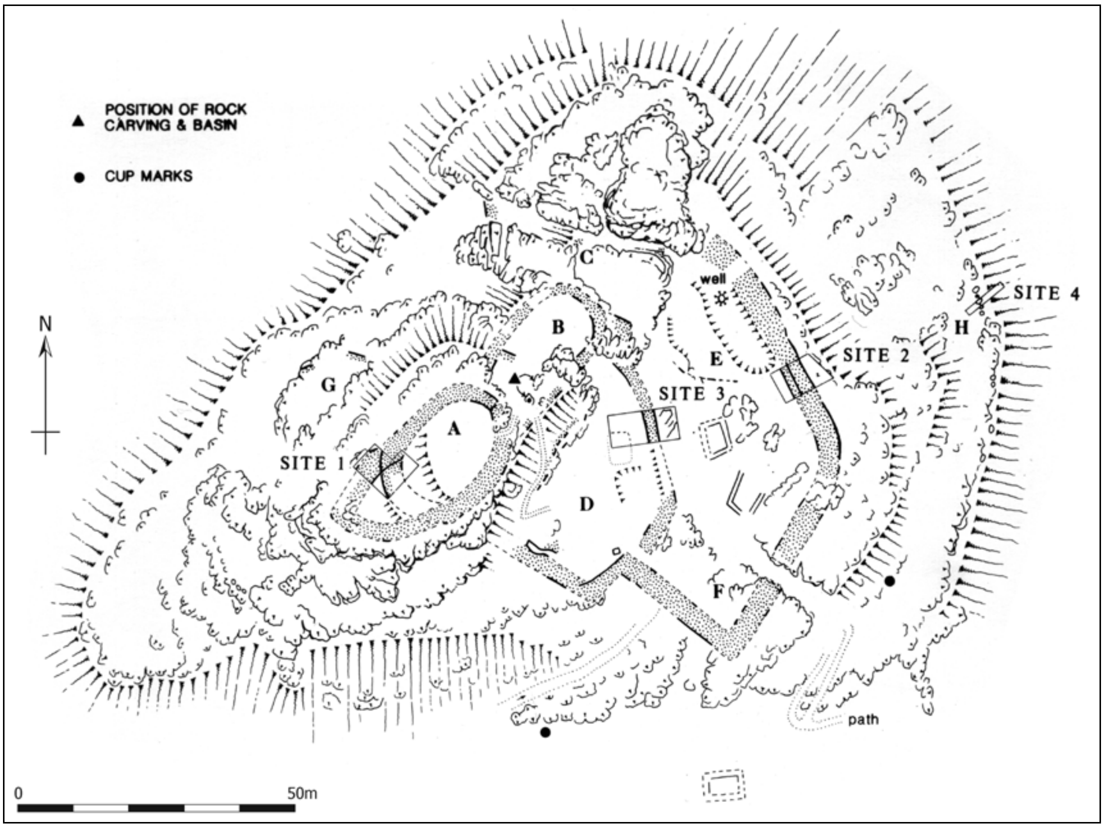


Figure 4.15: Site plan of Dunadd (AR-849) CSA, a large multivallate fort (Source: Lane & Campbell 2000.

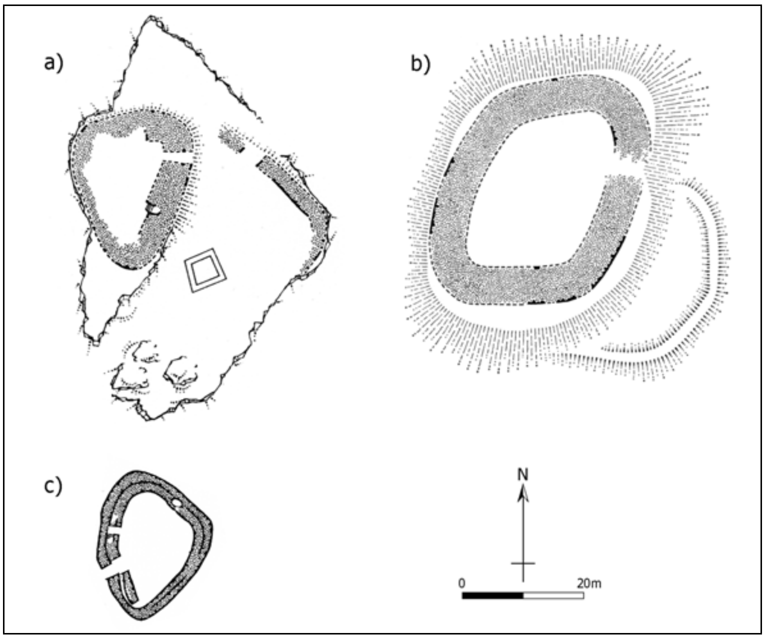


Figure 4.16: Site plans of drystone structures in Argyll possibly dating to mid 1st millennium AD: (a) Dun Aorain (AR-259) AFIR; (b) Ronachan Bay (AR-119) IRSB; (c) Kildonan Bay (AR-073) AFIR (Source: RCAHMS 1971; 1975).

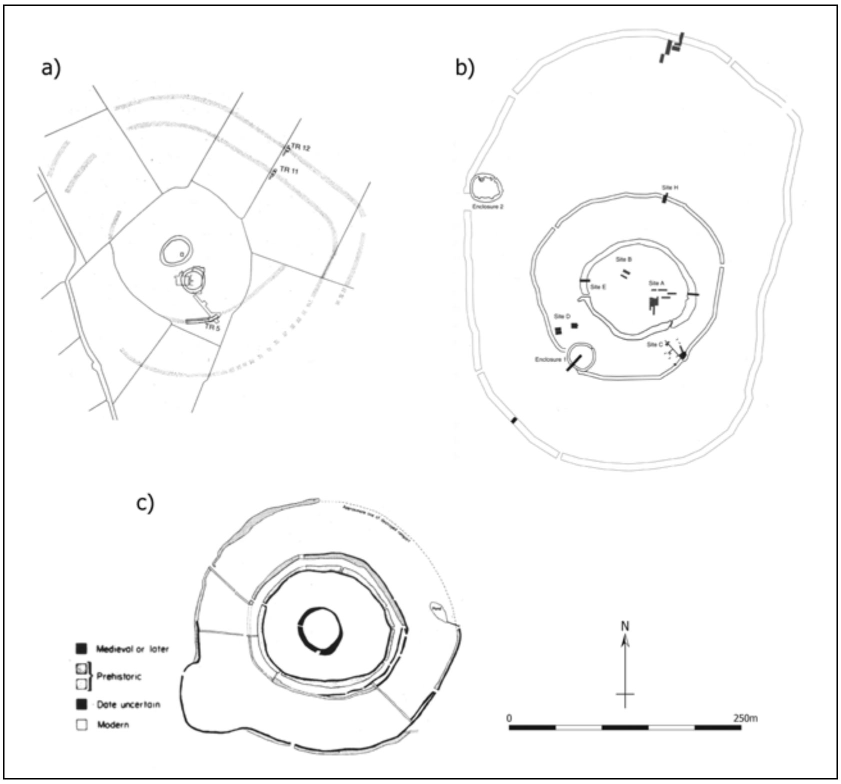


Figure 4.17: Site plans of large curvilinear structures in Ireland and Northern Ireland with long periods of activity dating throughout the 1st millennium BC: (a) Mooghaun South, Co. Clare (Source: Grogan 1996); (b) Haughey's Fort, Co. Armagh (NI-1850) CEA (Source: Waddell 1998); (c) Rathgall, Co. Wicklow (Source: Waddell 1998).

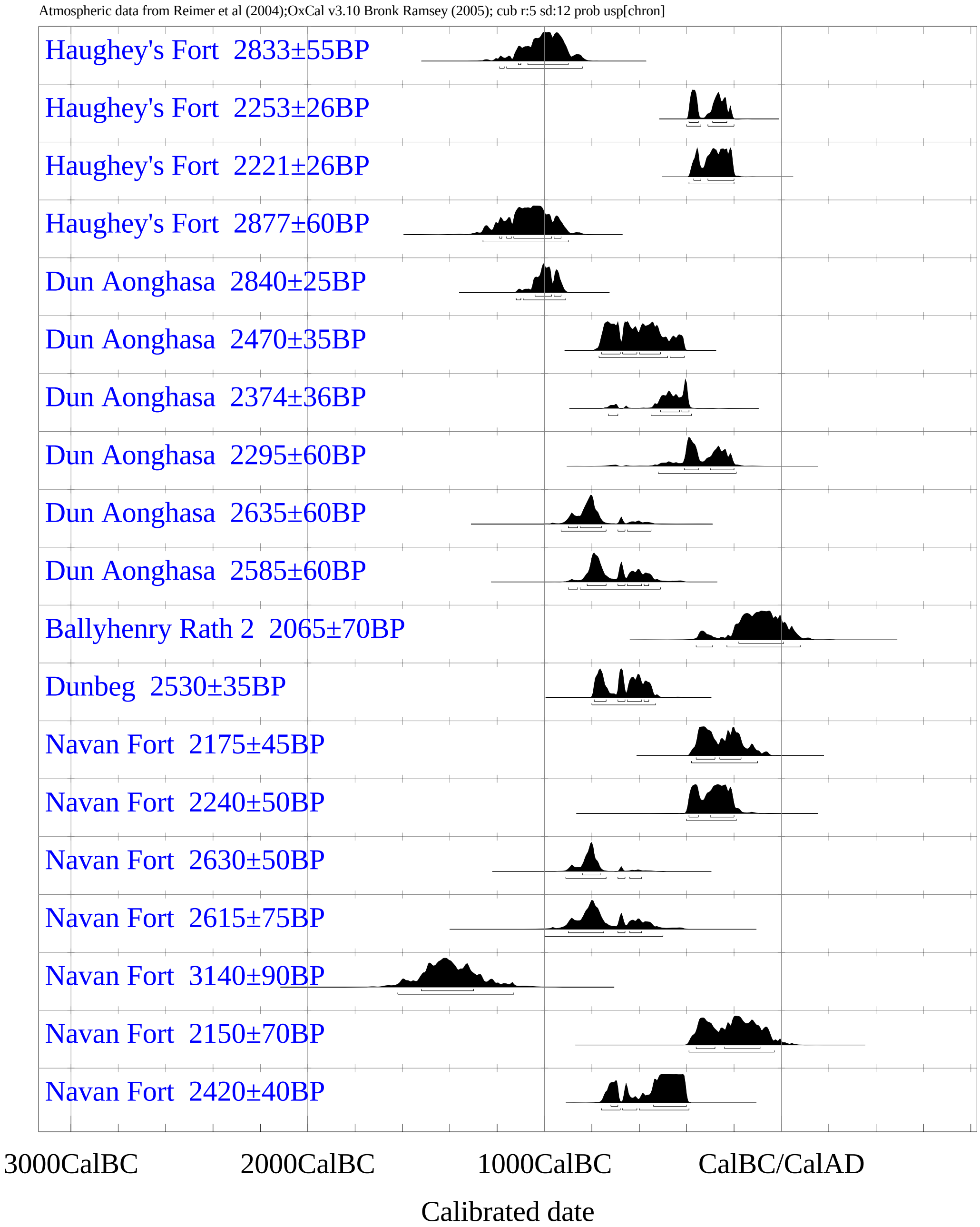


Figure 4.18: Table of radiocarbon dates discussed in the text from sites in Ireland and Northern Ireland dating to the 1st millennium BC.

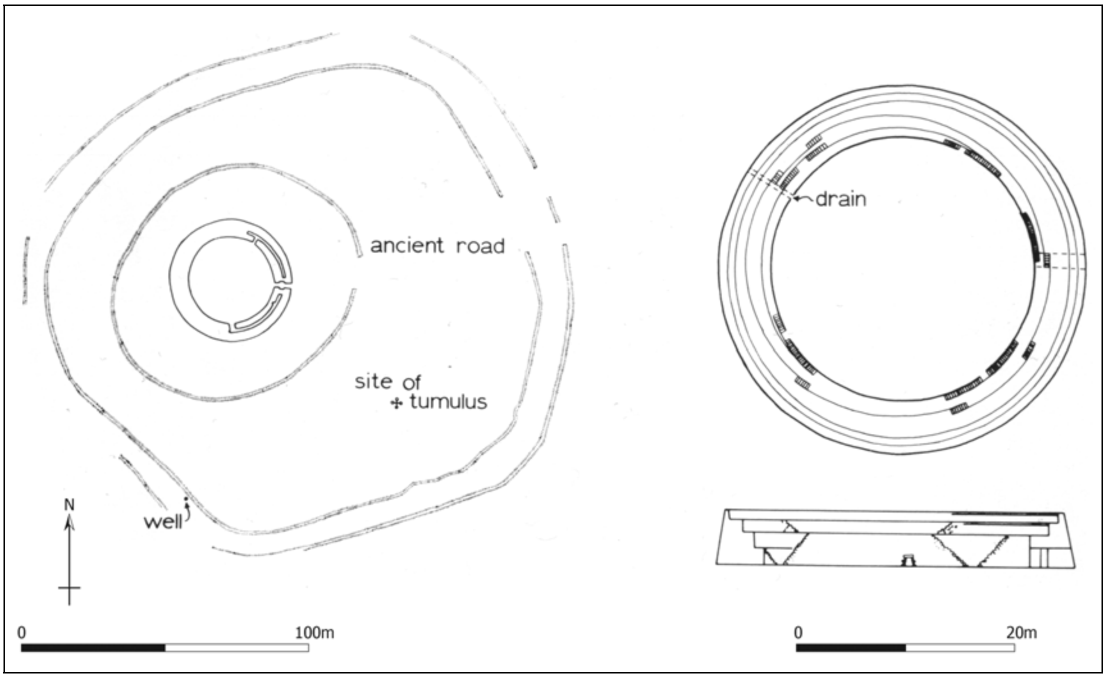


Figure 4.19: Plan of the stone fort and outer enclosure banks at Grianán Ailech, Co. Donegal (DO-018) AFCA(Source: Lacy 1983).

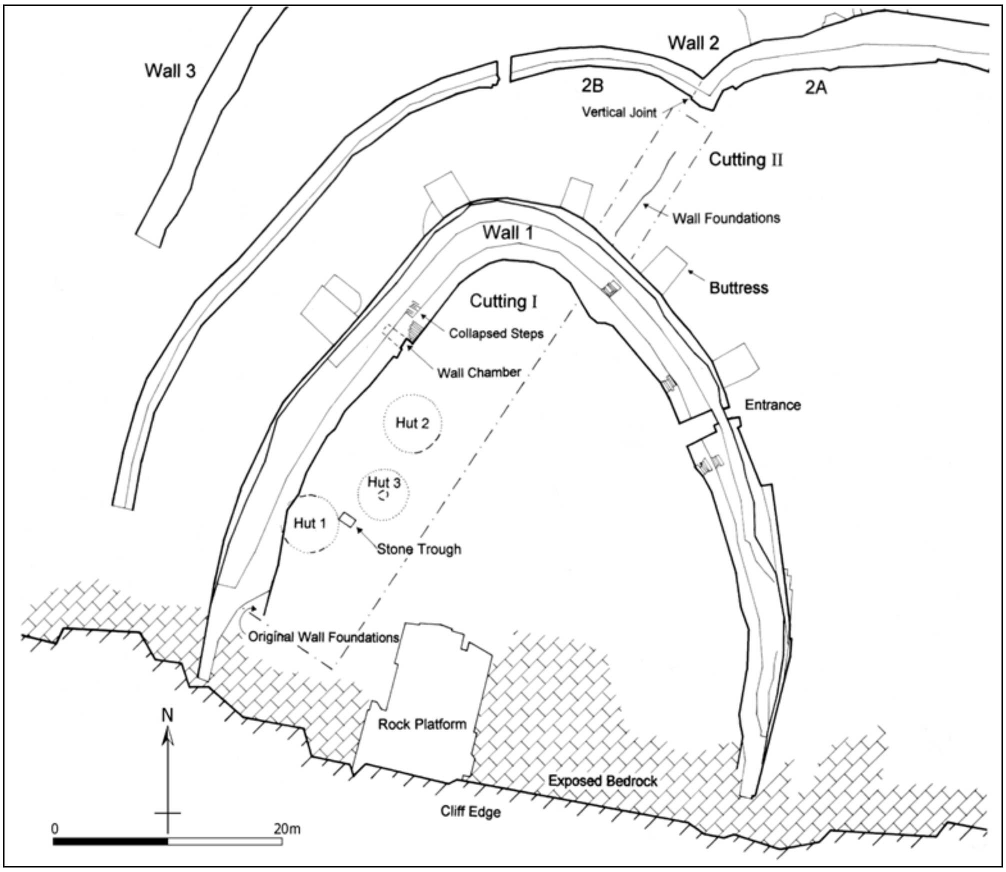


Figure 4.20: Site plan of the drystone structure at Dún Aonghasa, Co. Galway (Source Cotter 1993)

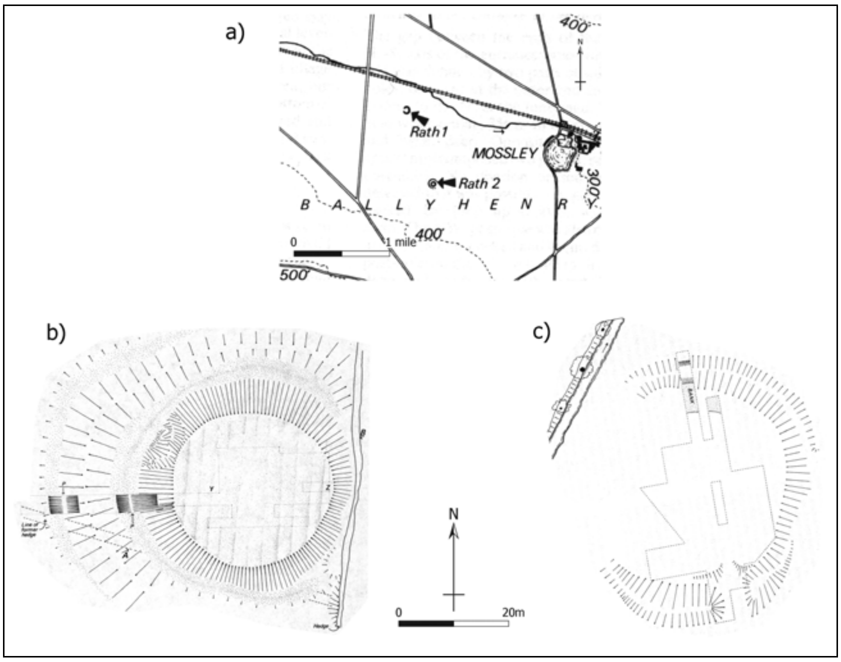


Figure 4.21: (a) location of two CEA sites (Rath 1 and Rath 2) at Ballyhenry, Co. Antrim with long periods of activity dating throughout the 1st millennium BC and AD; (b) site plan of Rath 1 (NI-1941) CEA; (c) site plan of Rath 2 (NI-1940) CEA (Source: Lynn 1983).

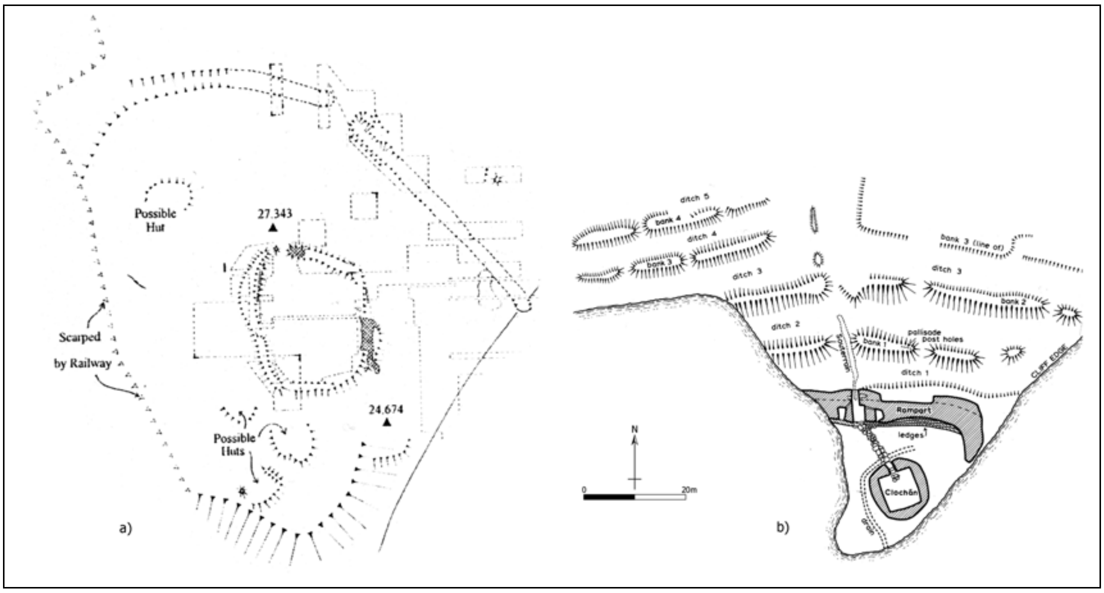


Figure 4.22: Site plans of promontory sites in Ireland with long periods of activity dating throughout the first millennium BC and AD: (a) Knoxpark, Co. Sligo (Source: Mount 1994); (b) Dunbeg, Co. Kerry (Source: Barry 1981).

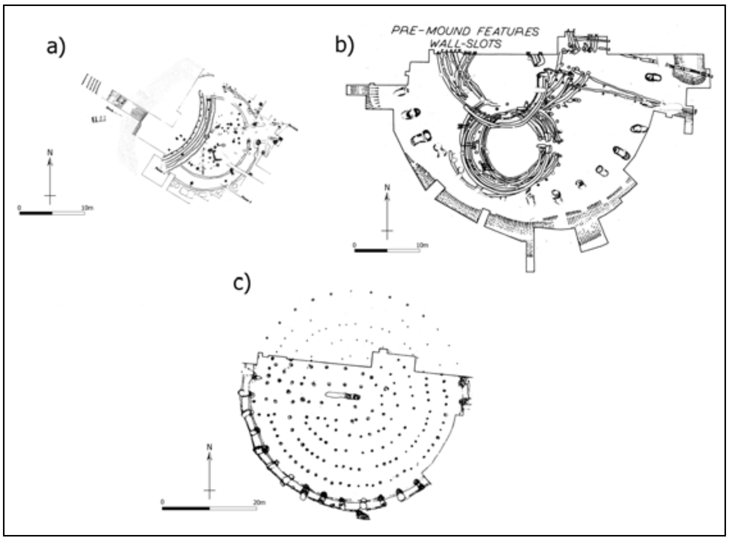


Figure 4.23: Site plans of the excavated enclosures at Navan Fort (Emain Macha) (NI-1727), Co. Armagh: (a) ringditch timber structure and later structure of two concentric rings at Site A; (b) successive ring slots in figure-of-eight pattern from phase 3ii at Site B; (c) large, circular posthole structure from Phase 4 at Site B (Source: Waddell 1998).

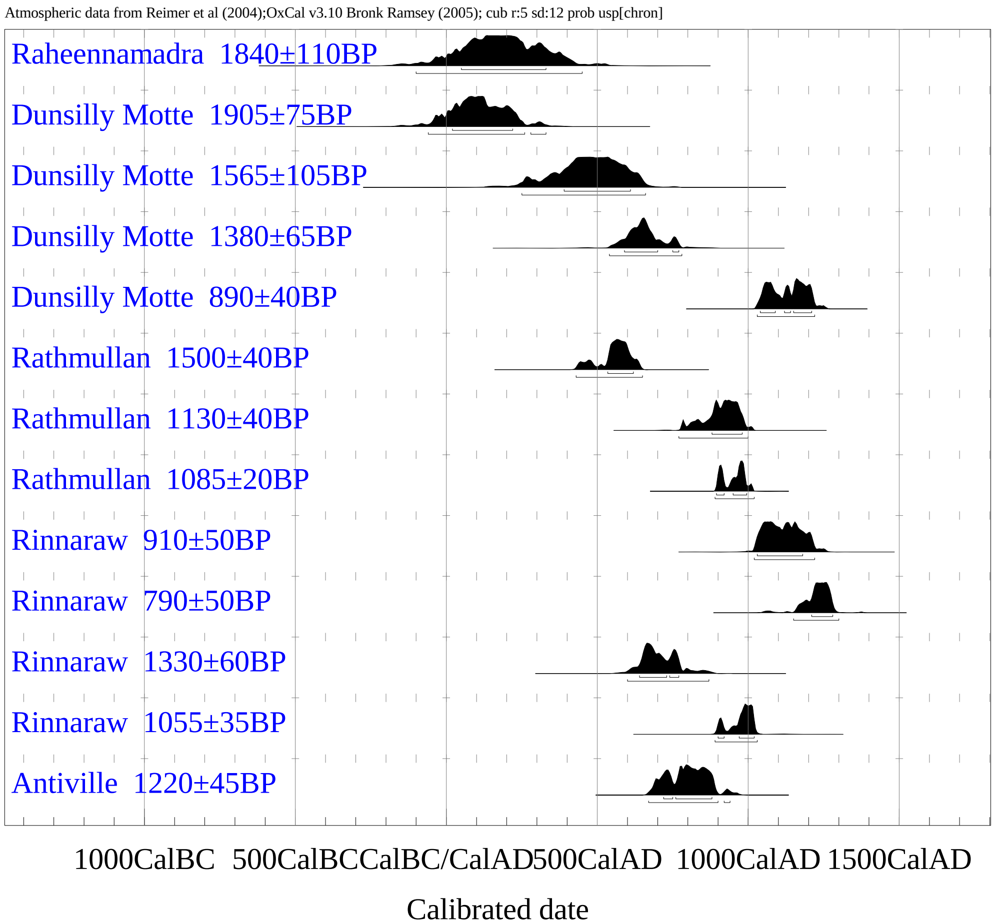


Figure 4.24: Table of radiocarbon dates discussed in the text from sites in Ireland and Northern Ireland dating to the 1st millennium AD.

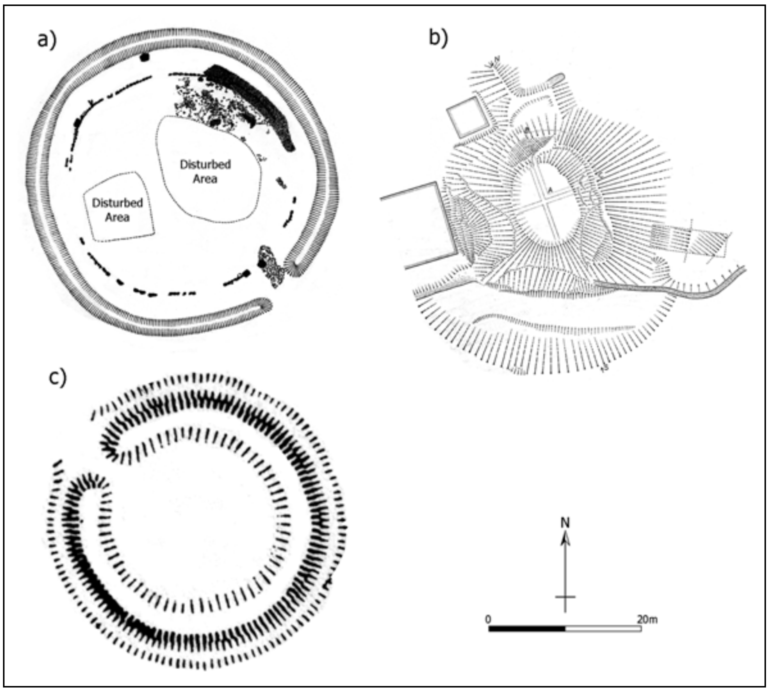


Figure 4.25: Site plans of earthen raths with activity originating around the turn of the millennia and 1st millennium AD: (a) Ráth of Ferrwore, Co. Galway (Source: Raftery 1944); (b) Raheennamadra, Co. Limerick (Source: Stenberger 1966); (c) raised rath at Rathmullan Lower, Co. Down (NI-2719) CEA (source: Edwards 2005).

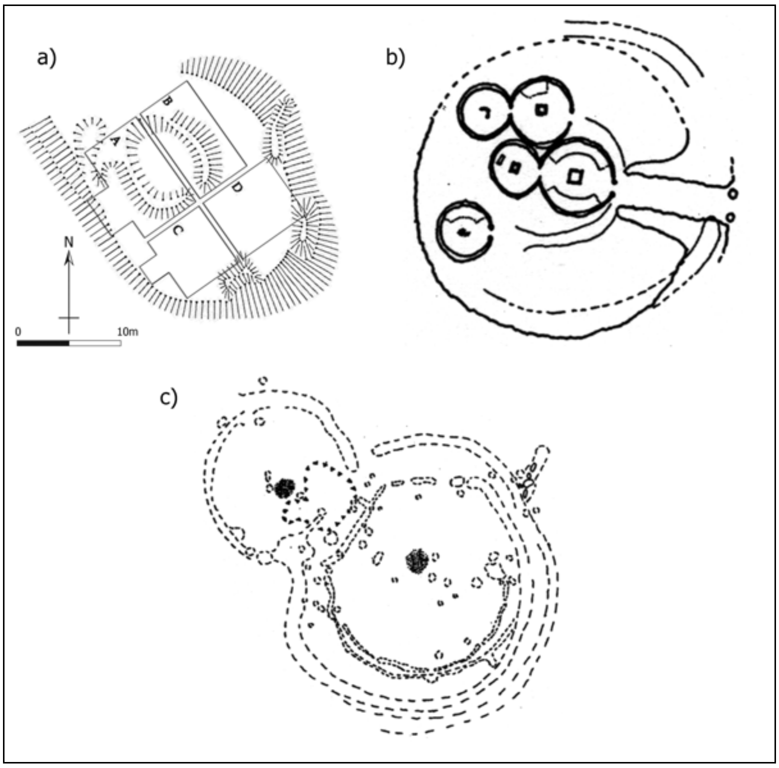


Figure 4.26: Sites dating to the 1st millennium AD (a) Rinnaraw, Co. Donegal (DO-221) CSA, and an internal stone house foundations (Source: Comber 2006); (b) Deer Park Farms house and enclosure, Co. Antrim (NI-2767) CSAEA (Source: Lynn 1988b); (c) Dressogagh house, Co. Armagh (NI-2929)(Source: Collins 1966).

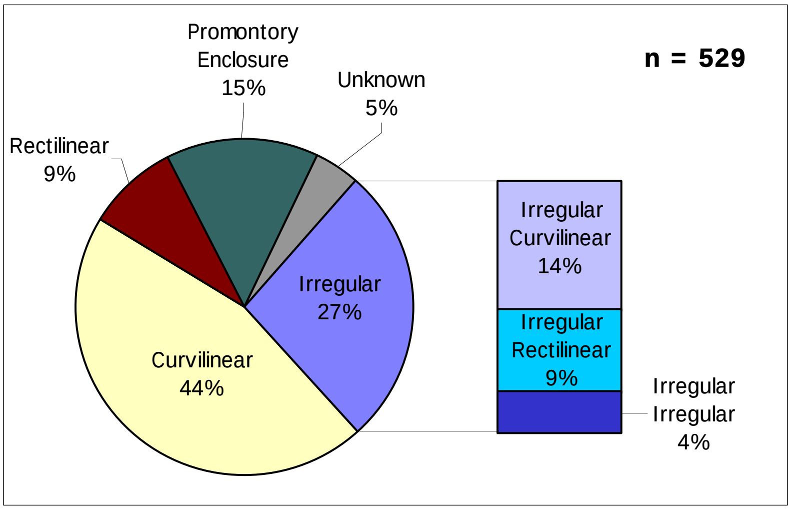


Figure 4.27: New classification of Argyll sites showing dominance of curvilinear sites across the region.

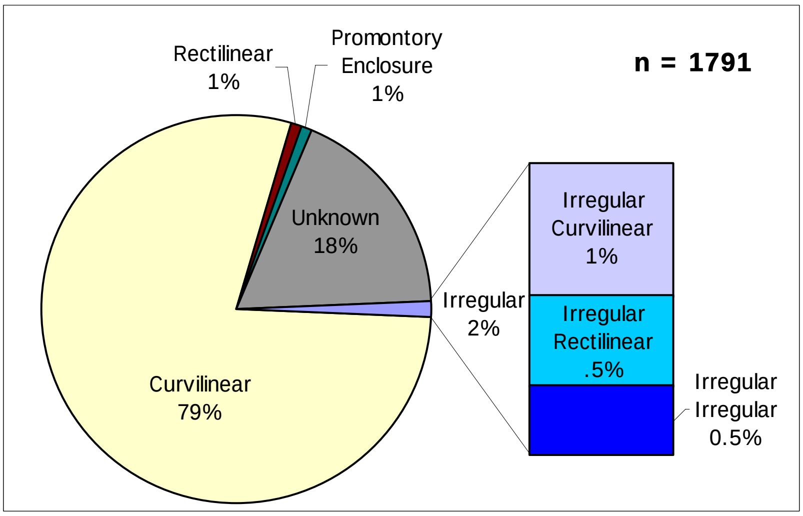


Figure 4.28: New classification of Northern Ireland sites showing dominance of curvilinear sites across the region.

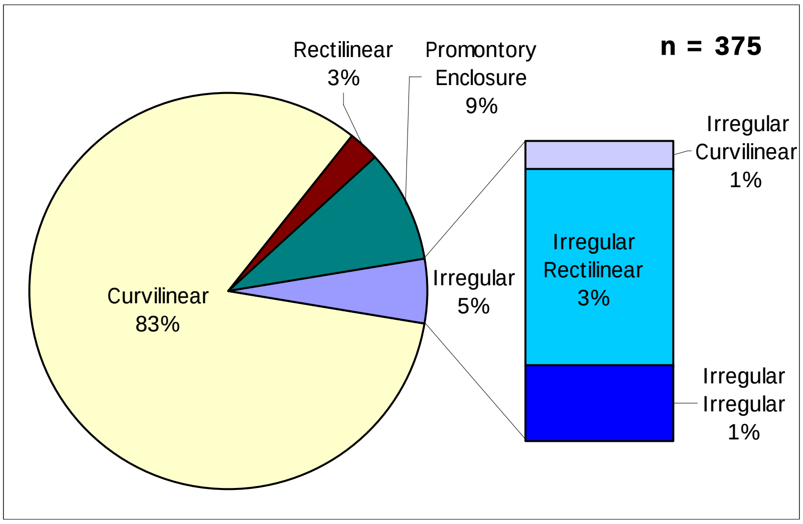


Figure 4.29: New classification of sites in Co. Donegal showing dominance of curvilinear sites across the region.

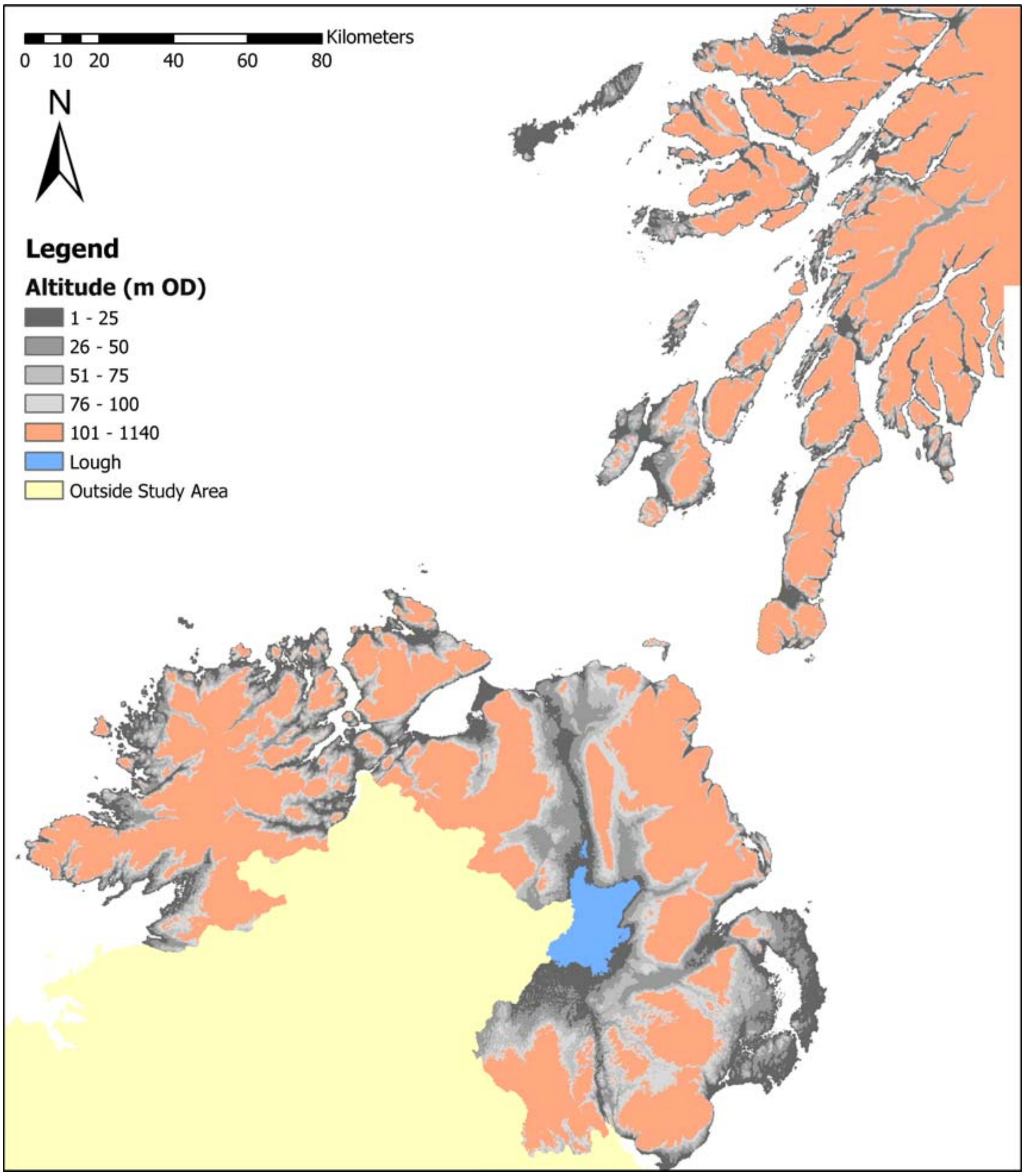


Figure 4.30: Land over 101m OD in the study region.

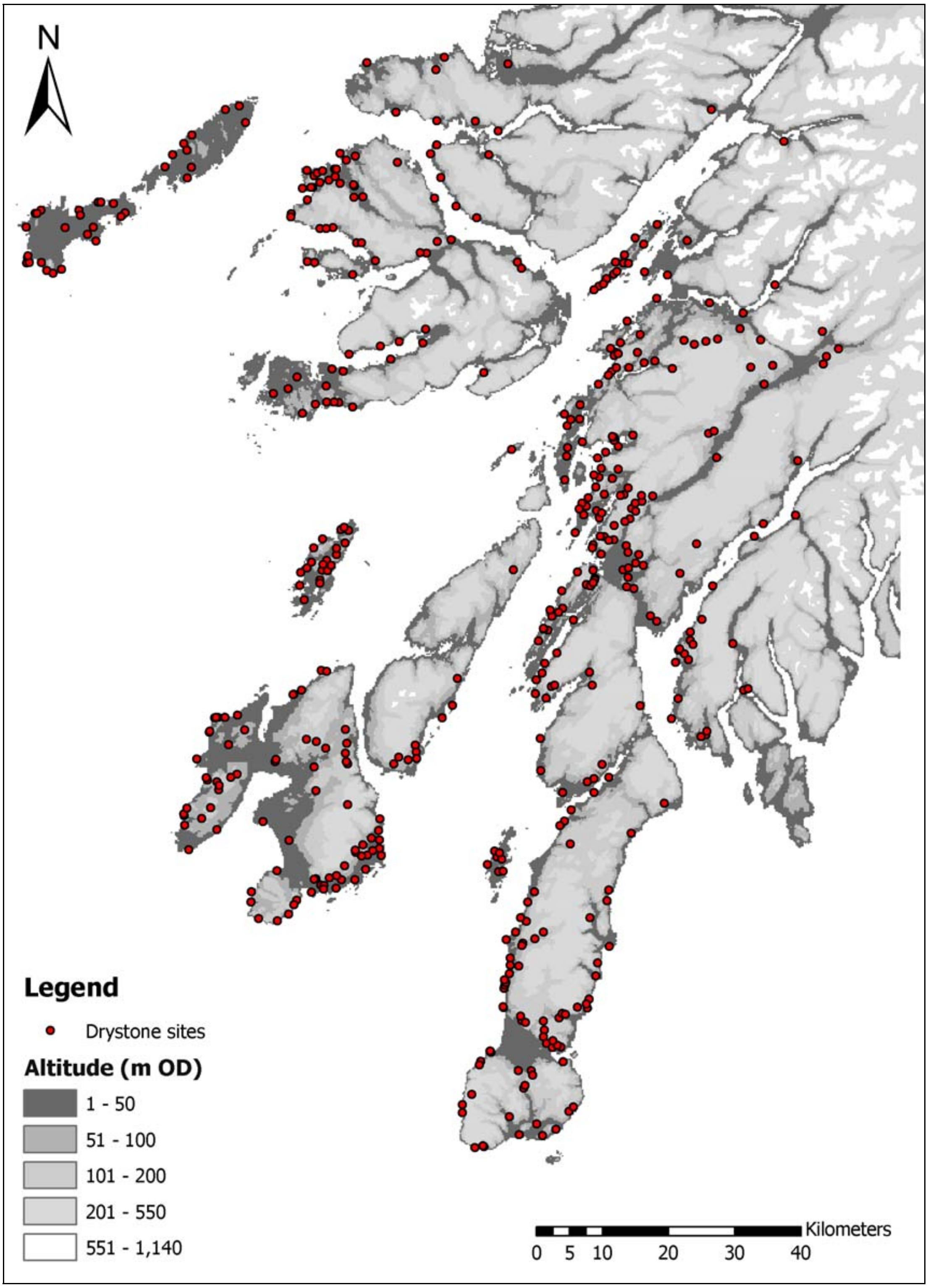


Figure 4.31: Distribution of drystone walled sites in Argyll.

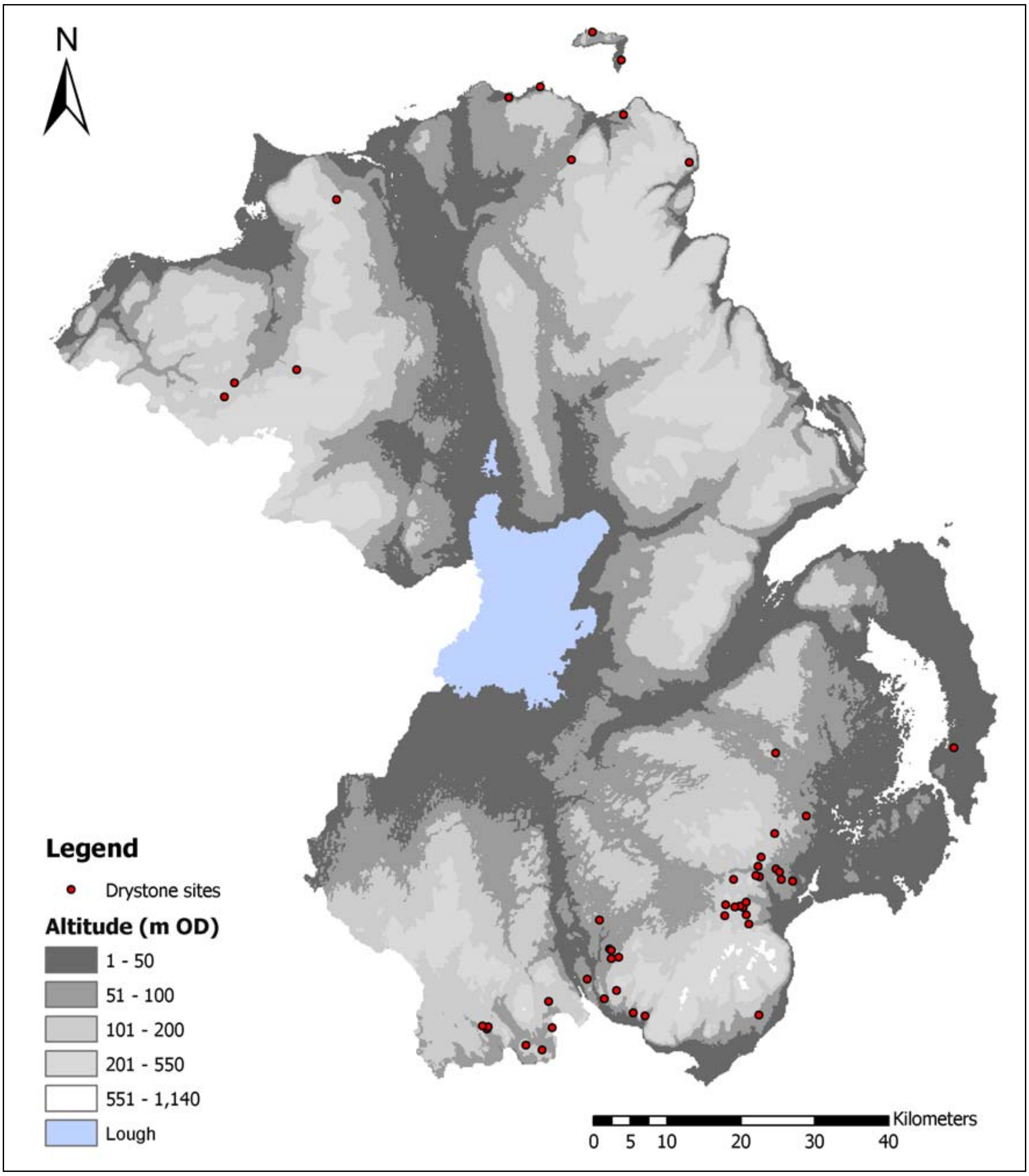


Figure 4.32: Distribution of drystone walled sites in Northern Ireland.

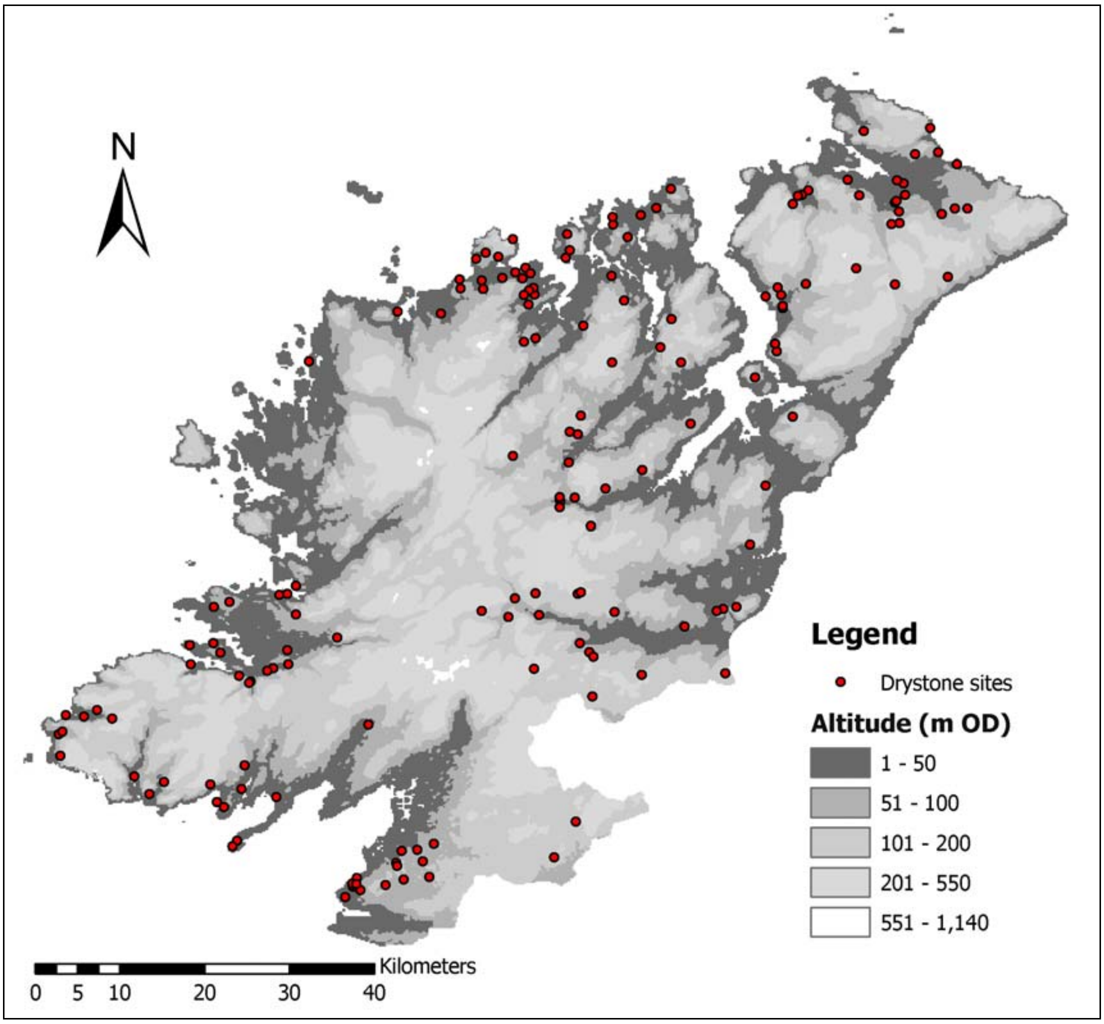


Figure 4.33: Distribution of drystone walled sites in Donegal.

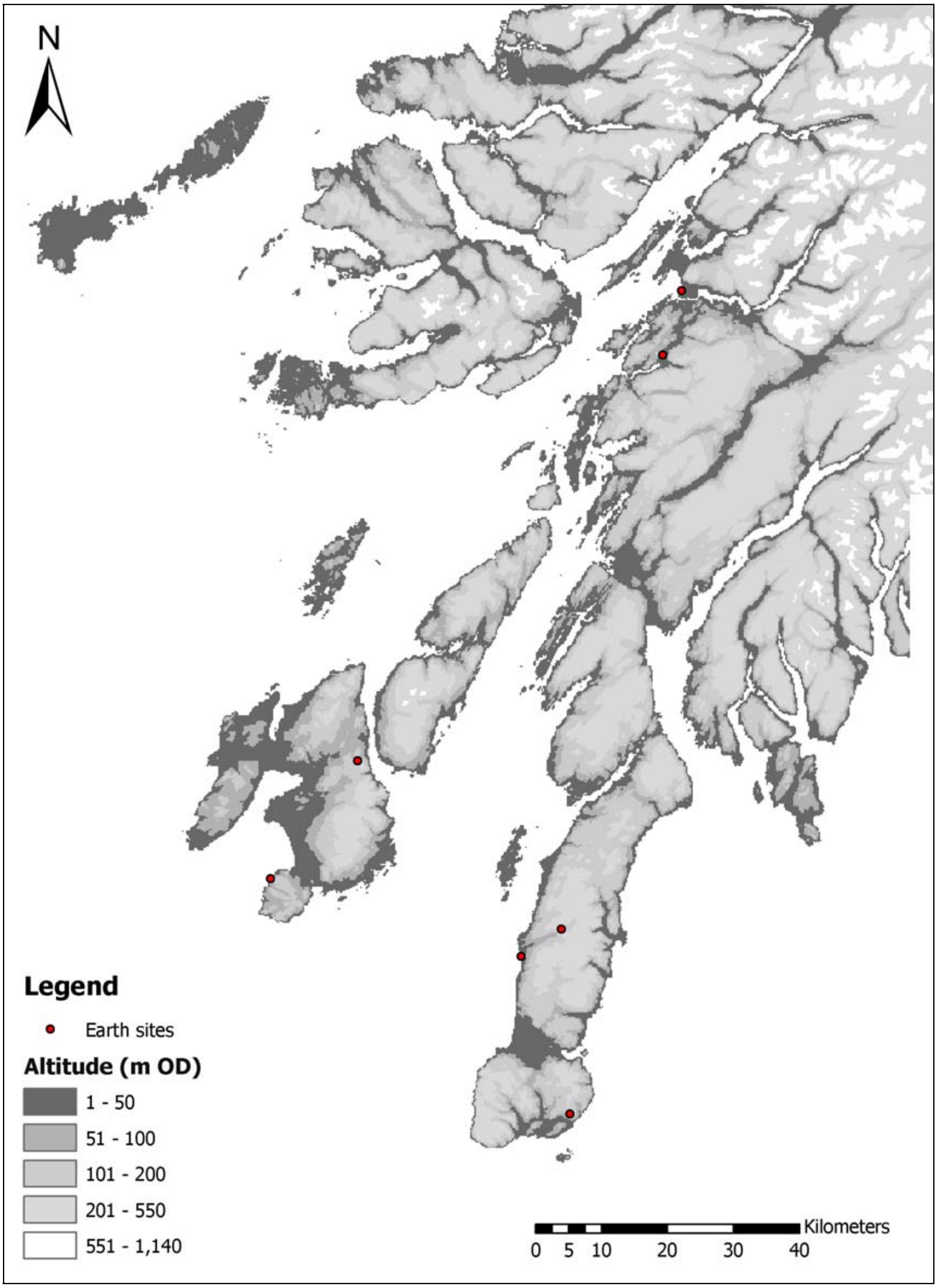


Figure 4.34: Distribution of earthen rampart enclosure sites in Argyll.

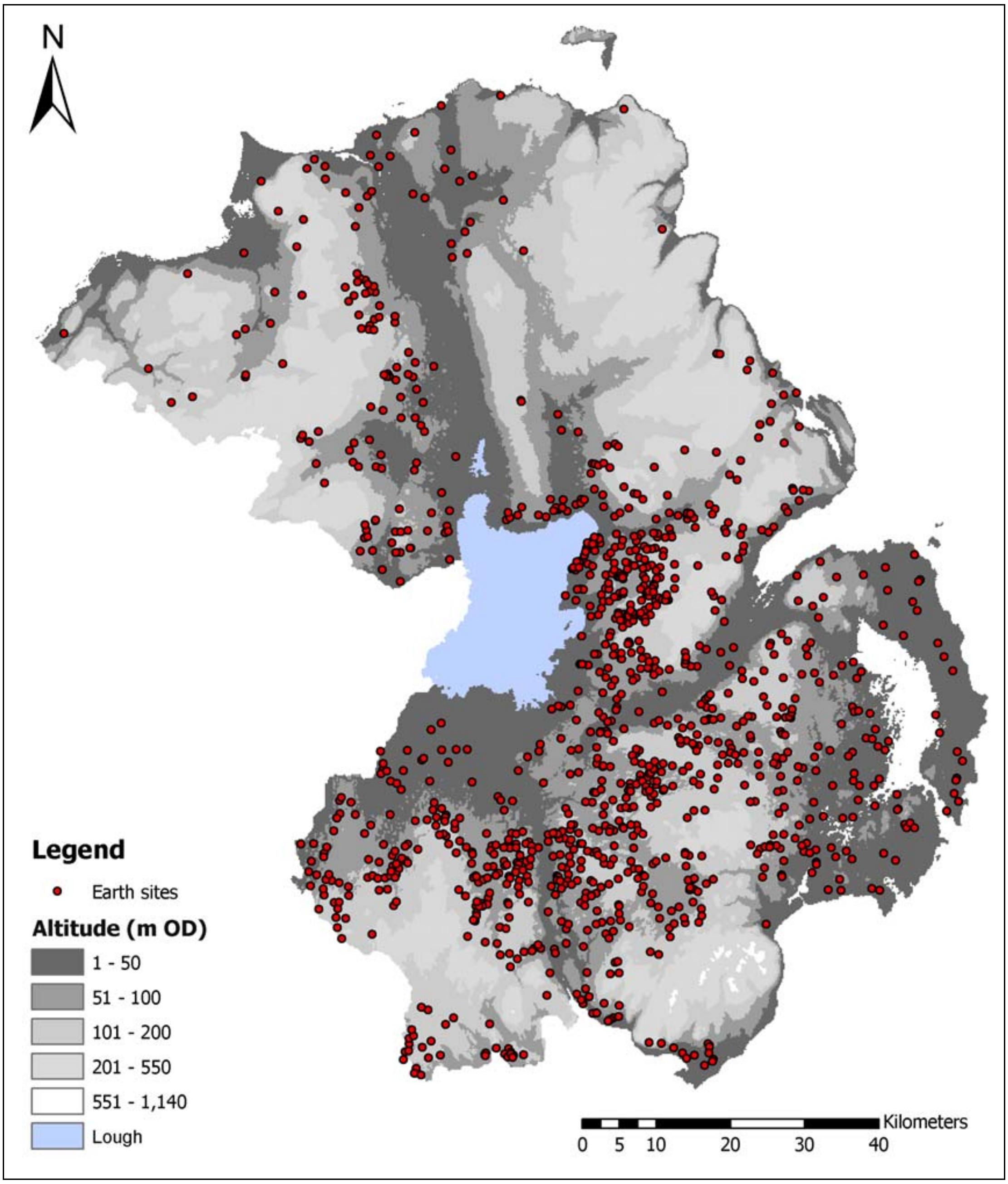


Figure 4.35: Distribution of earthen rampart enclosure sites in Northern Ireland.

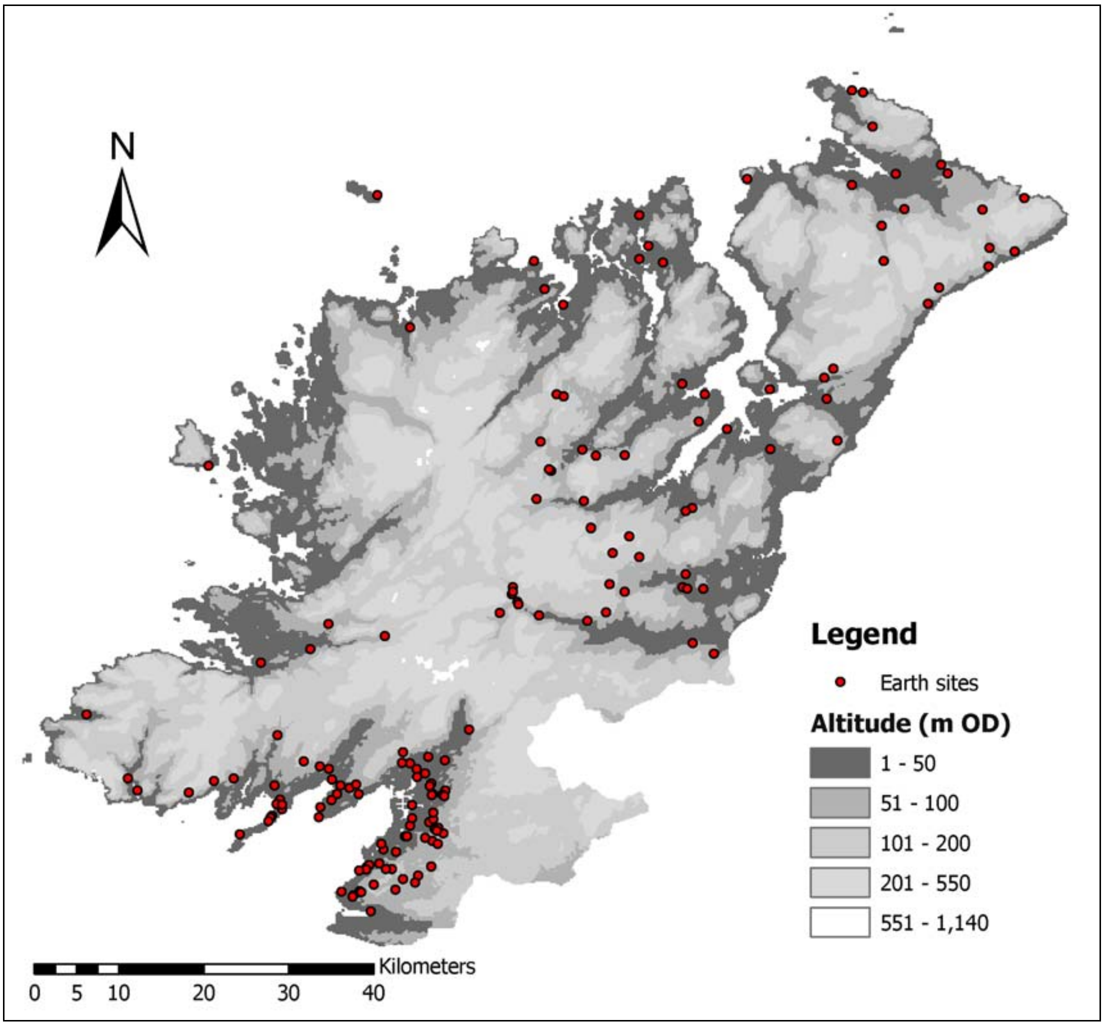


Figure 4.36: Distribution of earthen rampart enclosure sites in Co. Donegal.

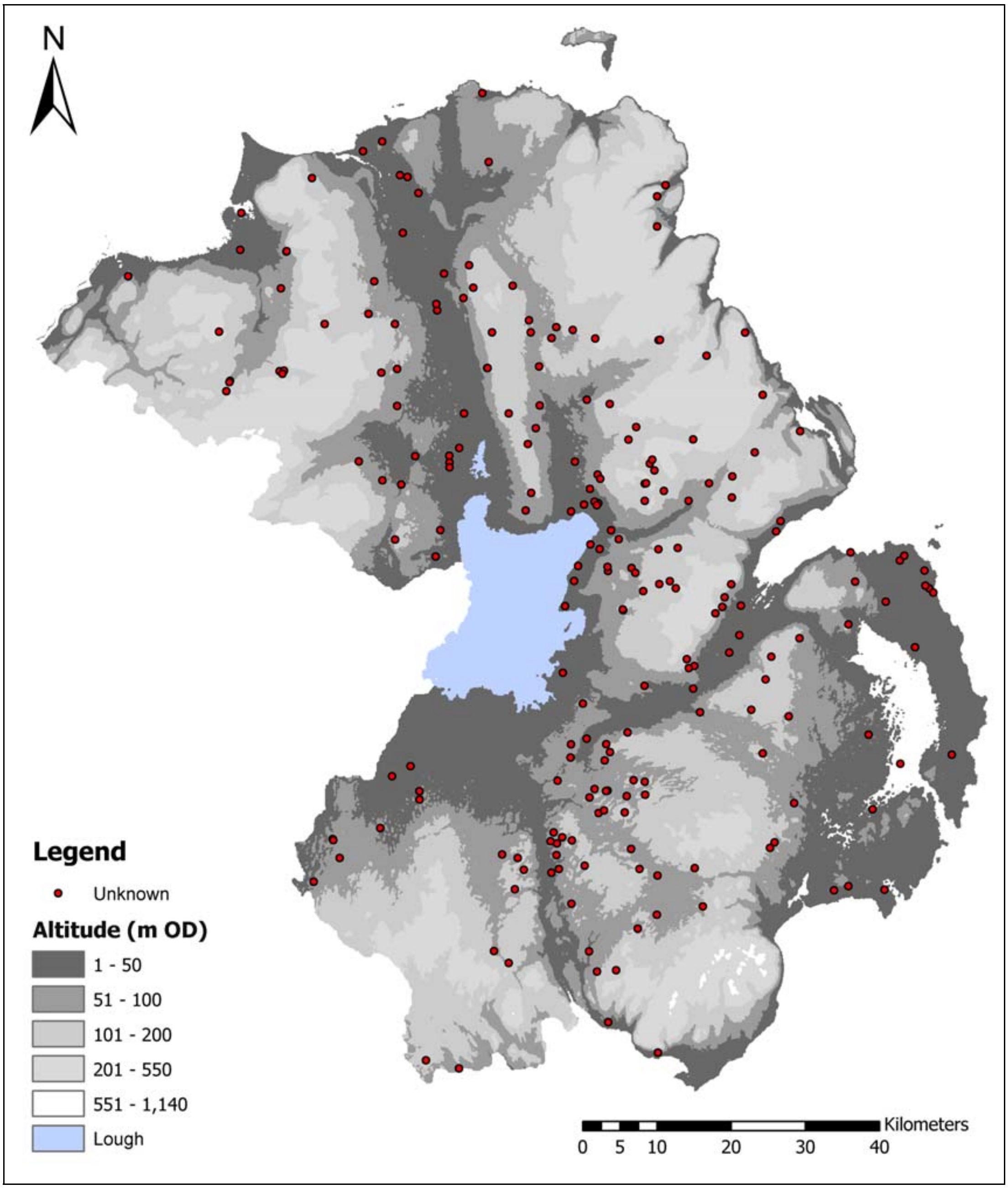


Figure 4.37: 'Destroyed enclosure' sites in the Northern Ireland study area with no available information on construction material type and size.

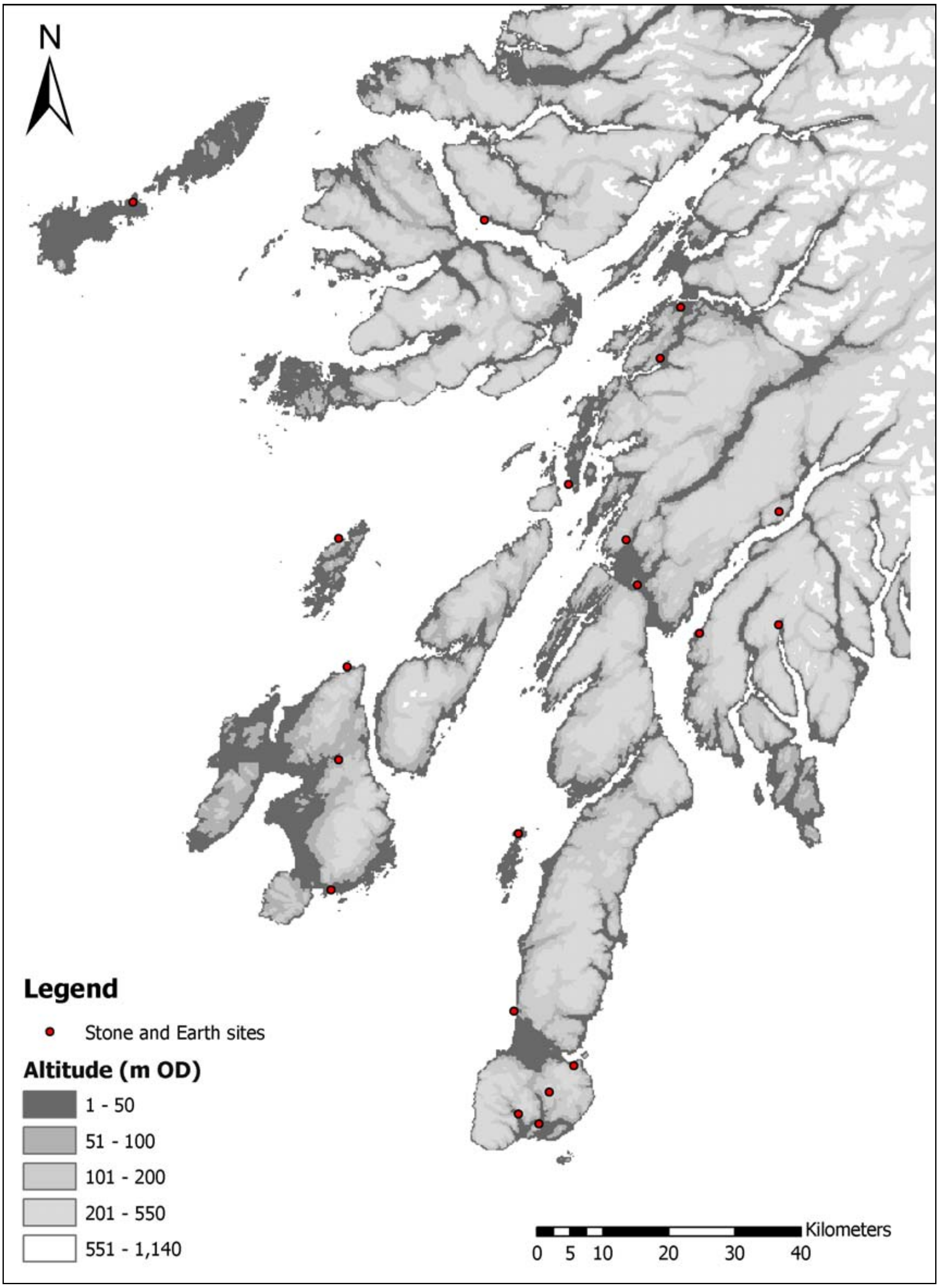


Figure 4.38: Distribution of sites enclosed by stone and earthen ramparts in Argyll.

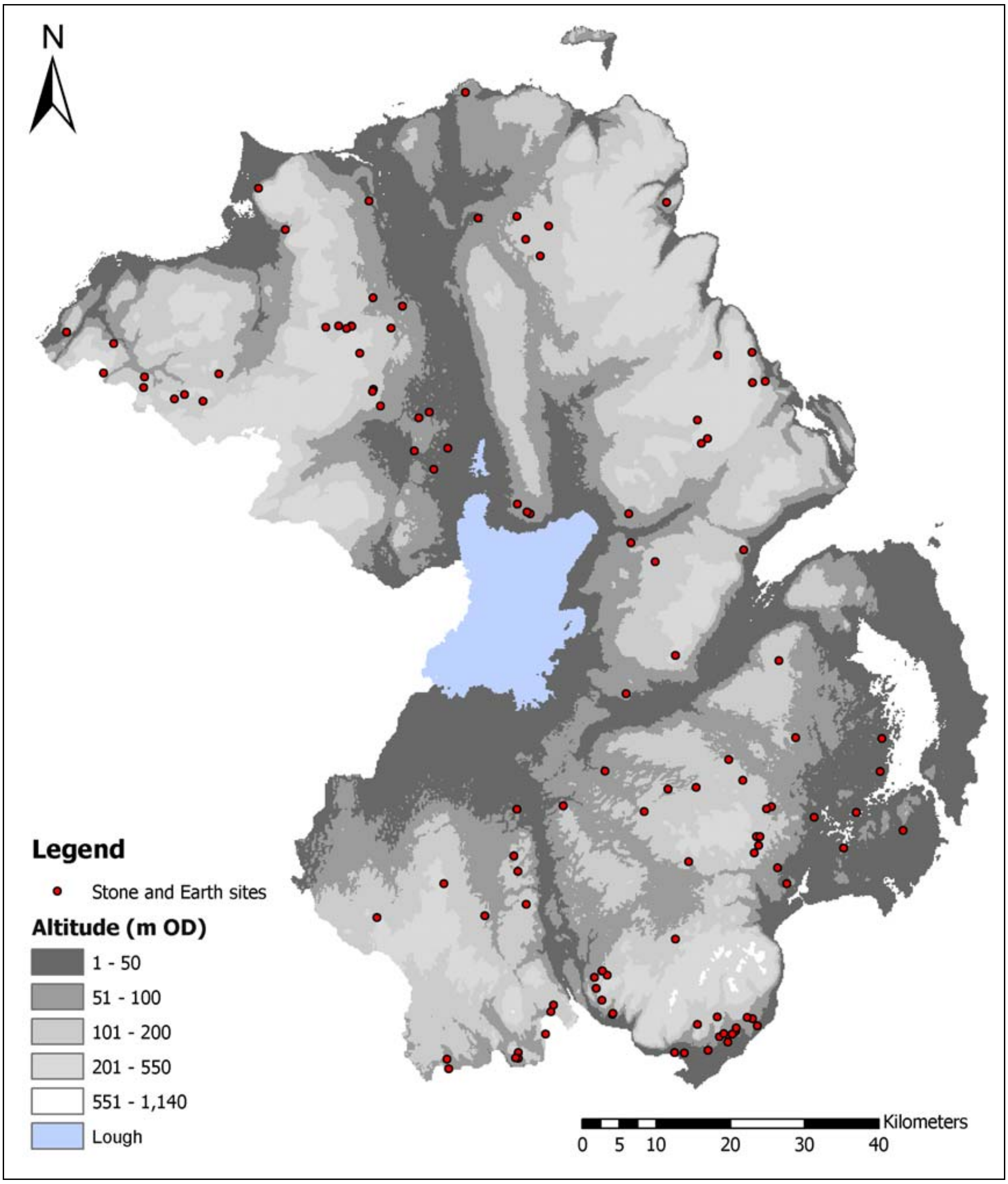


Figure 4.39: Distribution of sites enclosed by stone and earthen ramparts in Northern Ireland.

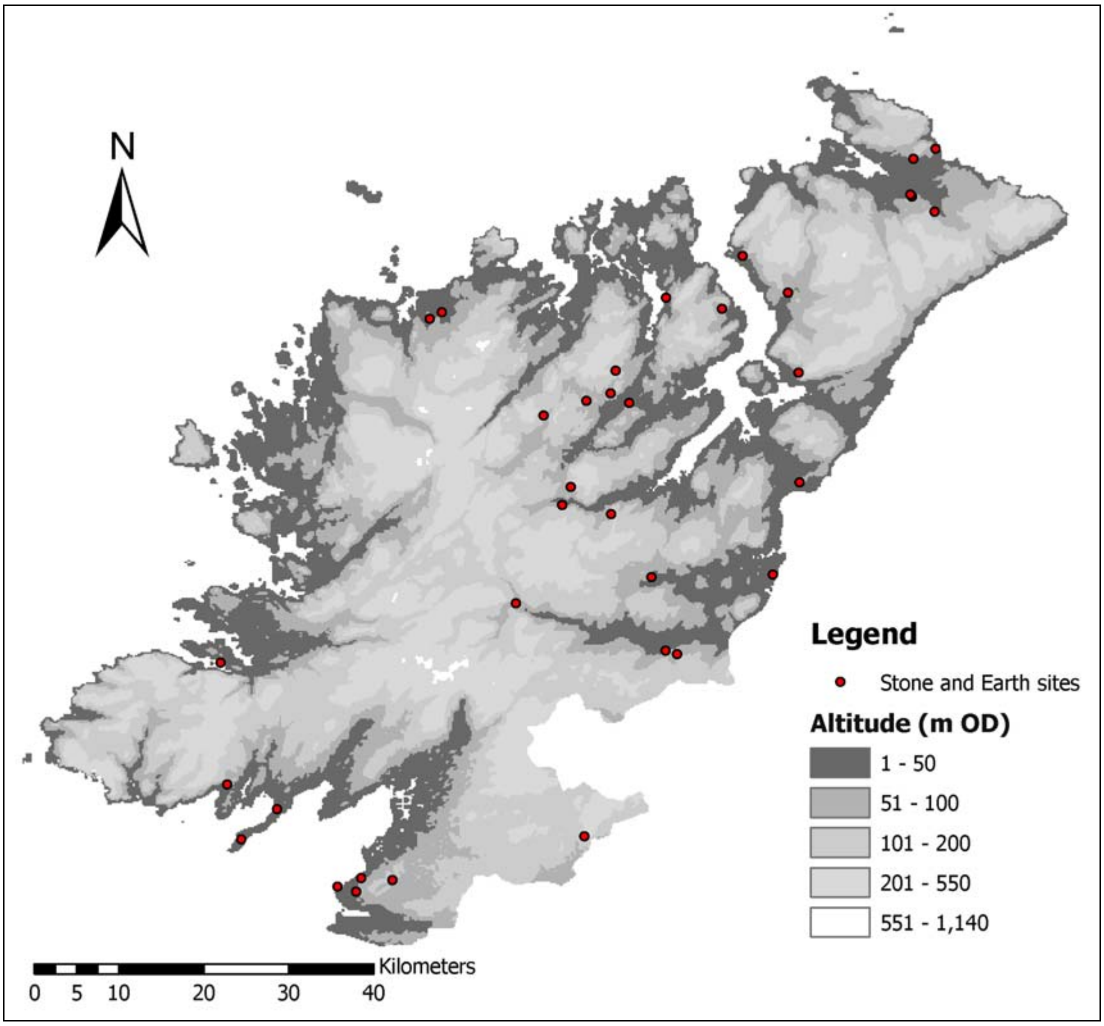


Figure 4.40: Distribution of sites enclosed by stone and earthen ramparts in Co. Donegal.

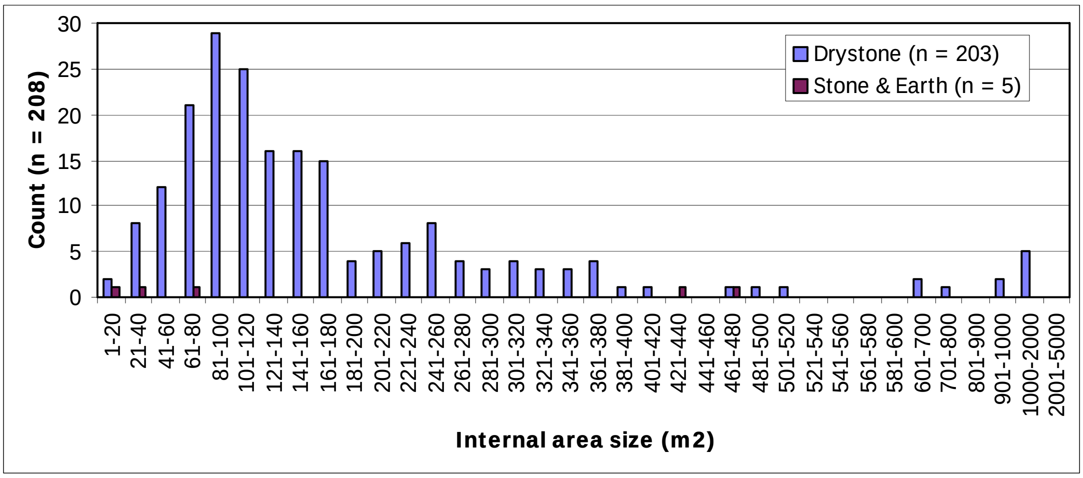


Figure 4.41: Internal area size of curvilinear sites in Argyll with documented measurements showing a predominant size range between 41m² and 180m².

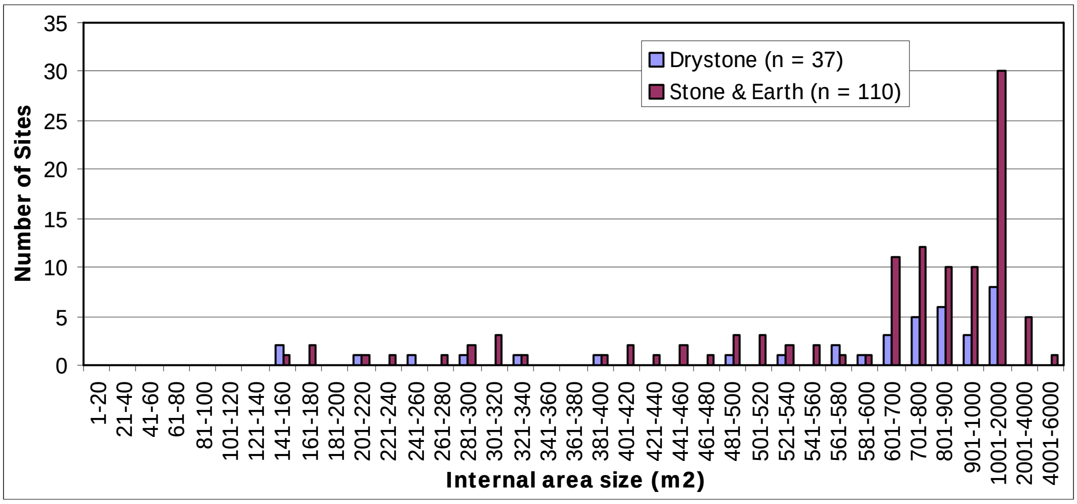


Figure 4.42: Internal area size of curvilinear drystone sites and sites of stone and earth ramparts in Northern Ireland with documented measurements showing a predominant size range between 601m² and 5000m².

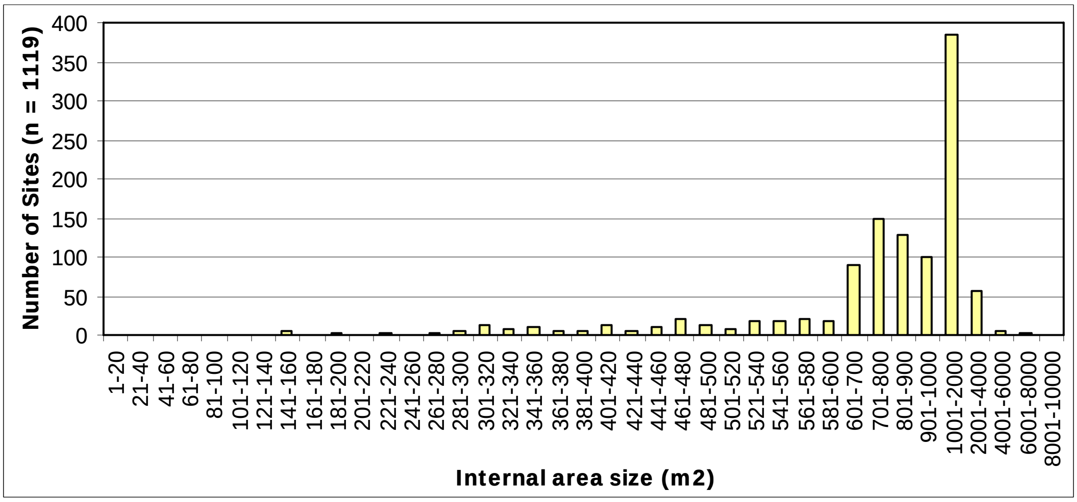


Figure 4.43: Internal area size of curvilinear earth sites in Northern Ireland with documented measurements showing a predominant size range between 601m² and 5000m².

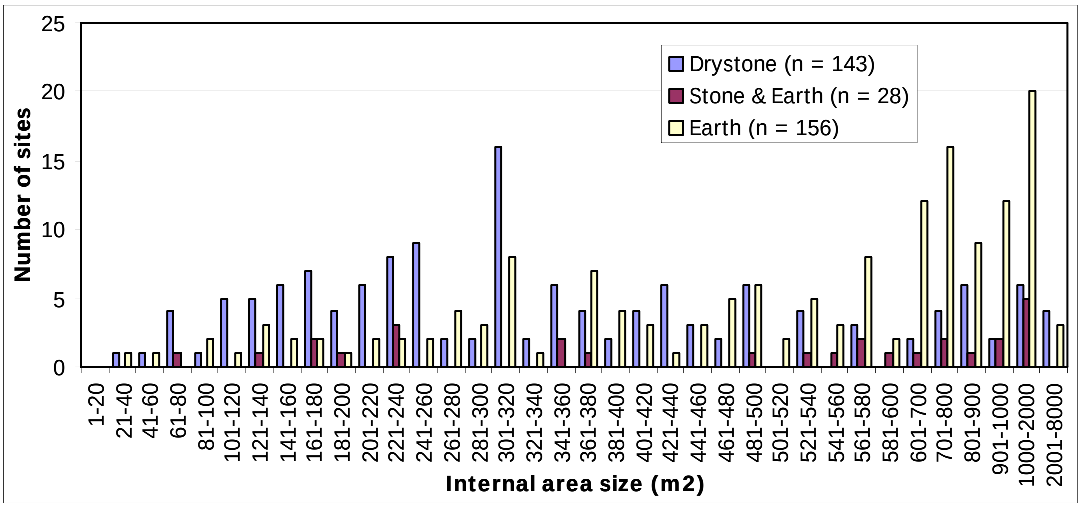


Figure 4.44: Internal area size of curvilinear sites in Co. Donegal with documented measurements showing the drystone and earthen rampart sites spanning the whole range.

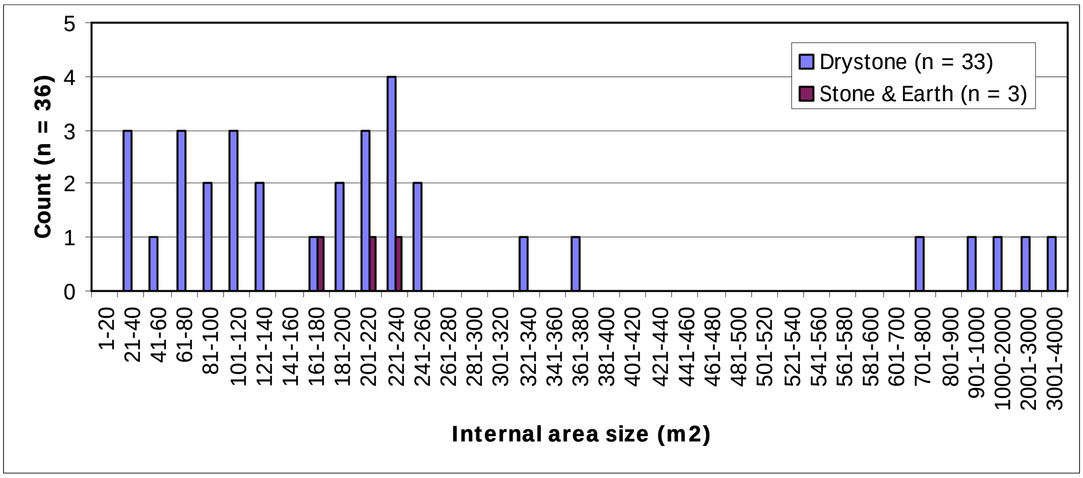


Figure 4.45: Internal area size of rectilinear sites in Argyll with documented measurements showing a bipolar distribution with the majority measuring below 260m².

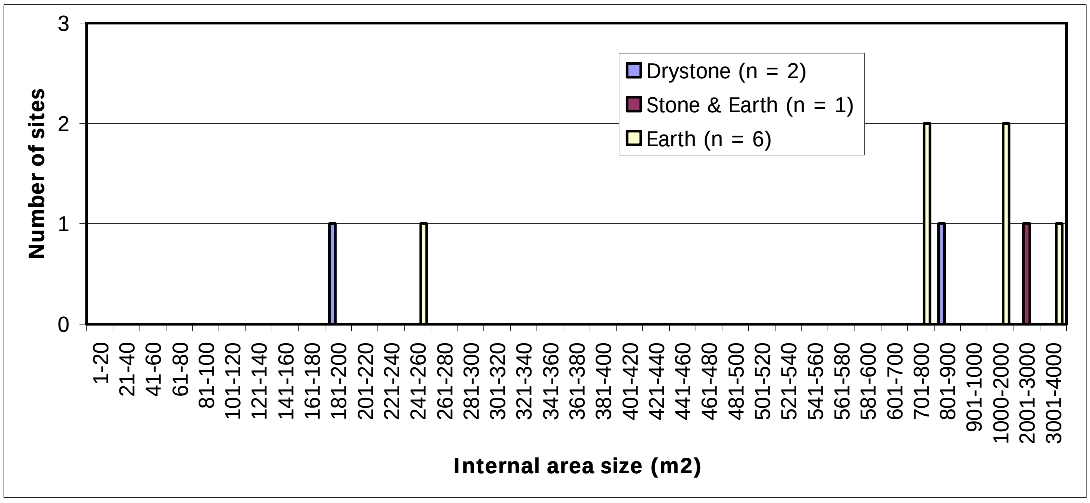


Figure 4.46: Internal area size of rectilinear sites in Northern Ireland with documented measurements showing a predominant distribution of sites above 701m².

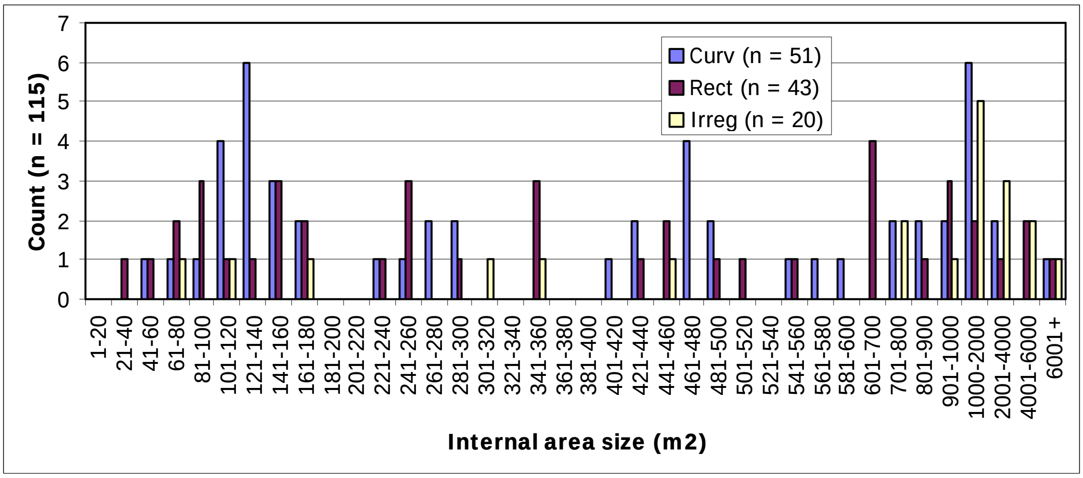


Figure 4.47: Internal area size of all variations of irregular sites in Argyll with documented measurements distributed throughout the range.

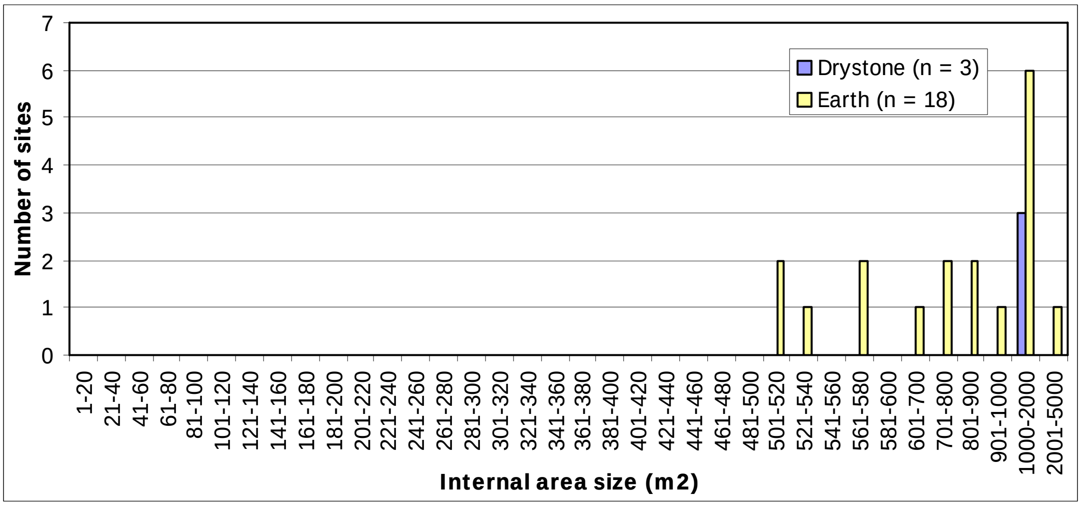


Figure 4.48: Area size of irregular sites in Northern Ireland with documented measurements showing all sites enclosing internal areas above 501m².

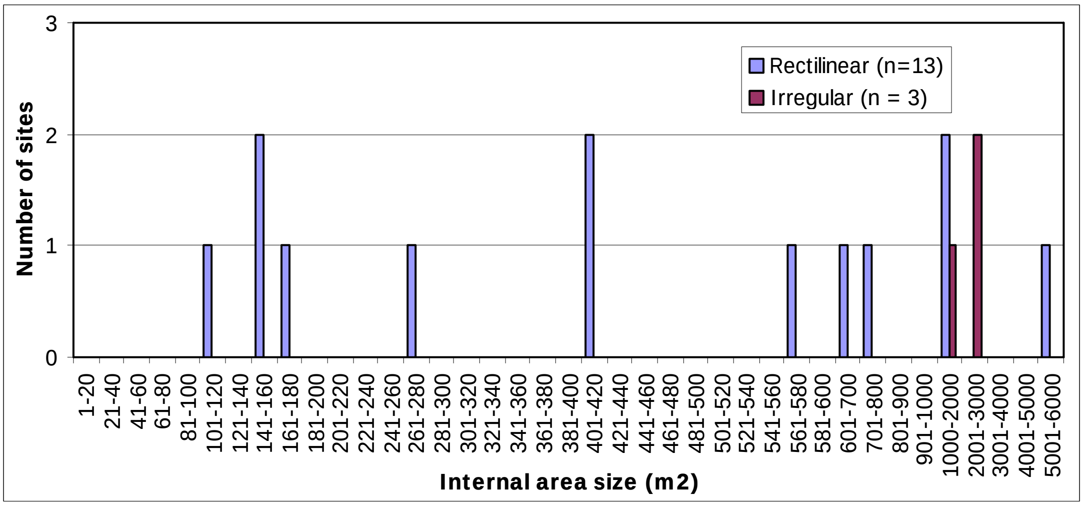


Figure 4.49: Internal area size of all irregular sites in Co. Donegal with documented measurements distributed throughout the range.

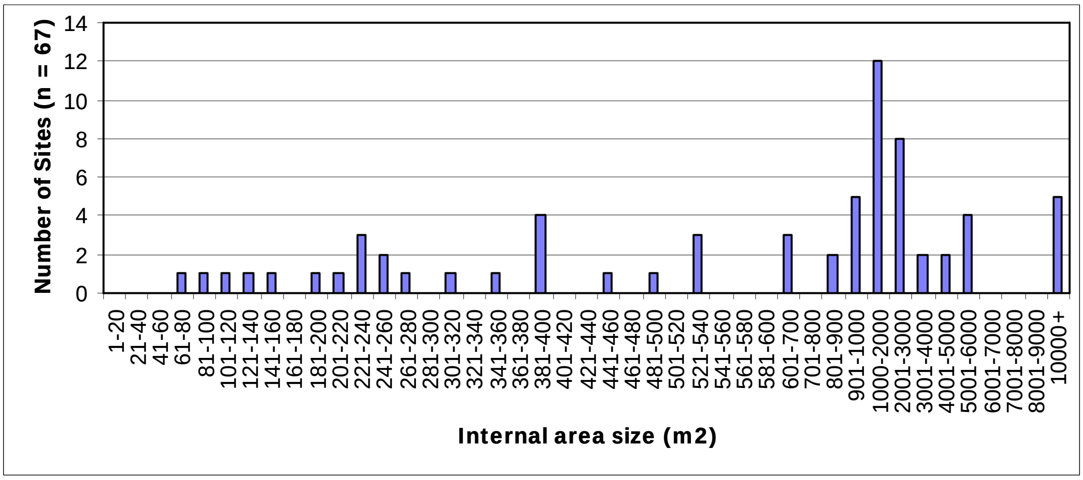


Figure 4.50: Internal area size of promontory enclosure sites in Argyll with measurements showing a predominate distribution above 800m².

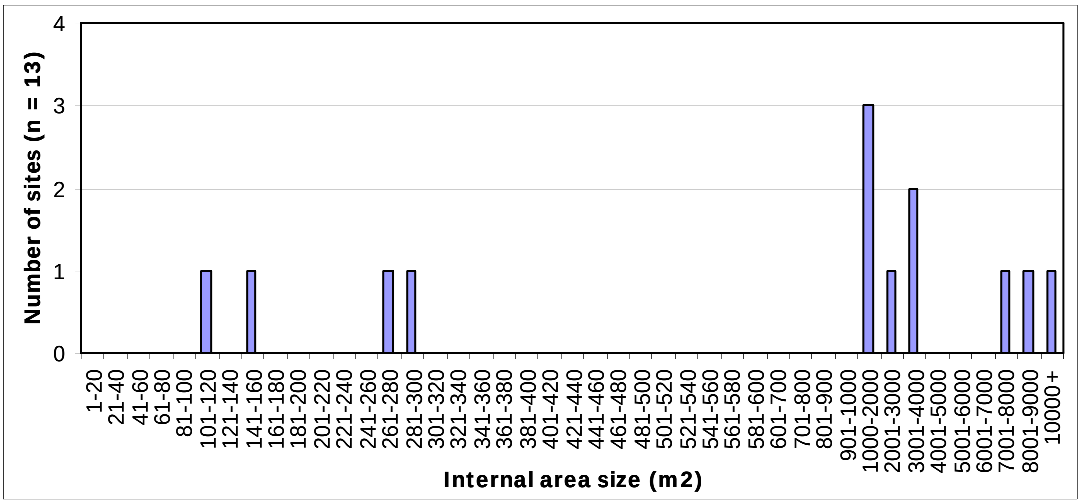


Figure 4.51: Internal area size of promontory enclosure sites in Co. Donegal with documented measurements showing a bipolar distribution.

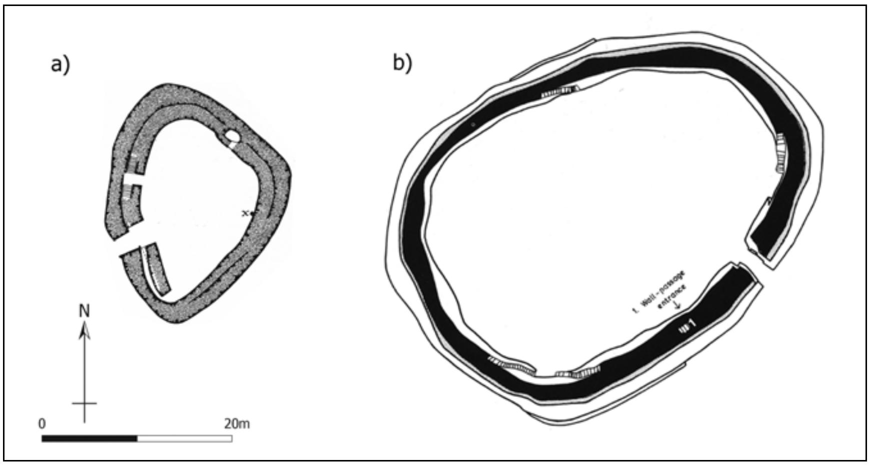


Figure 4.52: Plan of: (a) Kildonan Bay (AR-073)(AFIR)(Source: RCAHMS 1971); (b) Drumboghill (DN-130)(AFIR)(Source: Lacy 1983) illustrating similarities in plan and architectural features.

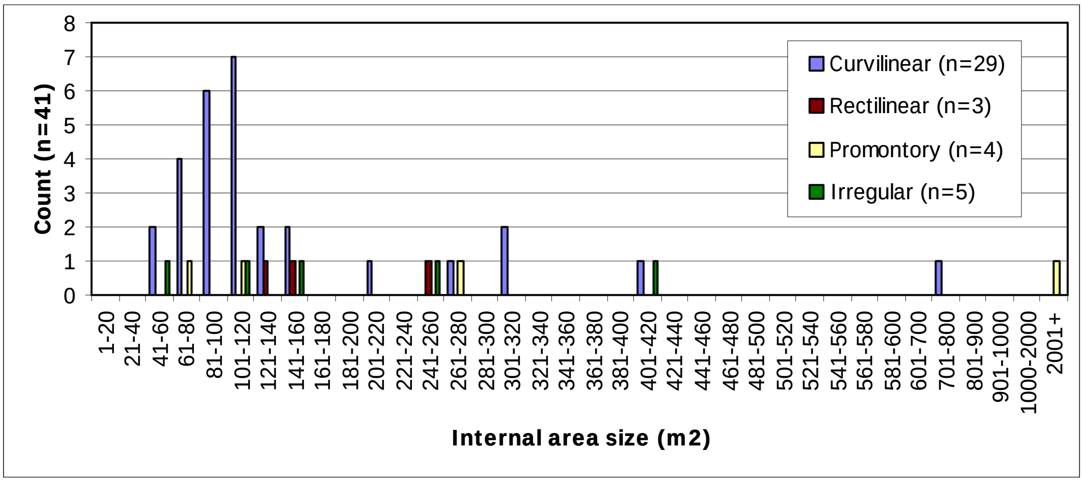


Figure 4.53: Internal area size of sites with architectural features, such as intramural cells, galleries or staircases, in Argyll with documented measurements showing a predominate distribution below 160m^2.

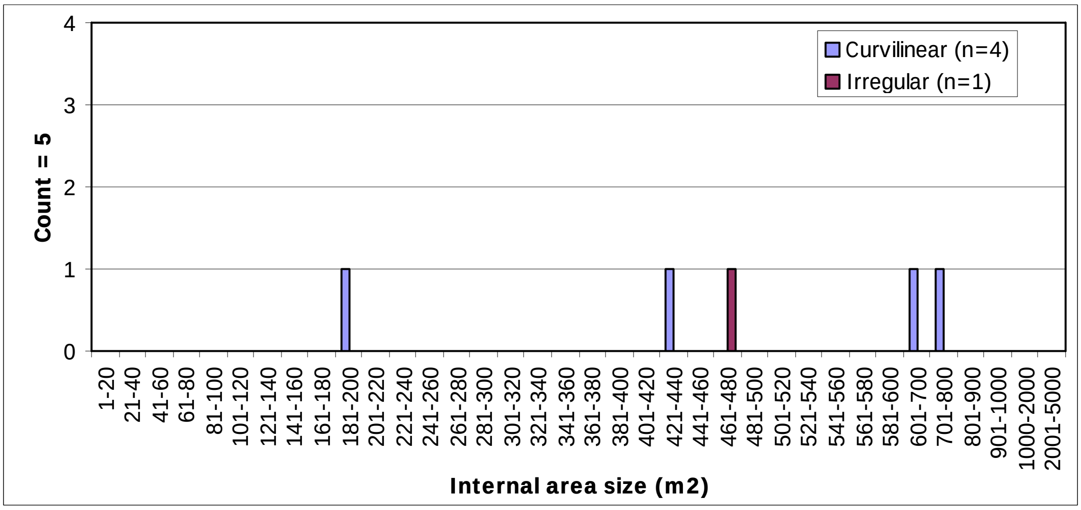


Figure 4.54: Internal area size of sites with architectural features, such as intramural cells, galleries or staircases, in Co. Donegal with documented measurements distributed throughout the range.

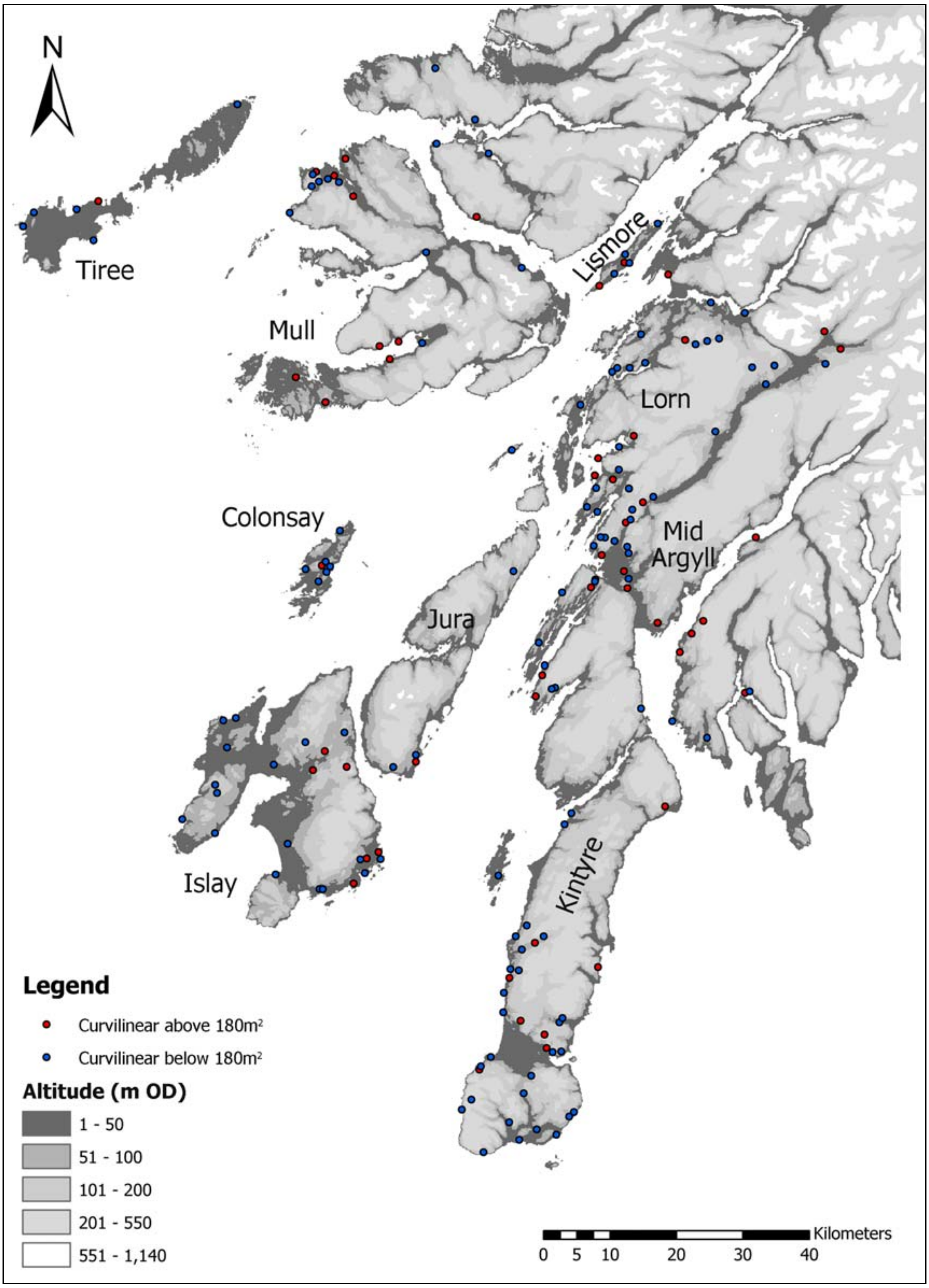


Figure 4.55: Distribution of CSB and CSA sites in Argyll showing concentrations in particular areas.

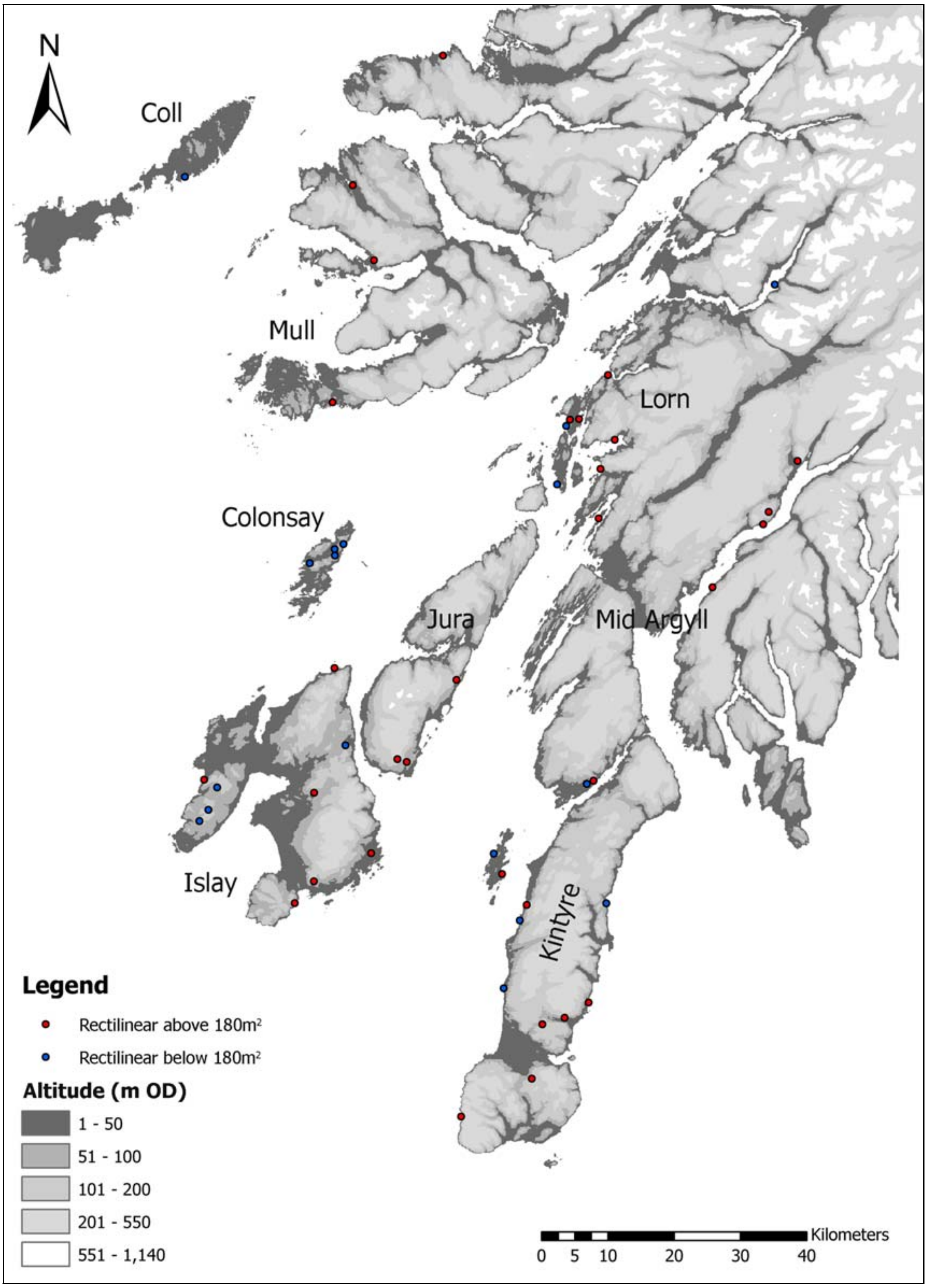


Figure 4.56: RSB and RSA sites in Argyll mainly distributed in the southern half of the study area.

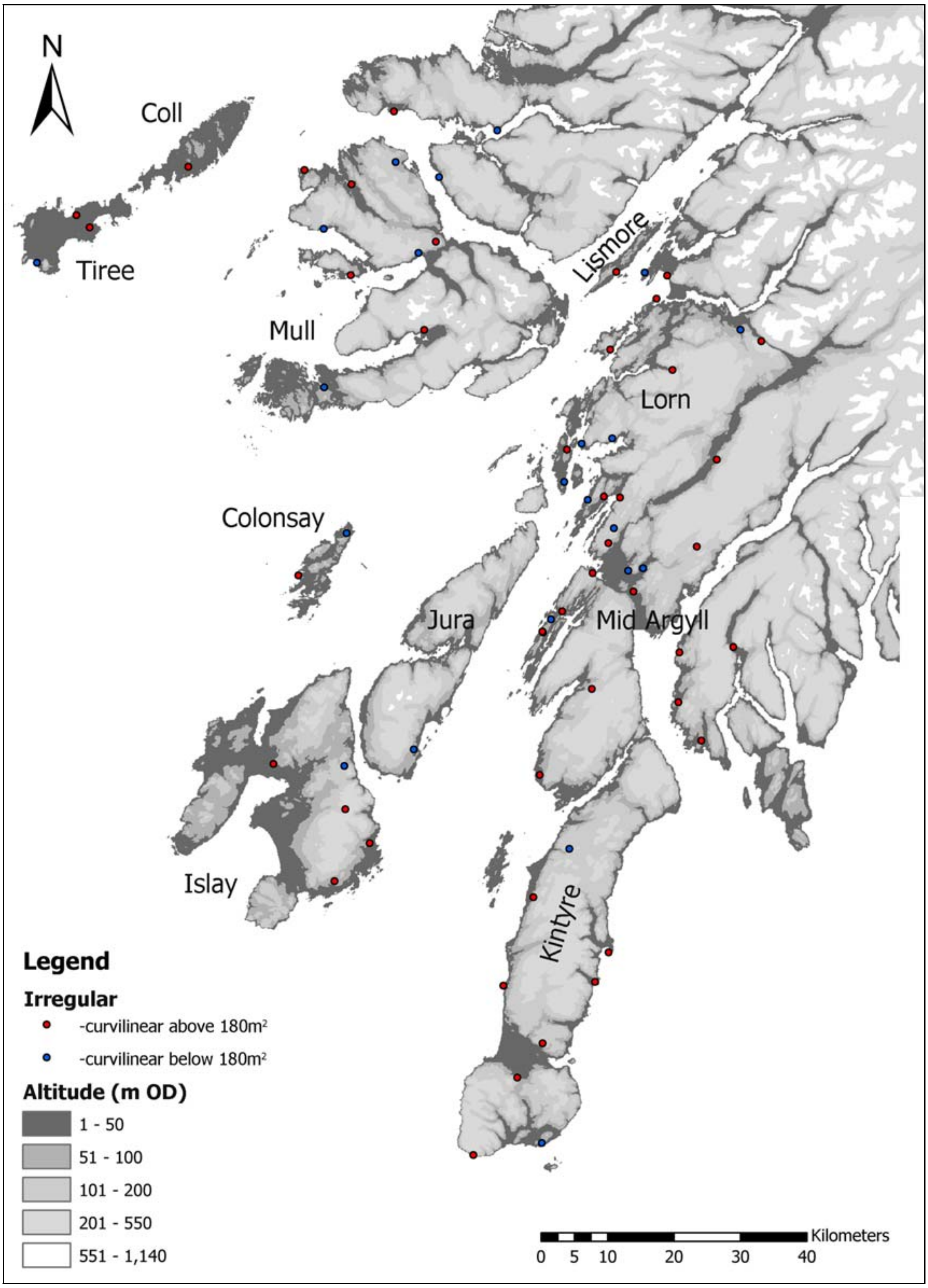


Figure 4.57: Distribution of ICSB and ICSA sites in Argyll showing a comparable pattern to that of the curvilinear sites.

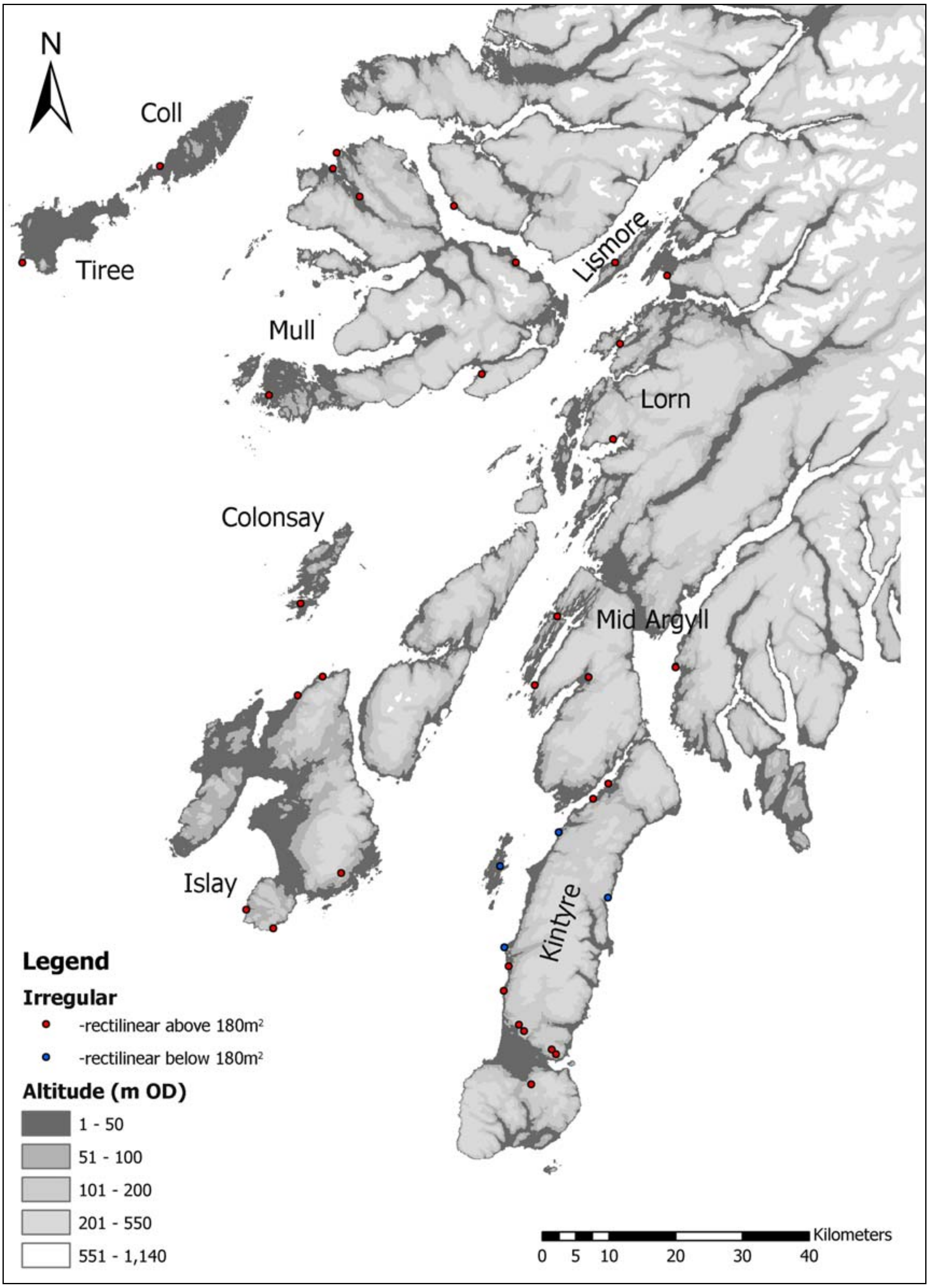


Figure 4.58: Distribution of IRSB and IRSA sites in Argyll showing a comparable pattern to that of the curvilinear sites.

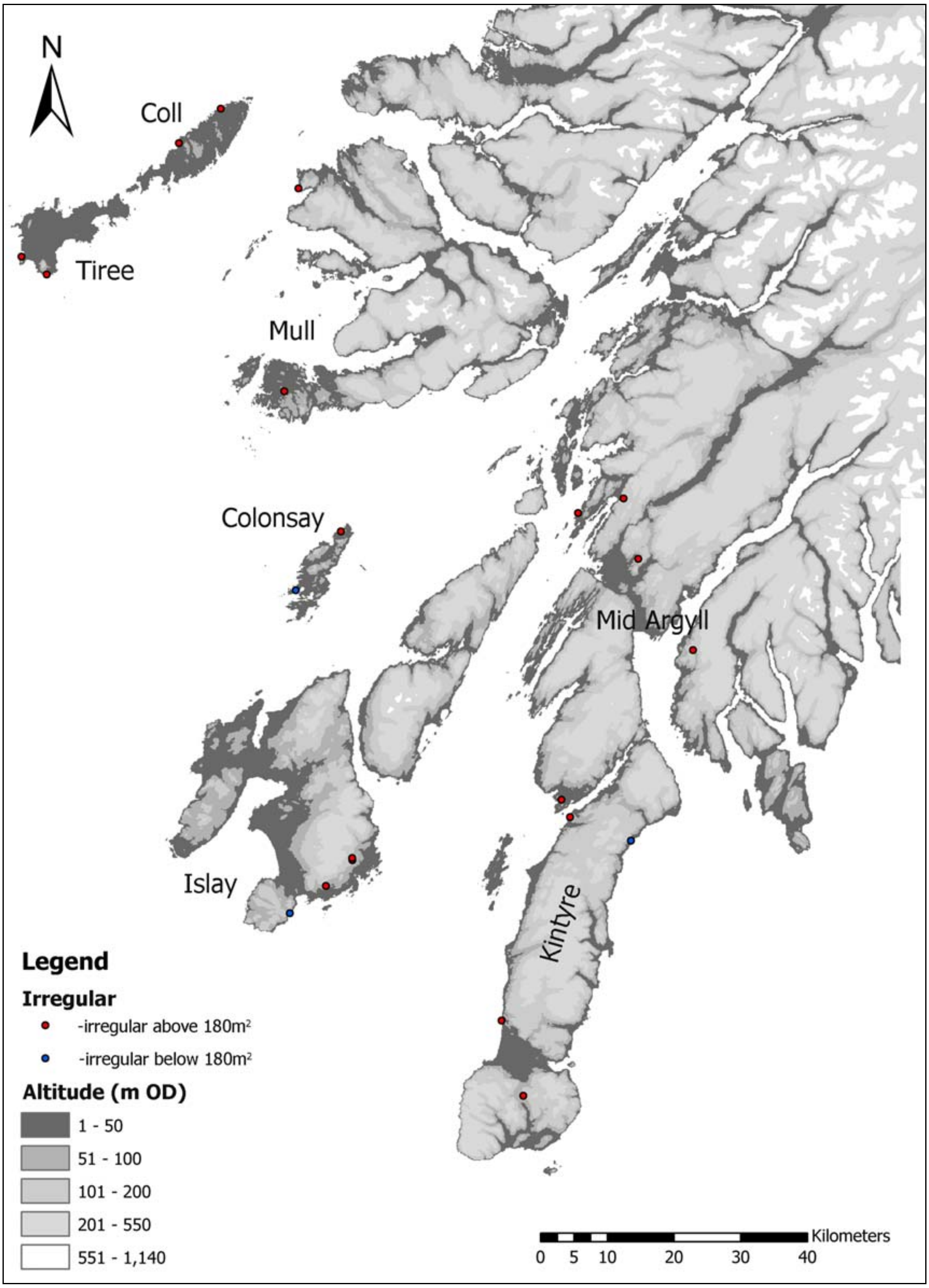


Figure 4.59: Distribution of IISB and IISA sites in Argyll showing a comparable pattern to that of the curvilinear sites.

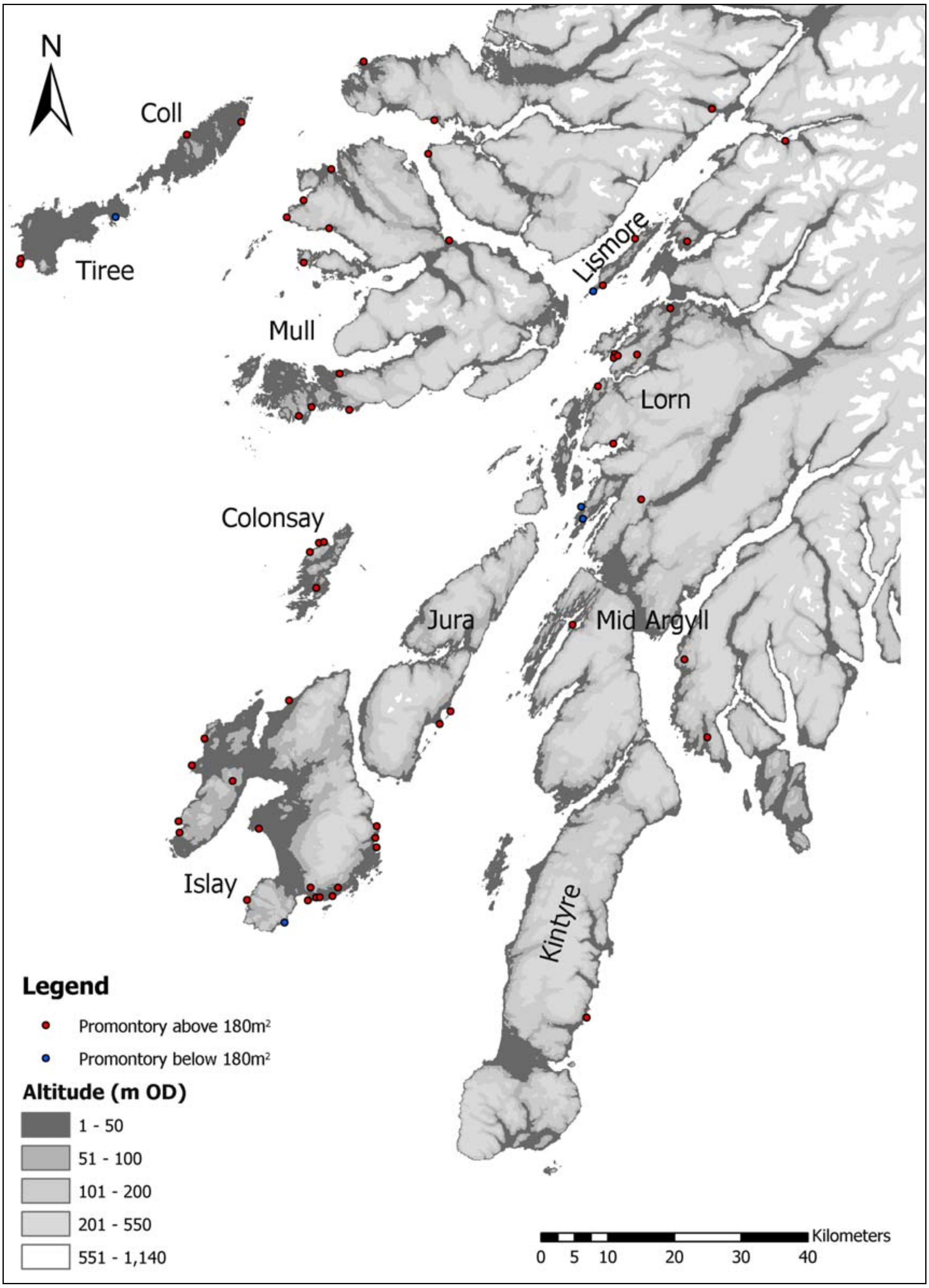


Figure 4.60: PB and PA sites in Argyll distributed along the coastlines of Islay, Mid Argyll, Mull, Coll and Tiree and a few inland sites in Mid Argyll.

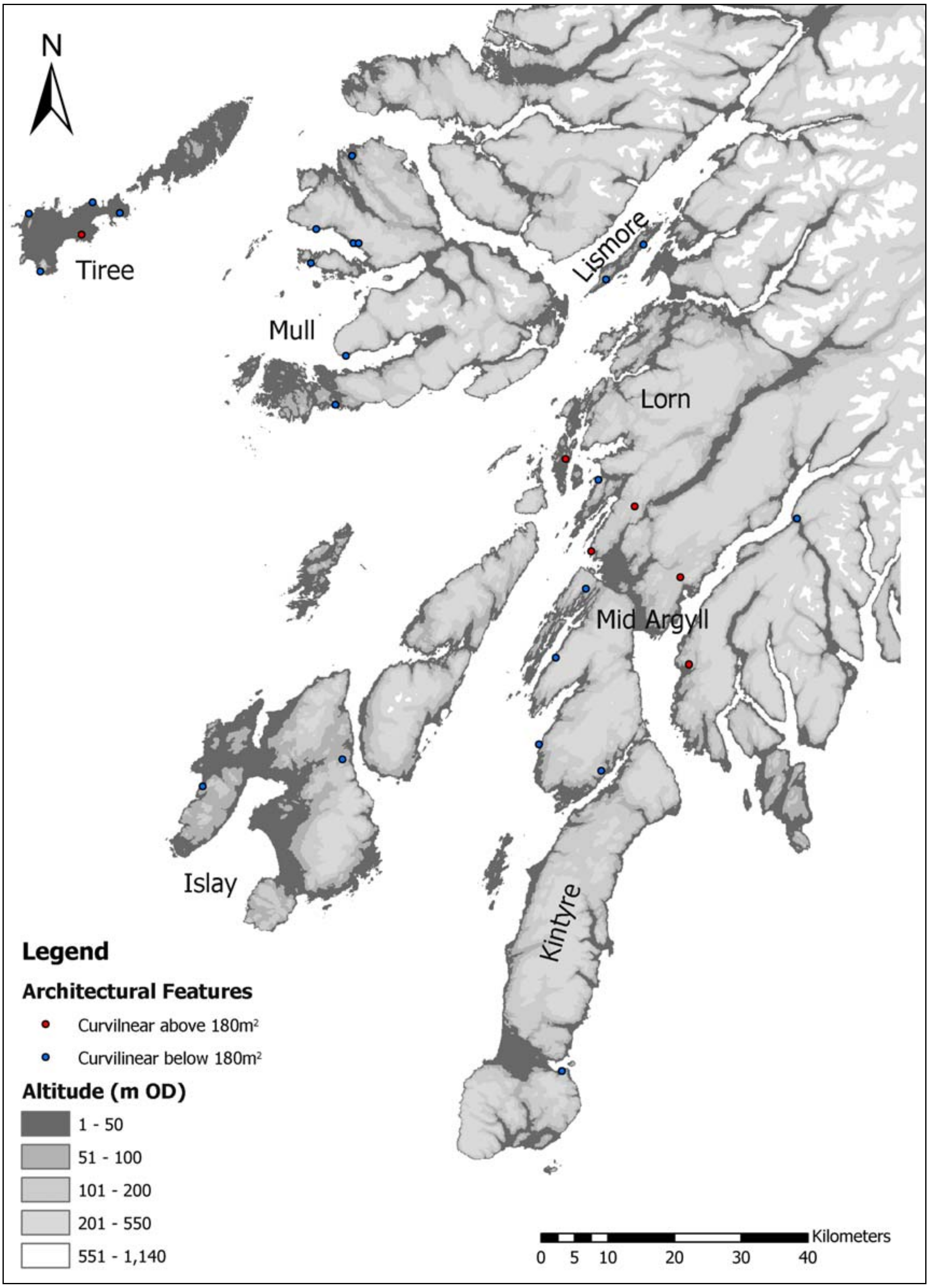


Figure 4.61: AFCB and AFCA sites in Argyll distributed throughout the study area.

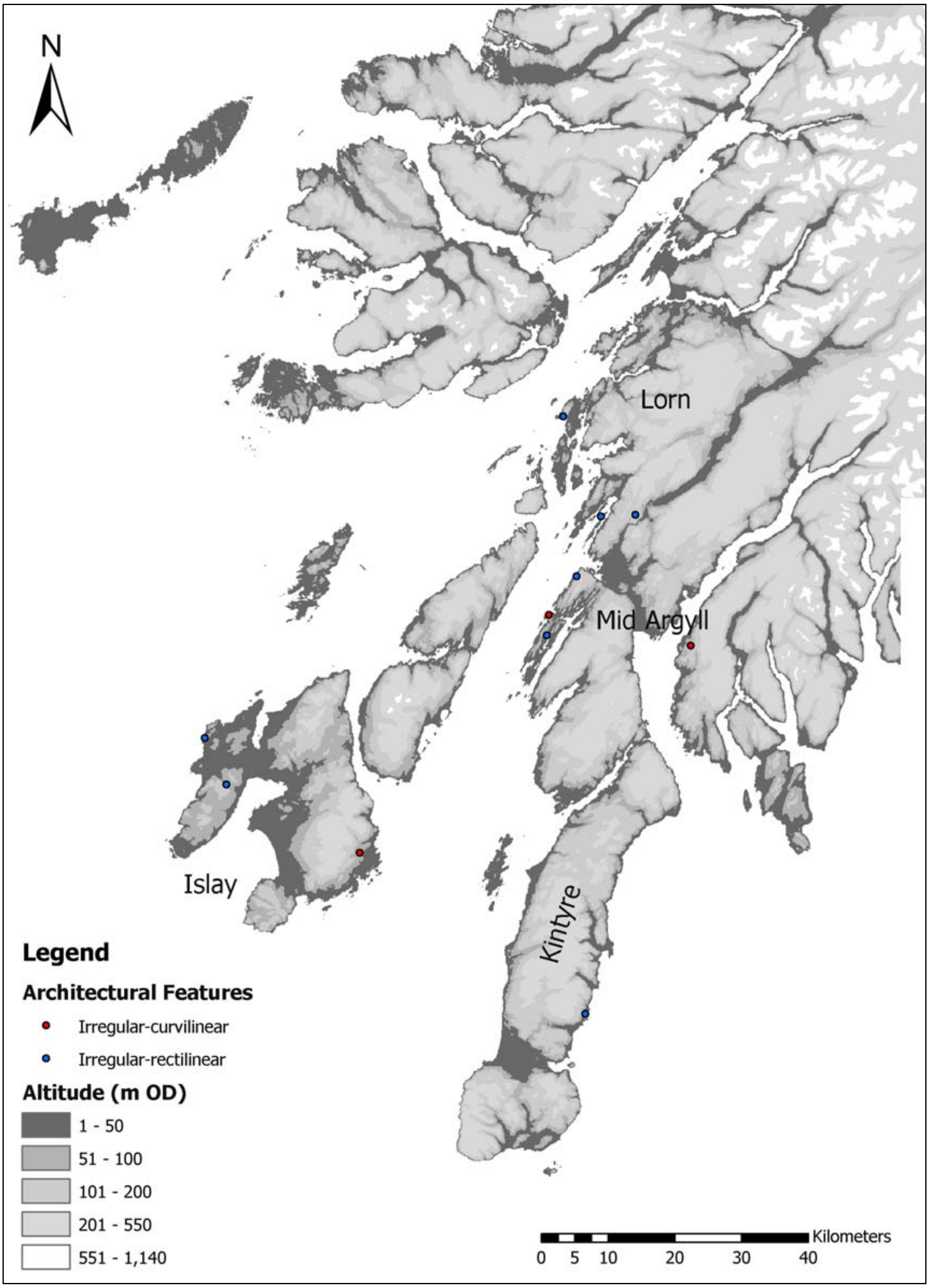


Figure 4.62: Irregular shaped sites with architectural features in Argyll distributed throughout the study area.

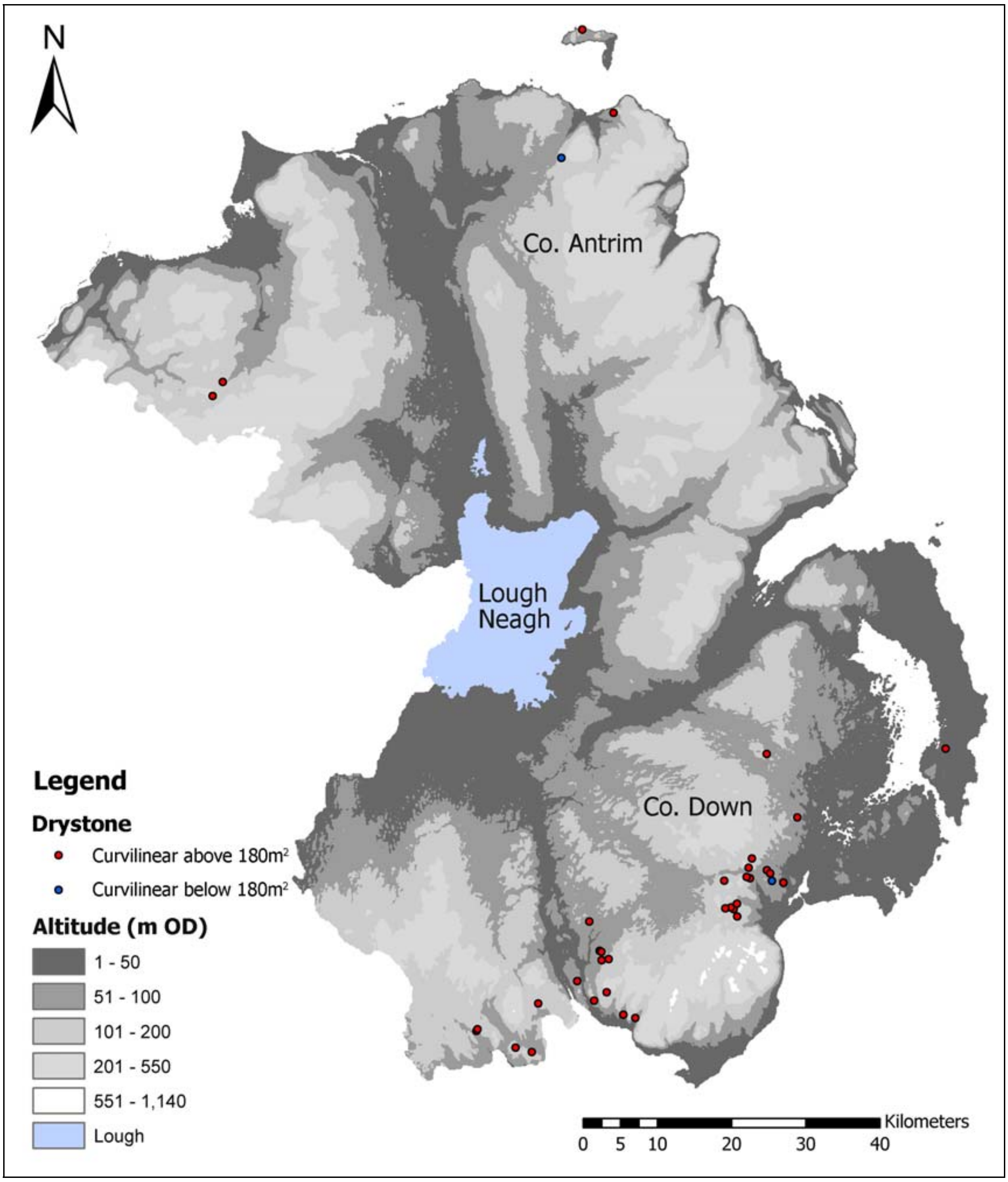


Figure 4.63: Distribution of CSB and CSA sites in the Northern Ireland showing higher numbers in the southern border of the study area.

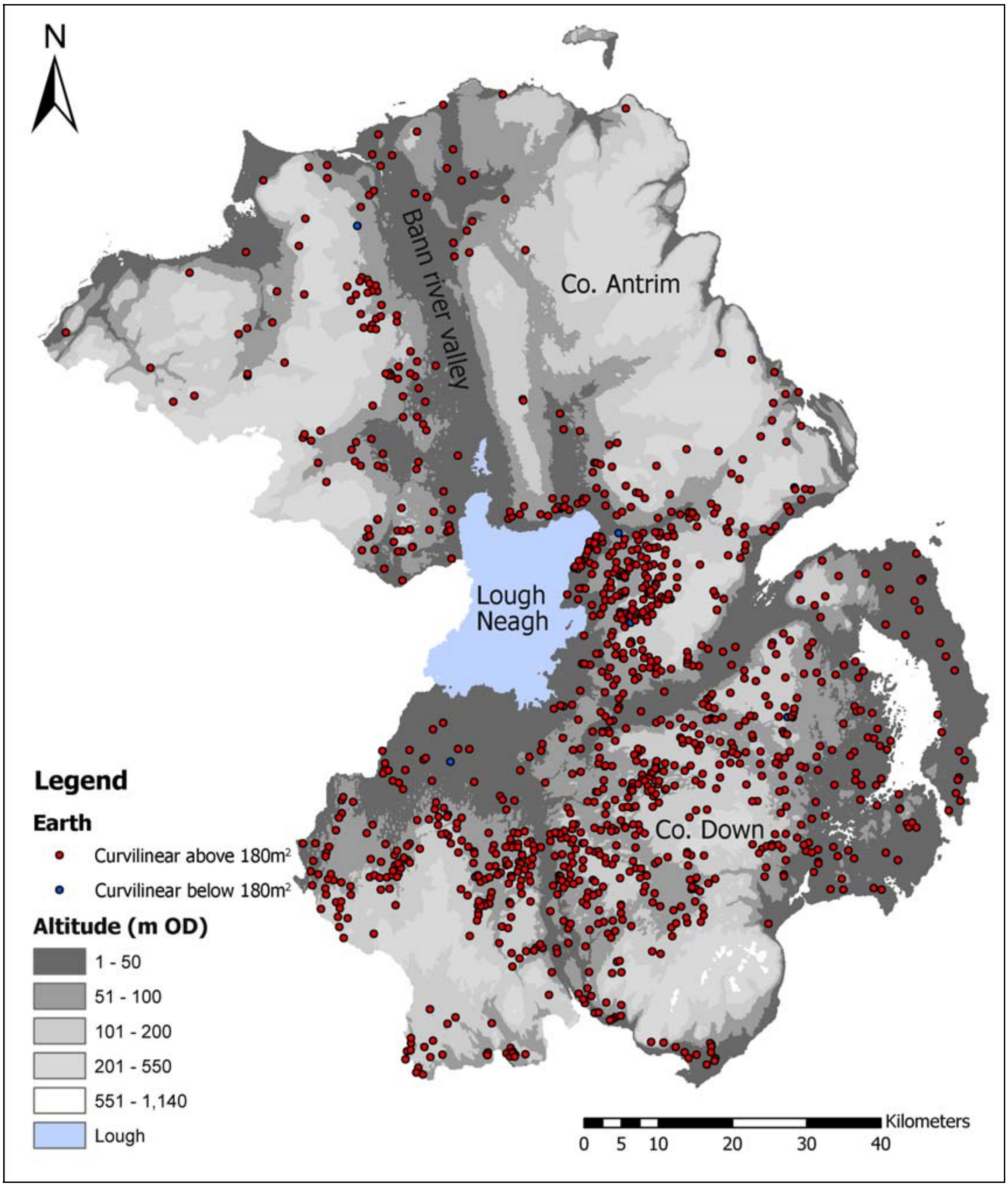


Figure 4.64: Distribution of CEB and CEA sites in the Northern Ireland showing concentrations along the major river valleys, to the north-west of Lough Neagh and in the southern half of the study area.

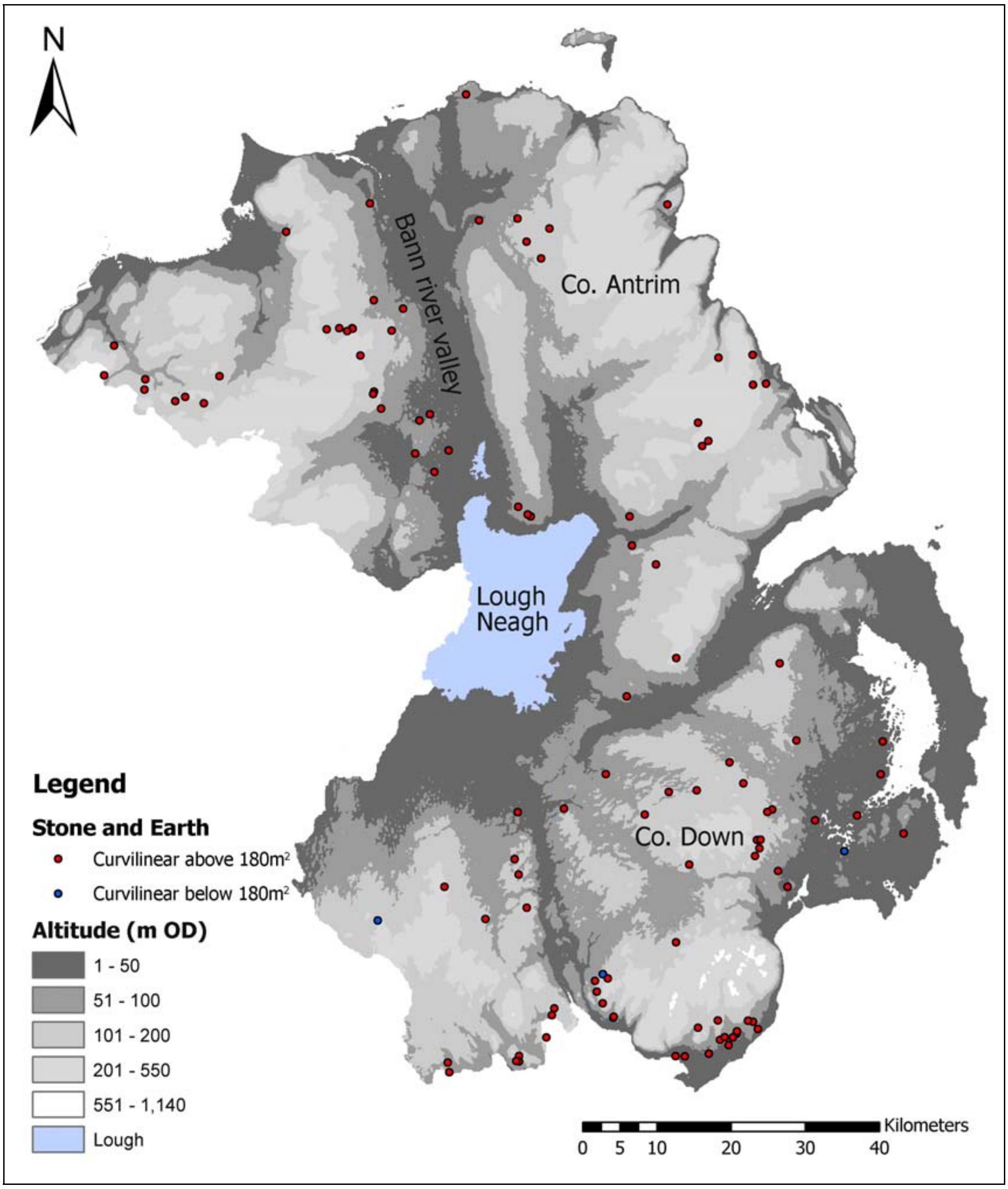


Figure 4.65: CSAEB and CSAEA sites in the Northern Ireland illustrating a widely dispersed distribution throughout the study area.

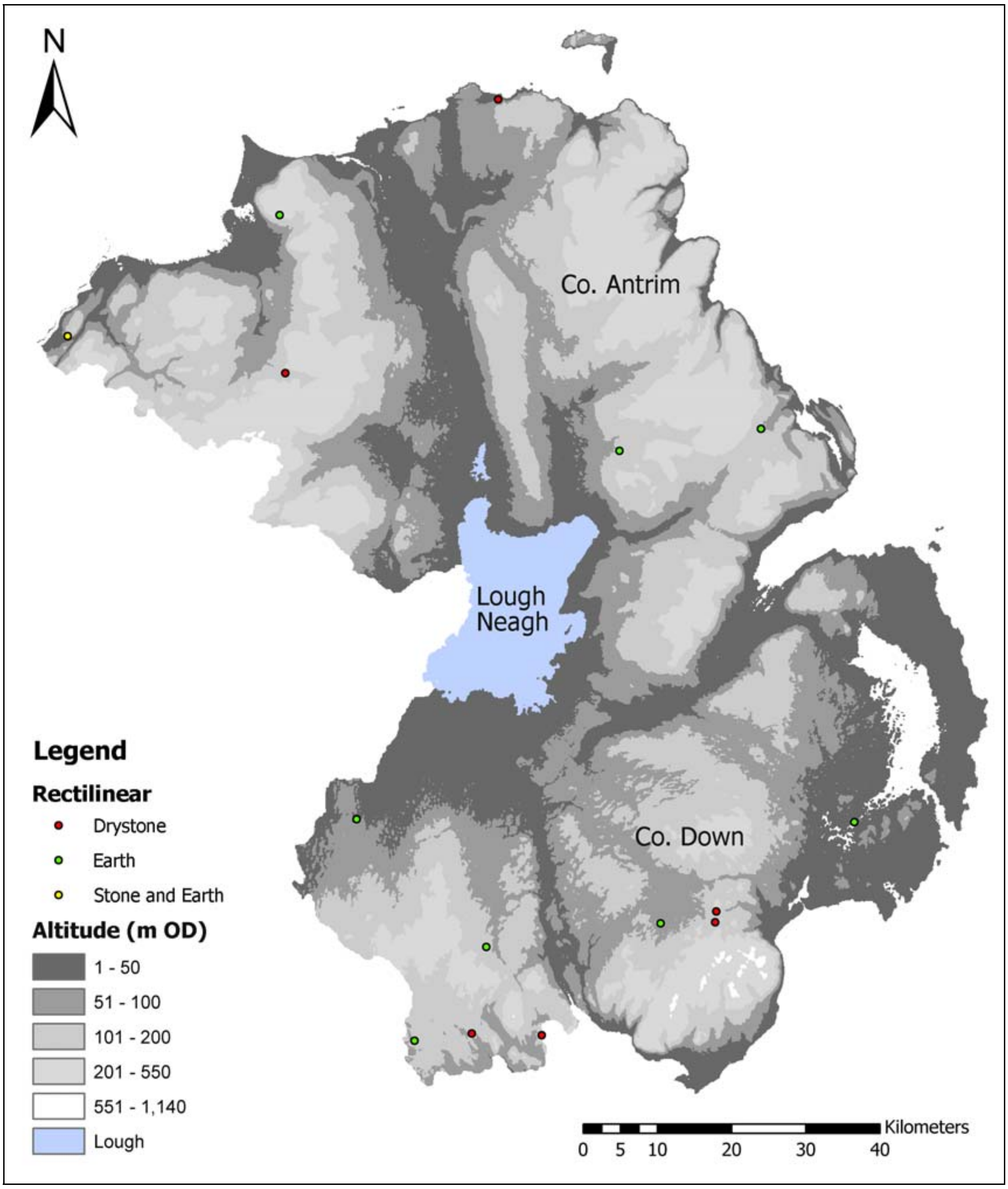


Figure 4.66: Distribution of rectilinear sites measuring above 180m² in the Northern Ireland study area.

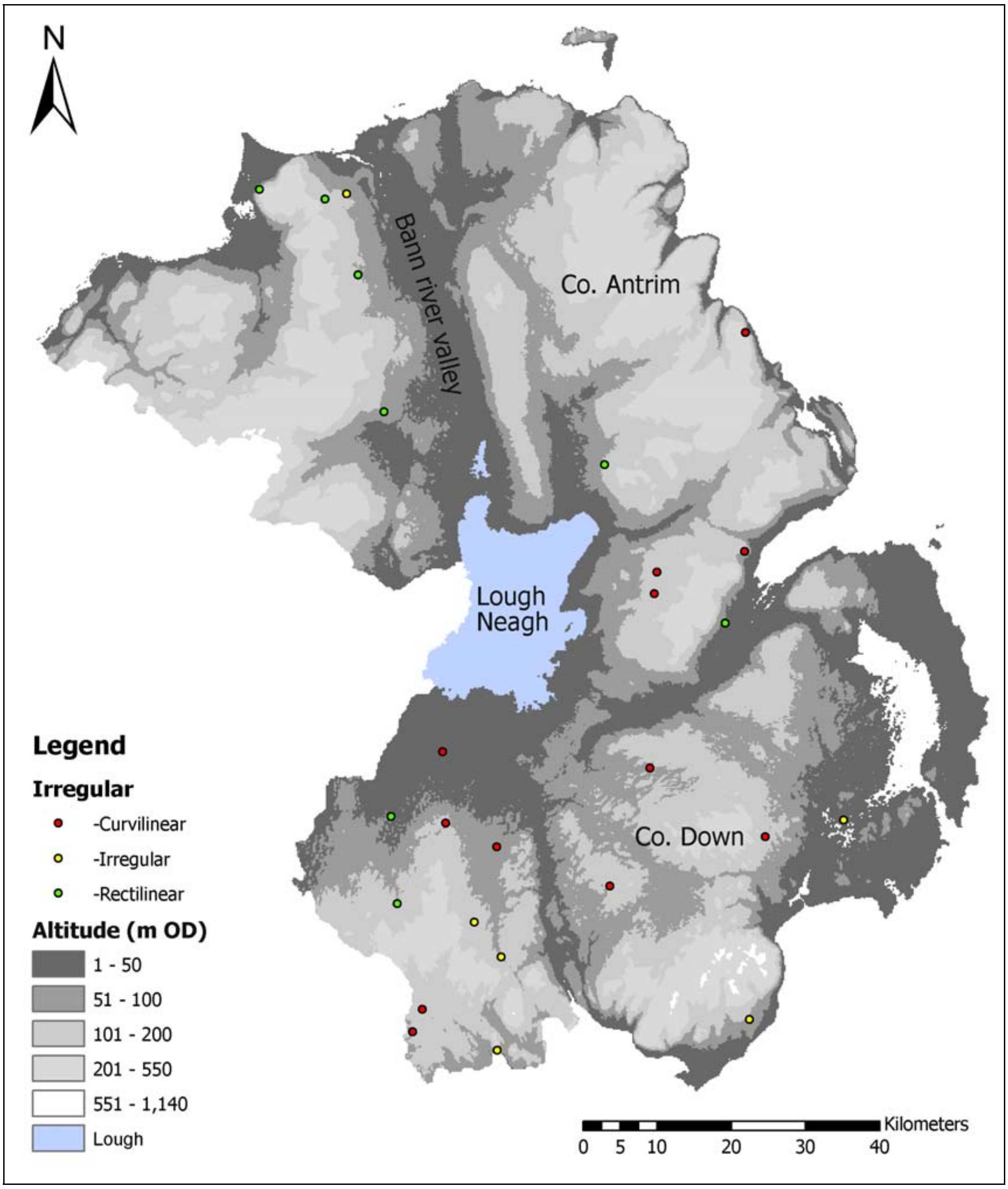


Figure 4.67: Distribution of all irregular site variations measuring above 180m² in the Northern Ireland study area illustrating a high number of sites scattered throughout the southern half of the study area.

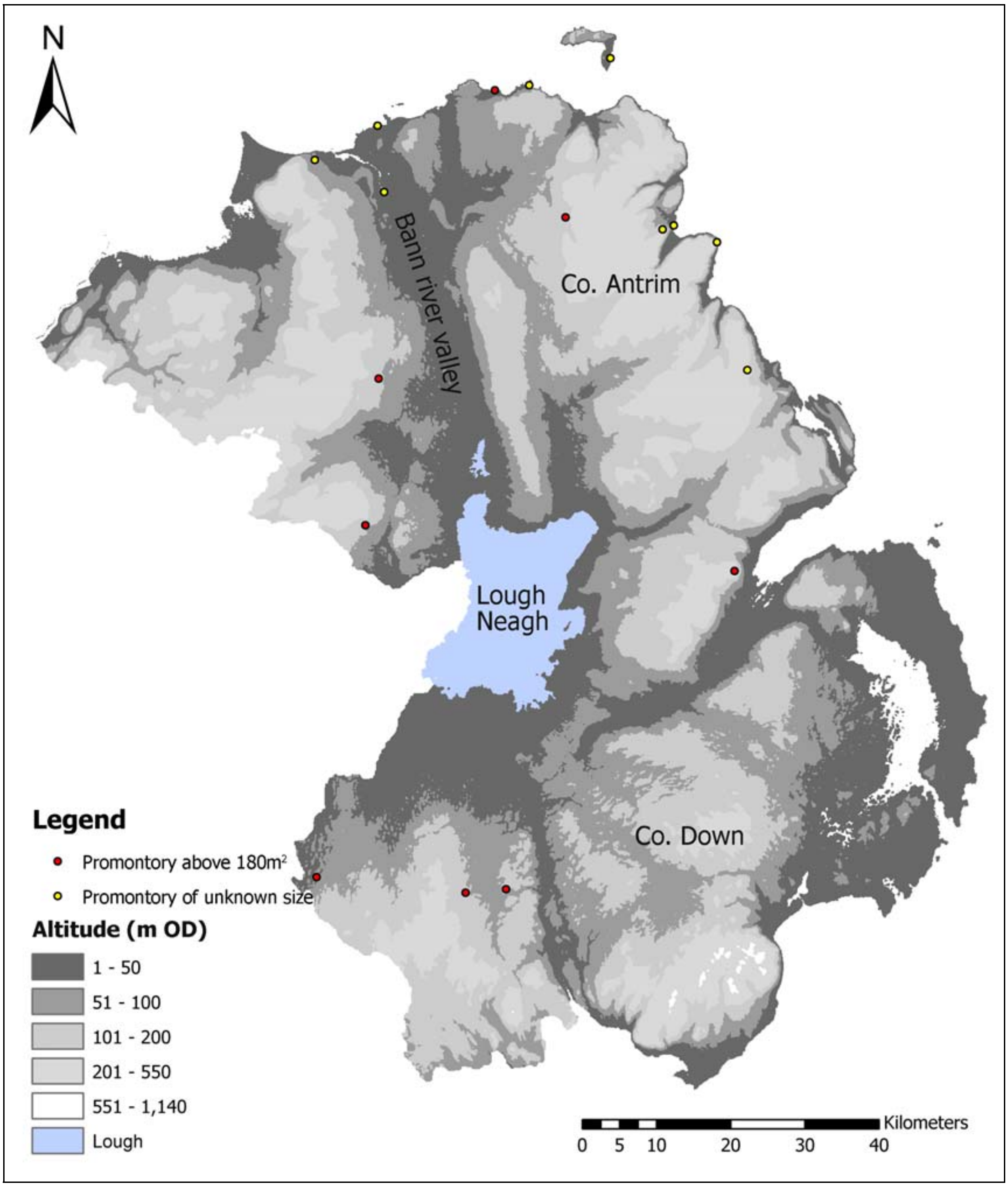


Figure 4.68: Distribution of promontory sites in the Northern Ireland study area illustrating a high number of sites in the northern half of the study area.

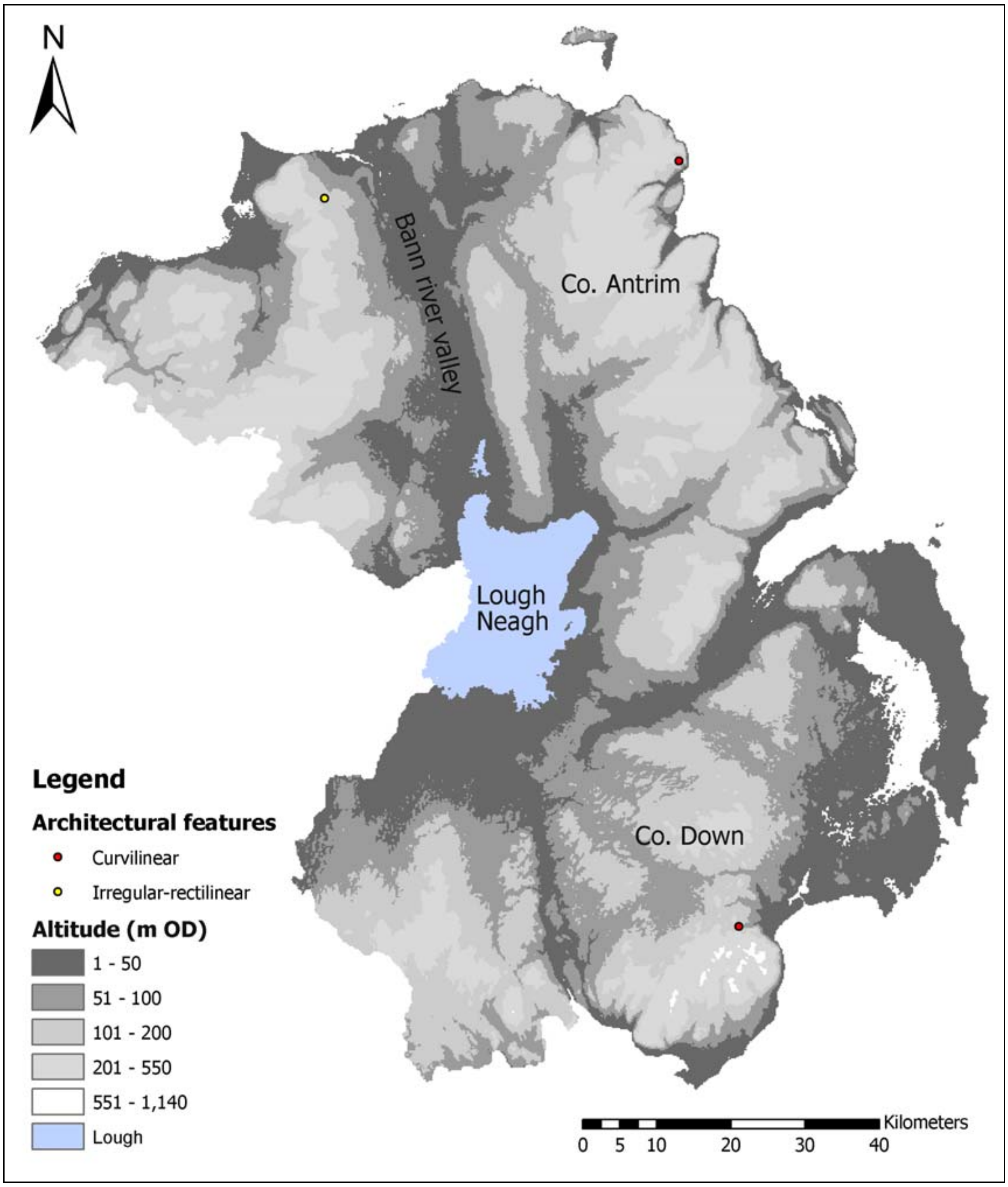


Figure 4.69: Sites with architectural features in the Northern Ireland study area.

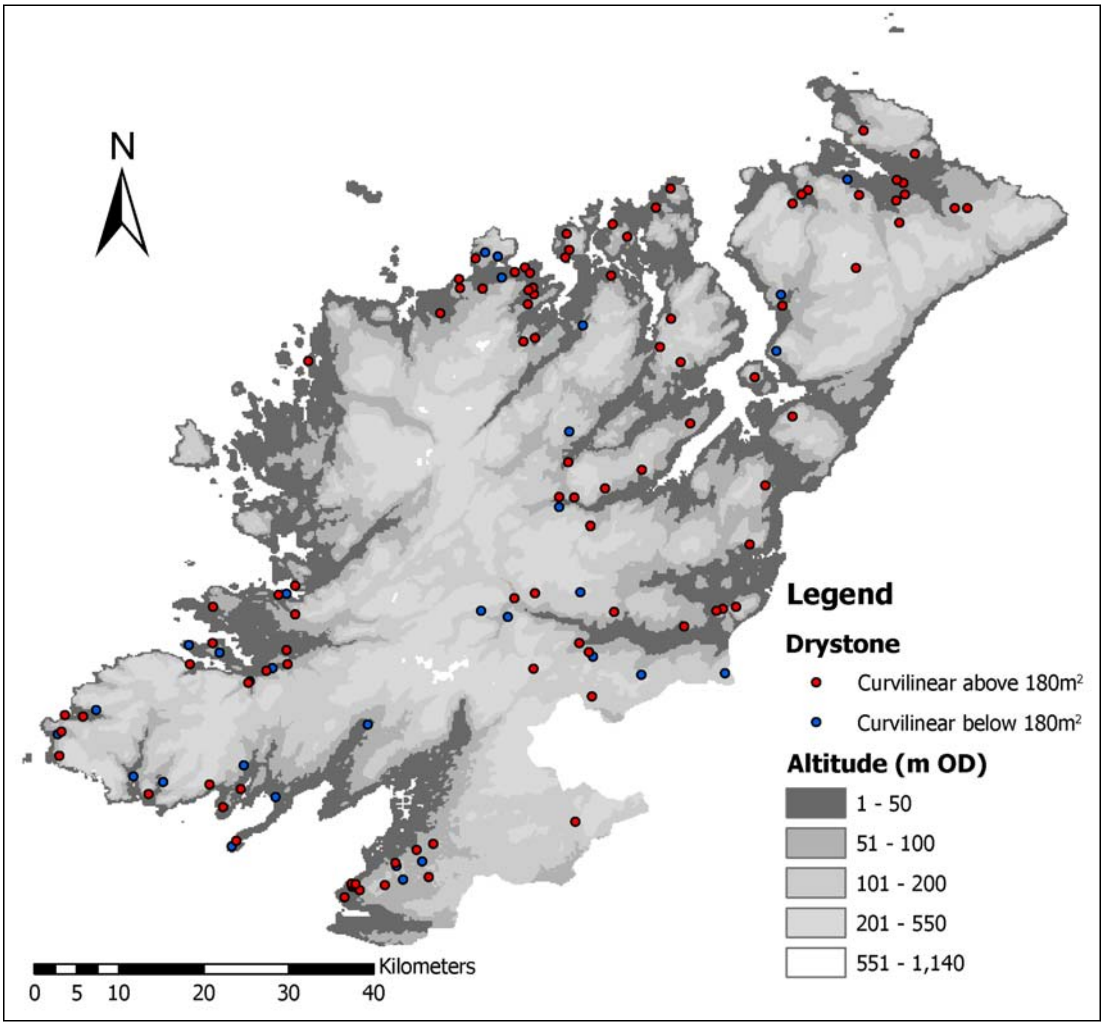


Figure 4.70: CSB and CSA sites in Co. Donegal distributed along the edges of the large river valleys eastern section of the study area and along the coastline.

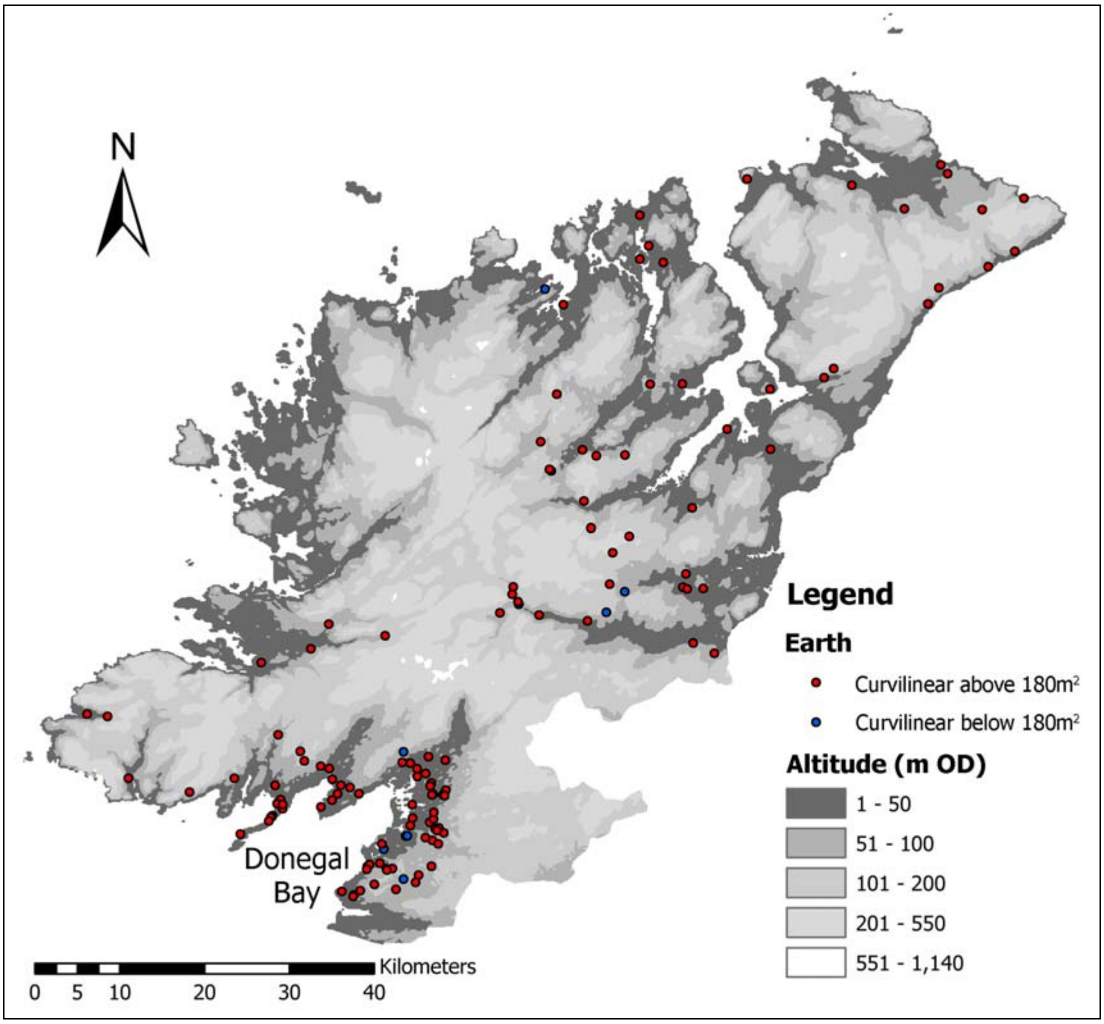


Figure 4.71: CEB and CEA sites in Co. Donegal concentrated near the south-western coastline and distributed in the north-eastern sector.

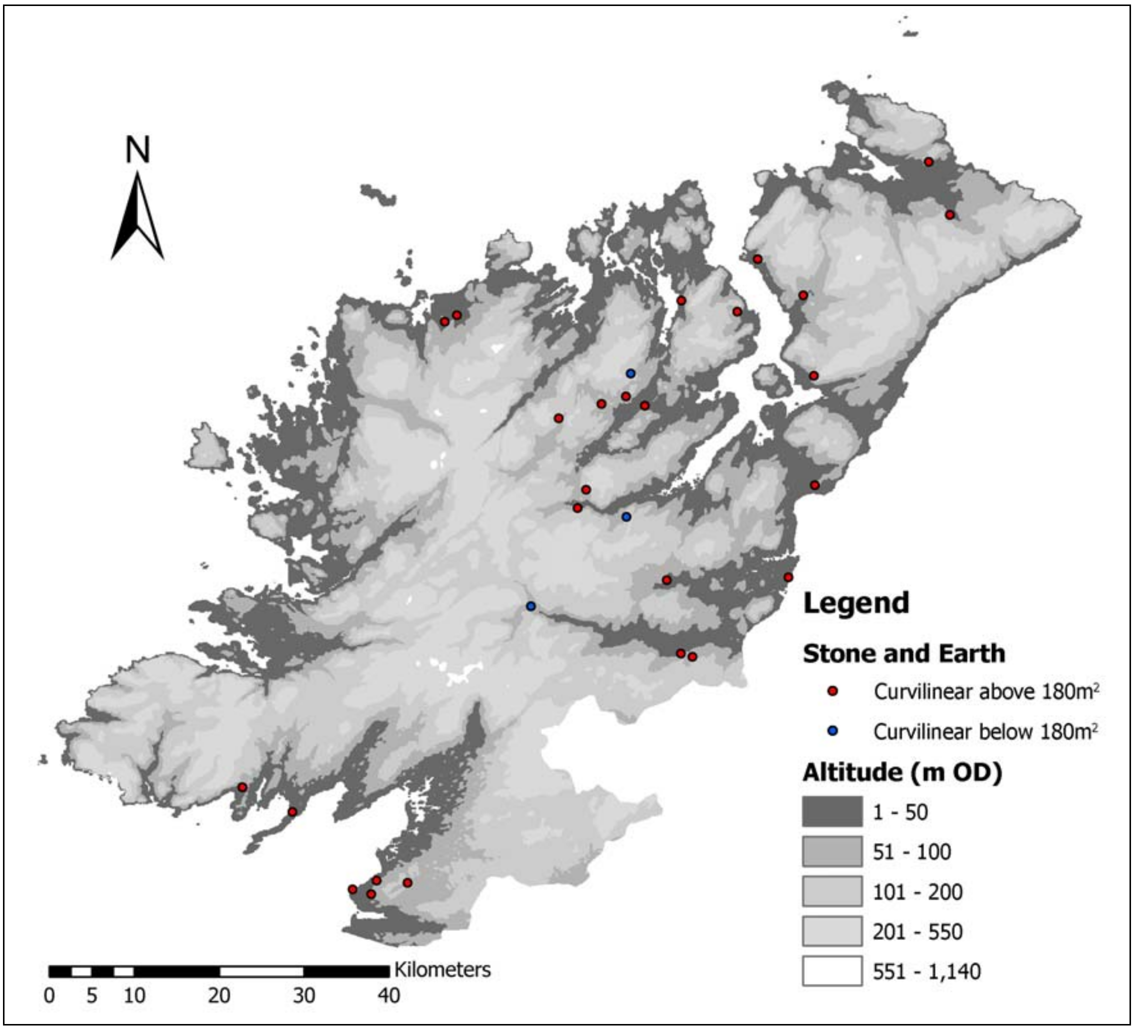


Figure 4.72: CSAEB and CSAEA sites in Co. Donegal distributed in the north-eastern part of the study area and a few sites on the south-western coastline.

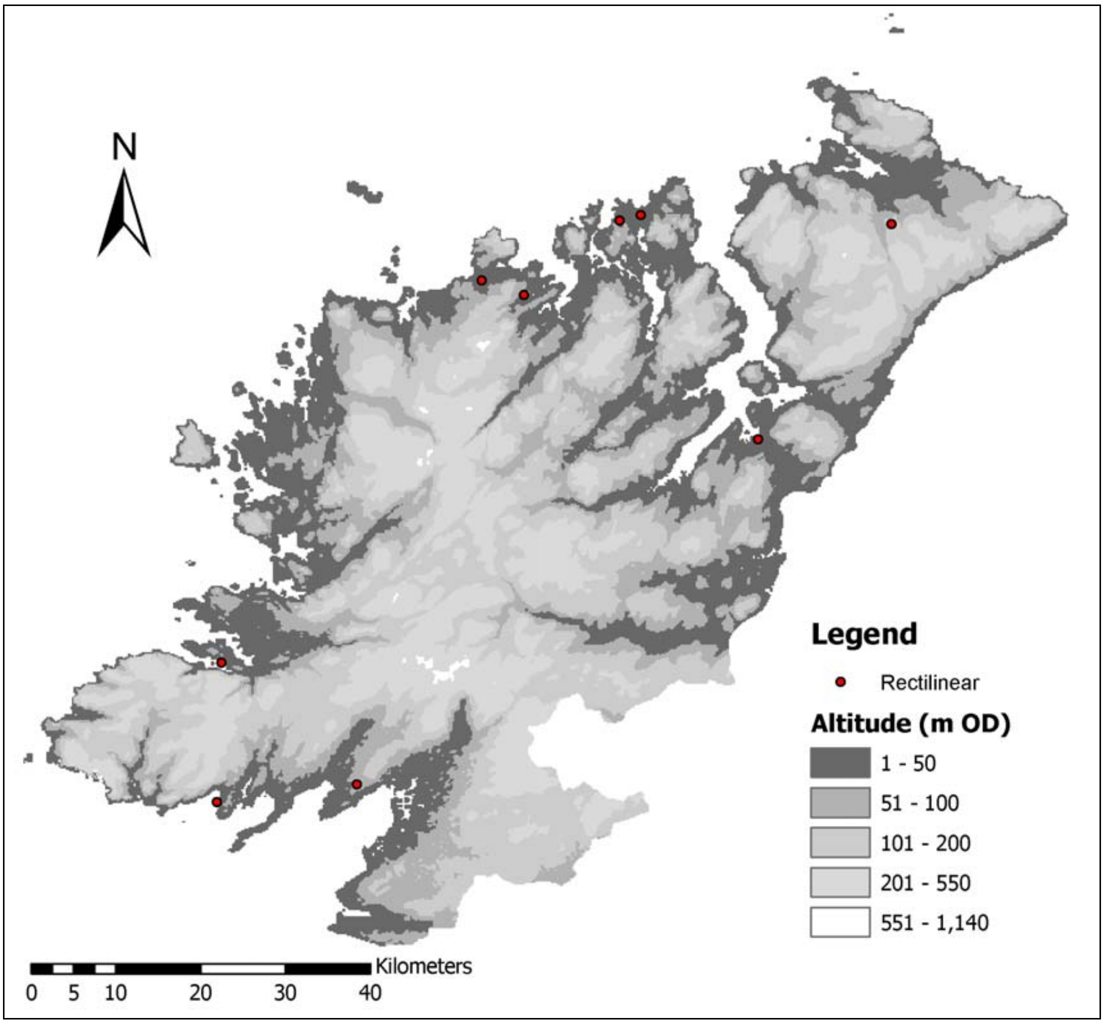


Figure 4.73: Rectilinear sites measuring above 180m² in Co. Donegal distributed along the northern and south-western coastlines.

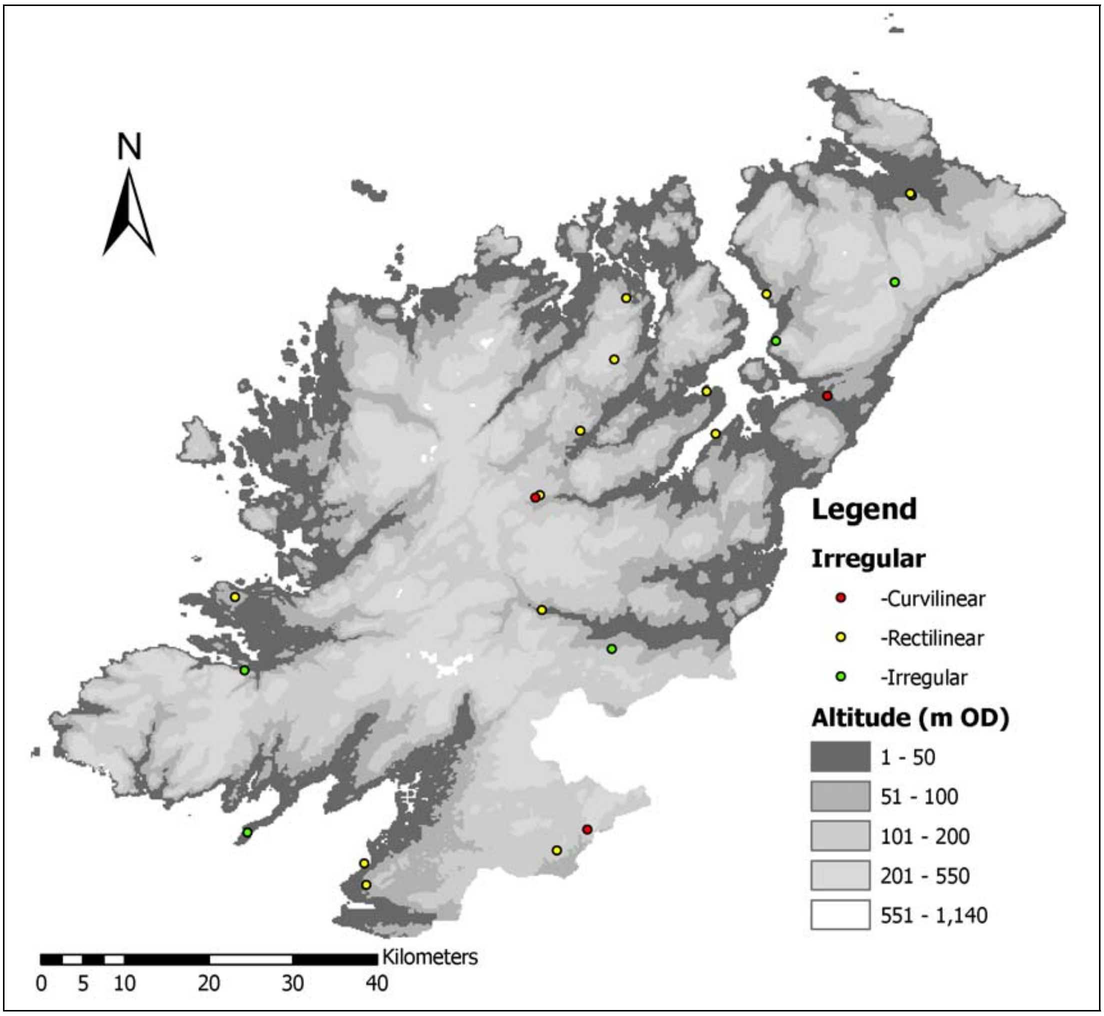


Figure 4.74: All Irregular site variations in Co. Donegal showing a widely dispersed distribution throughout the study area.

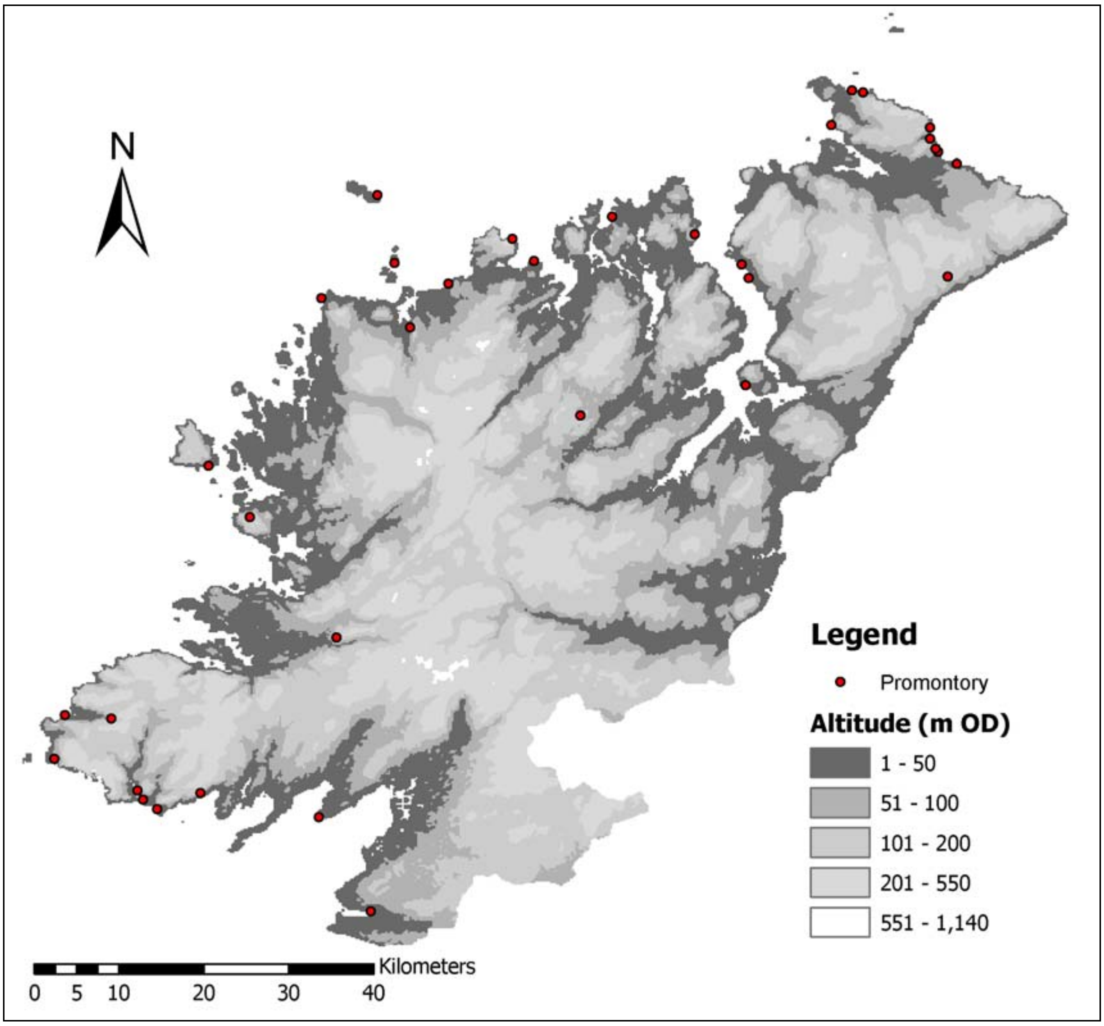


Figure 4.75: Distribution of PA sites in Co. Donegal along the coastline and two outlier inland.

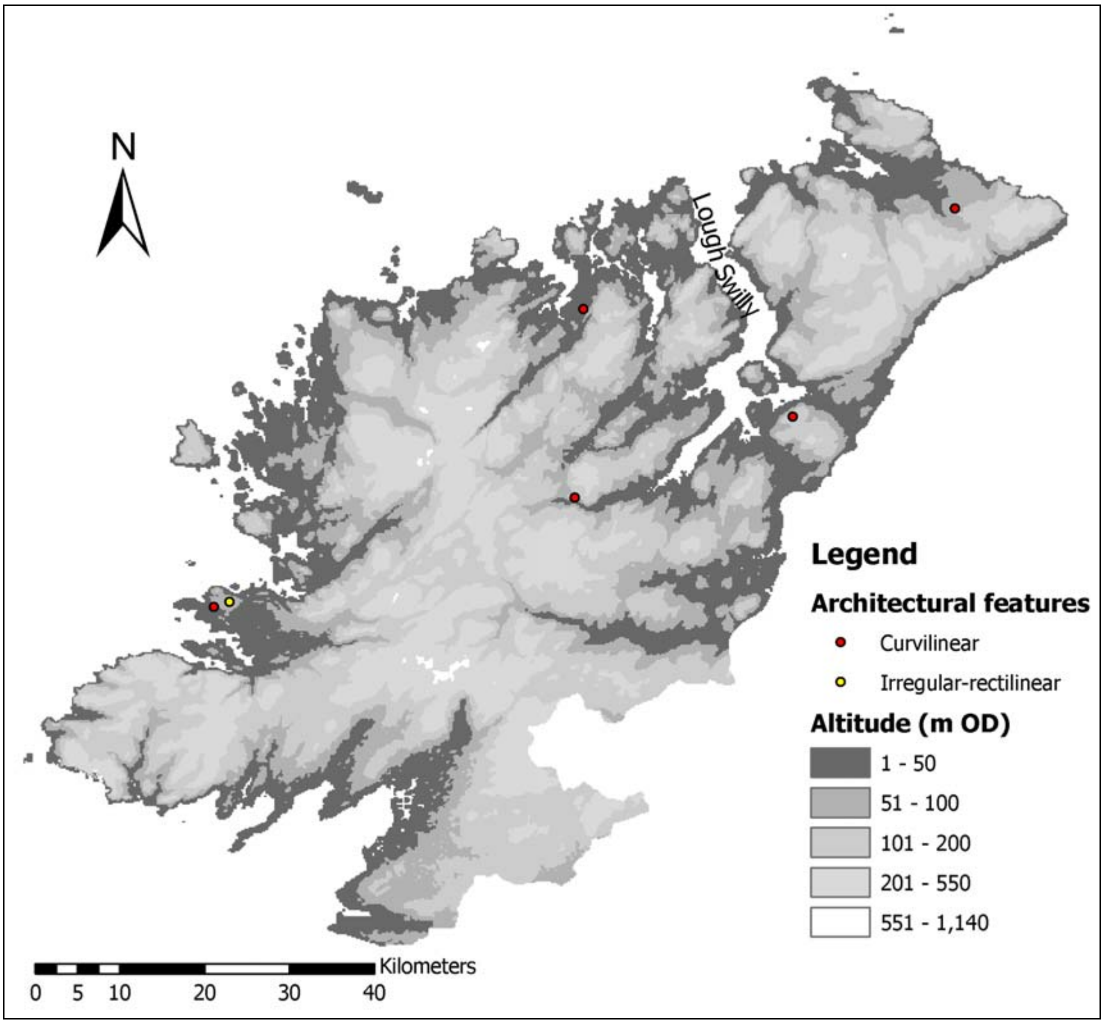
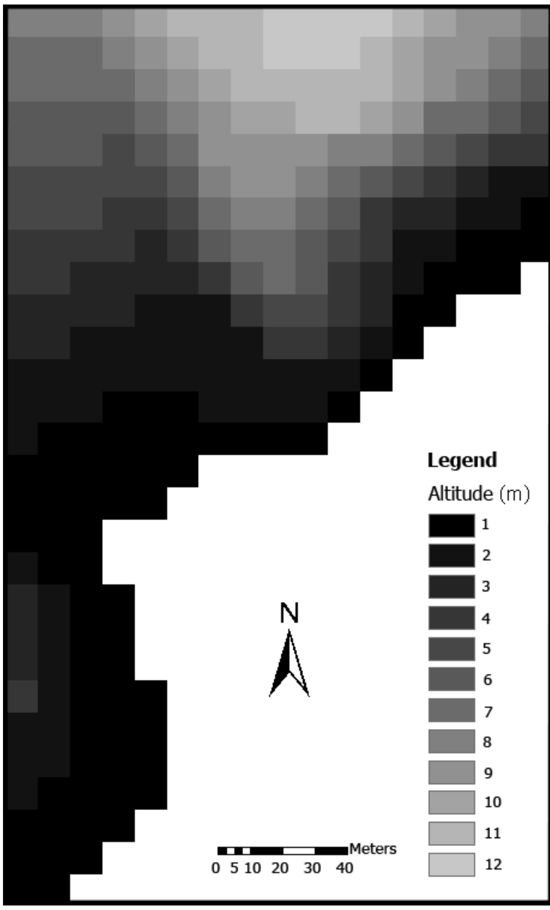


Figure 4.76: Sites encompassing architectural features in Co. Donegal scattered throughout the whole study area.



8	8	8	9	10	11	11	11	12	12	12	12	11	10	9	9	8
7	7	7	8	9	10	11	11	12	12	12	11	10	9	9	8	7
7	7	7	7	8	9	10	11	11	11	11	11	10	9	8	7	6
6	6	6	6	7	8	9	10	10	11	11	10	9	7	7	6	5
6	6	6	5	6	7	9	9	9	9	8	8	7	6	5	4	4
5	5	5	5	5	6	8	9	9	8	7	6	5	4	3	2	2
5	5	5	4	4	5	7	8	8	7	6	4	3	3	2	2	1
4	4	4	4	3	4	6	7	7	6	5	4	2	2	1	1	1
4	4	3	3	3	3	4	6	7	6	4	3	2	1	1	1	
3	3	3	3	2	2	2	4	5	5	4	3	1	1			
3	3	2	2	2	2	2	2	4	4	3	2	1				
2	2	2	2	2	2	2	2	2	2	2	1					
2	2	2	1	1	1	2	2	2	2	1						
2	1	1	1	1	1	1	1	1	1							
1	1	1	1	1	1											
1	1	1	1	1												
1	1	1														
2	1	1														
3	2	1	1													
3	2	1	1													
3	2	1	1													
4	2	1	1	1												
2	2	1	1	1												
2	2	1	1	1												
2	1	1	1	1												
1	1	1	1													
1	1	1														
1	1															

Figure 5.1: Example of DEM and corresponding data in metres OD.

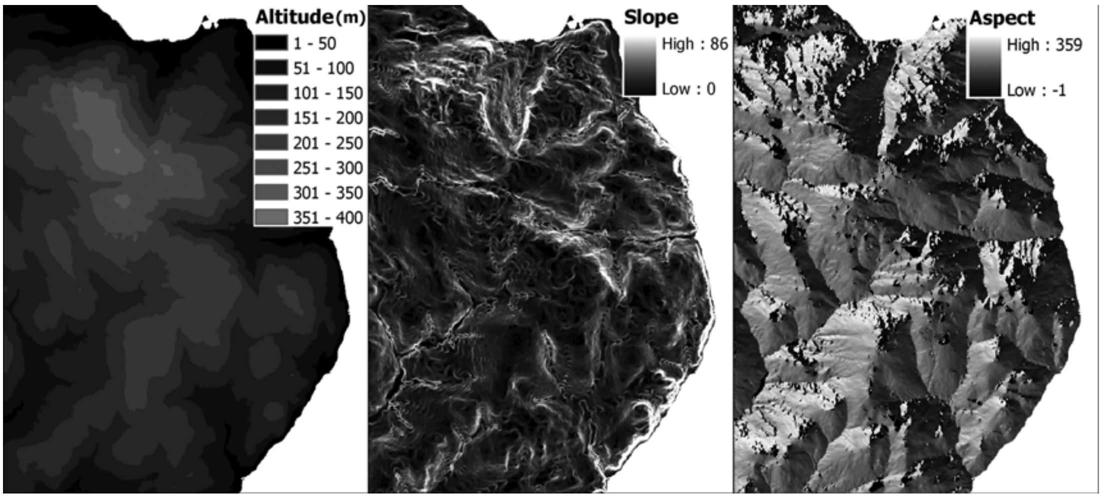


Figure 5.2: Example of DEM and corresponding slope and aspect data.

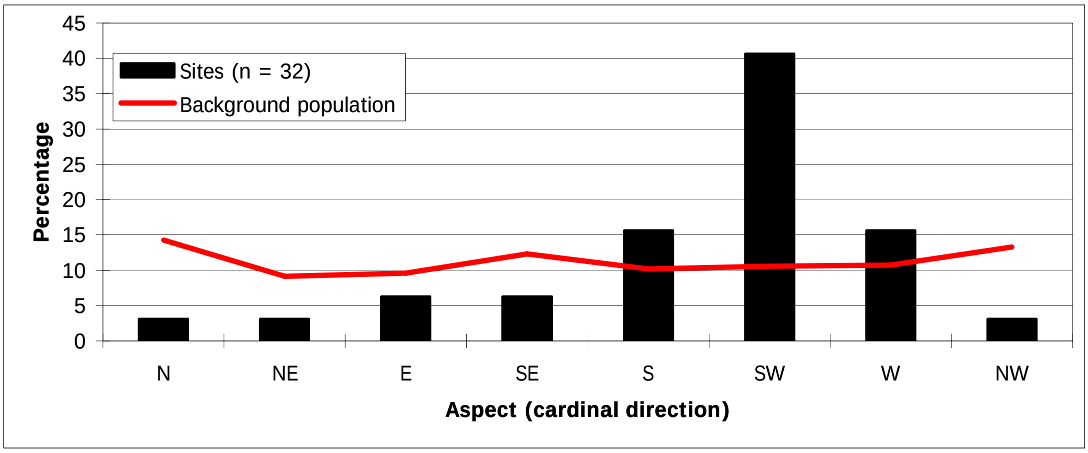


Figure 5.3: Example of distribution of sites and 'background' population. Sites are shown to favour southern, south-western and western facing aspects.

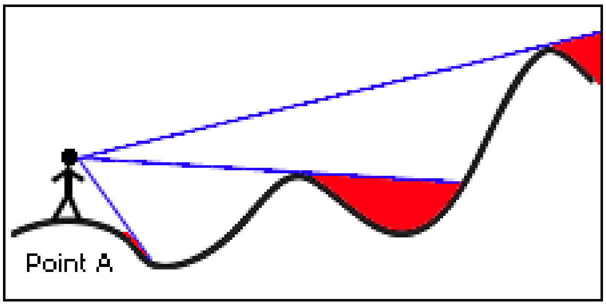


Figure 5.4: The Line-of-Sight from the viewing location to a target location in the landscape. Areas marked in red are not visible from the given viewing location.

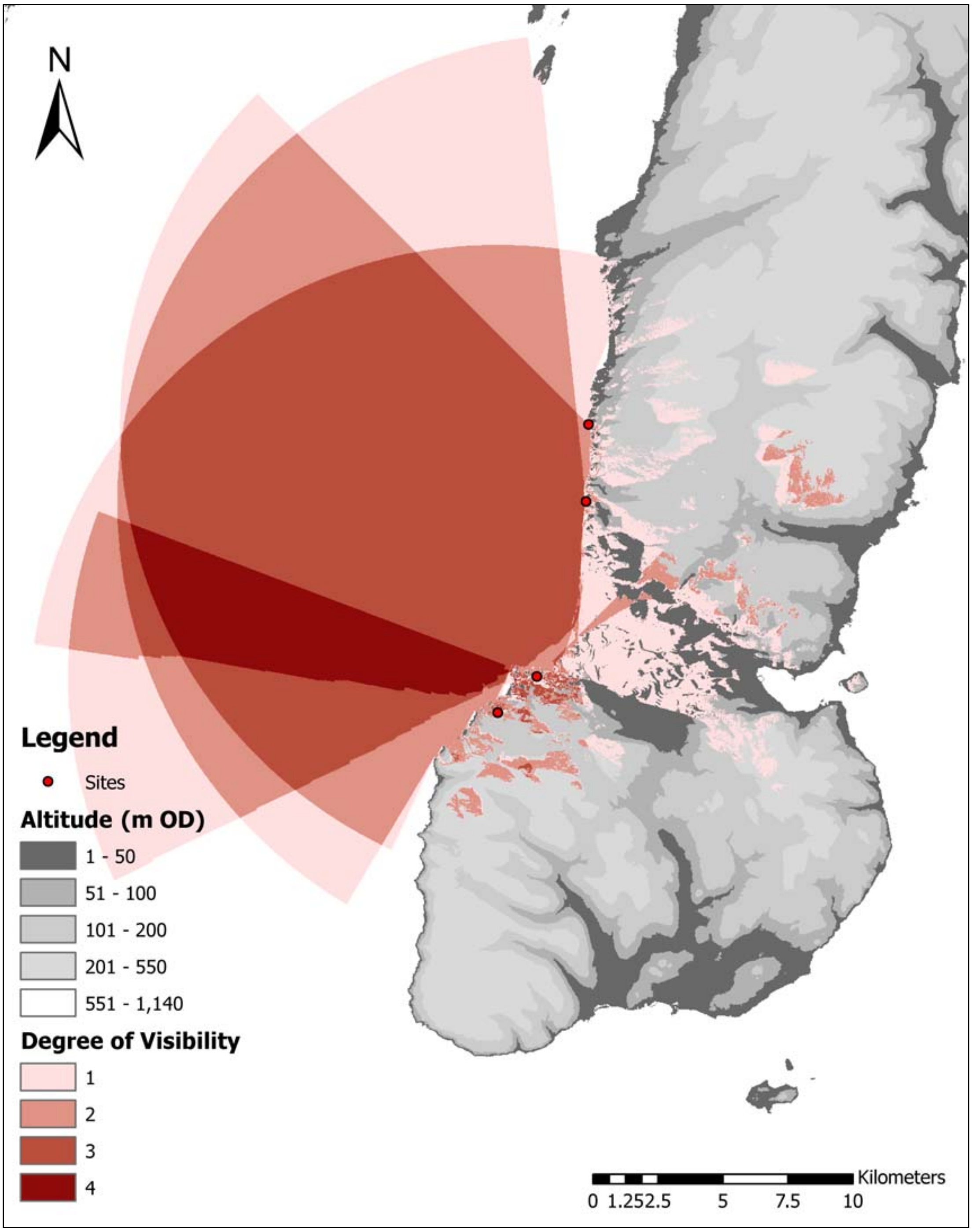


Figure 5.5: Example of cumulative viewshed map illustrating the visibility from four sites at an 18km radius.

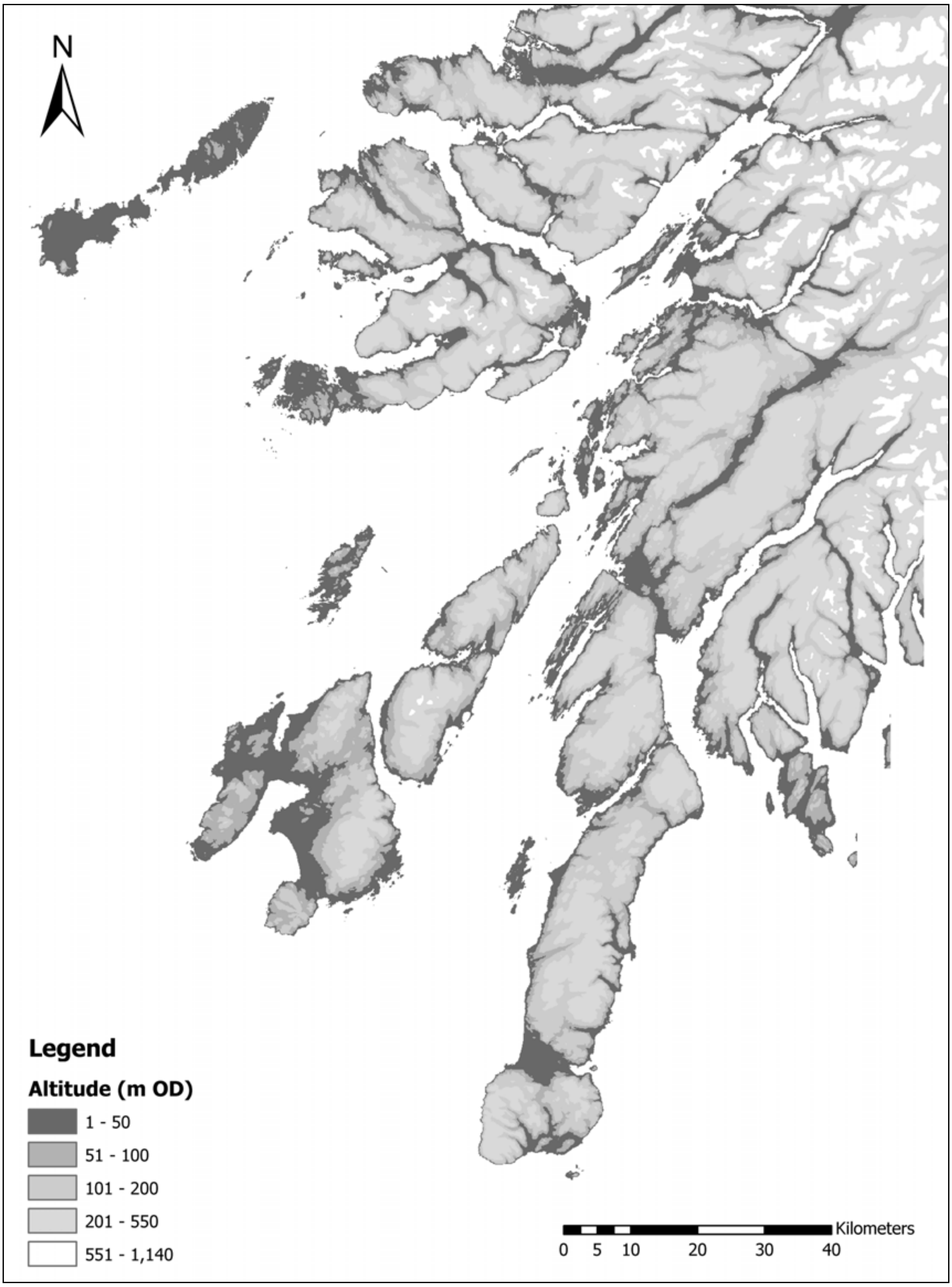


Figure 5.6: The final format of a 10m resolution DEM of the Argyll.

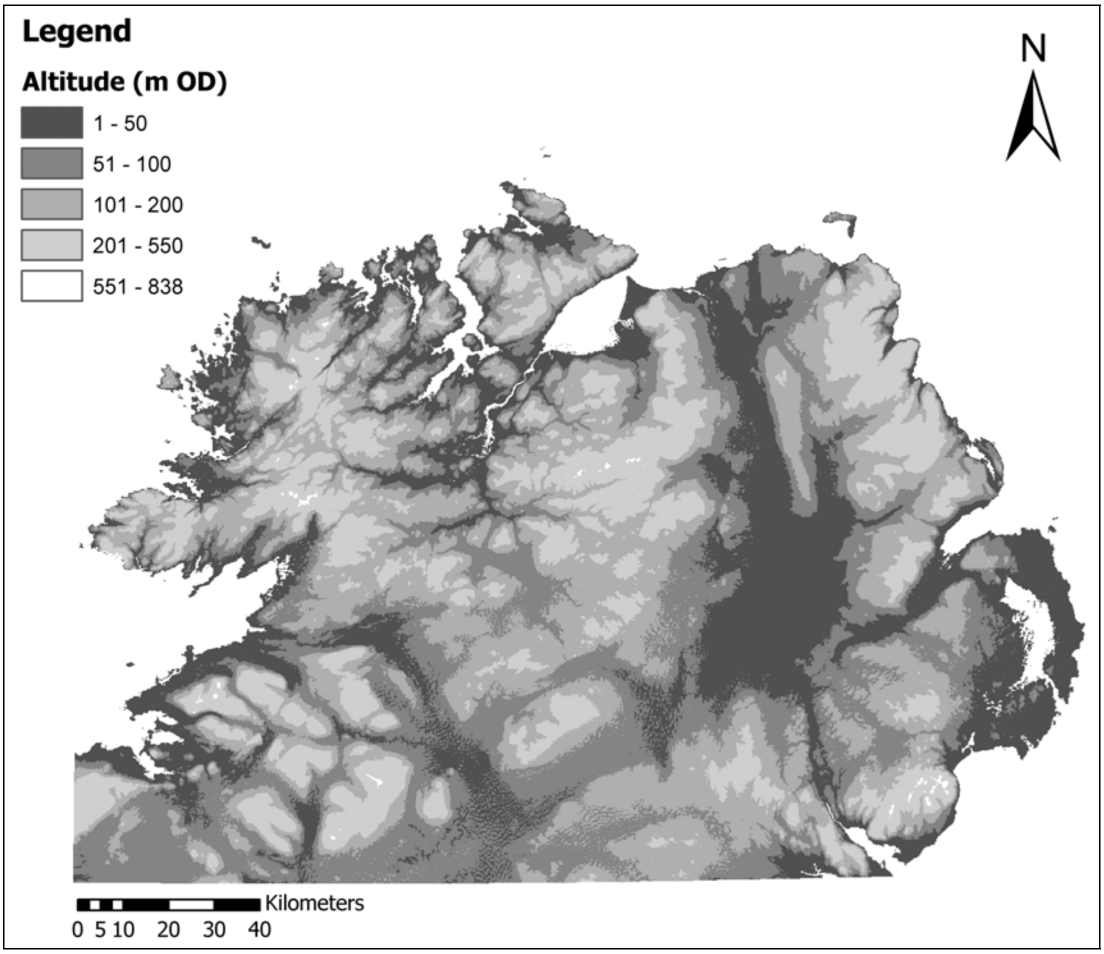


Figure 5.7: The final format of a 90m Resolution DEM of Northern Ireland and Co. Donegal.

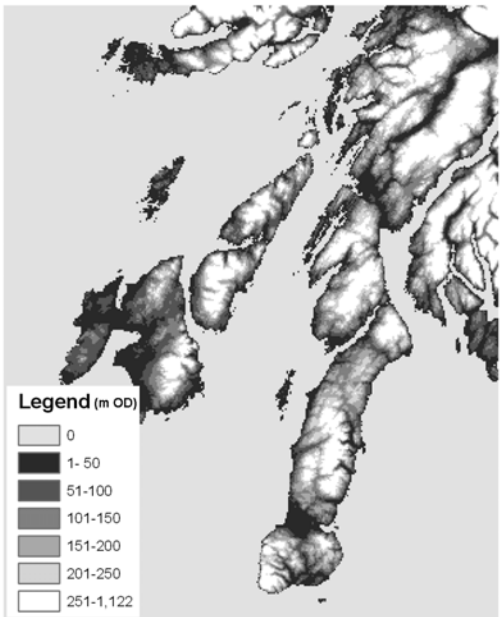


Figure 5.8: Area size included in the accuracy testing of various digital maps.

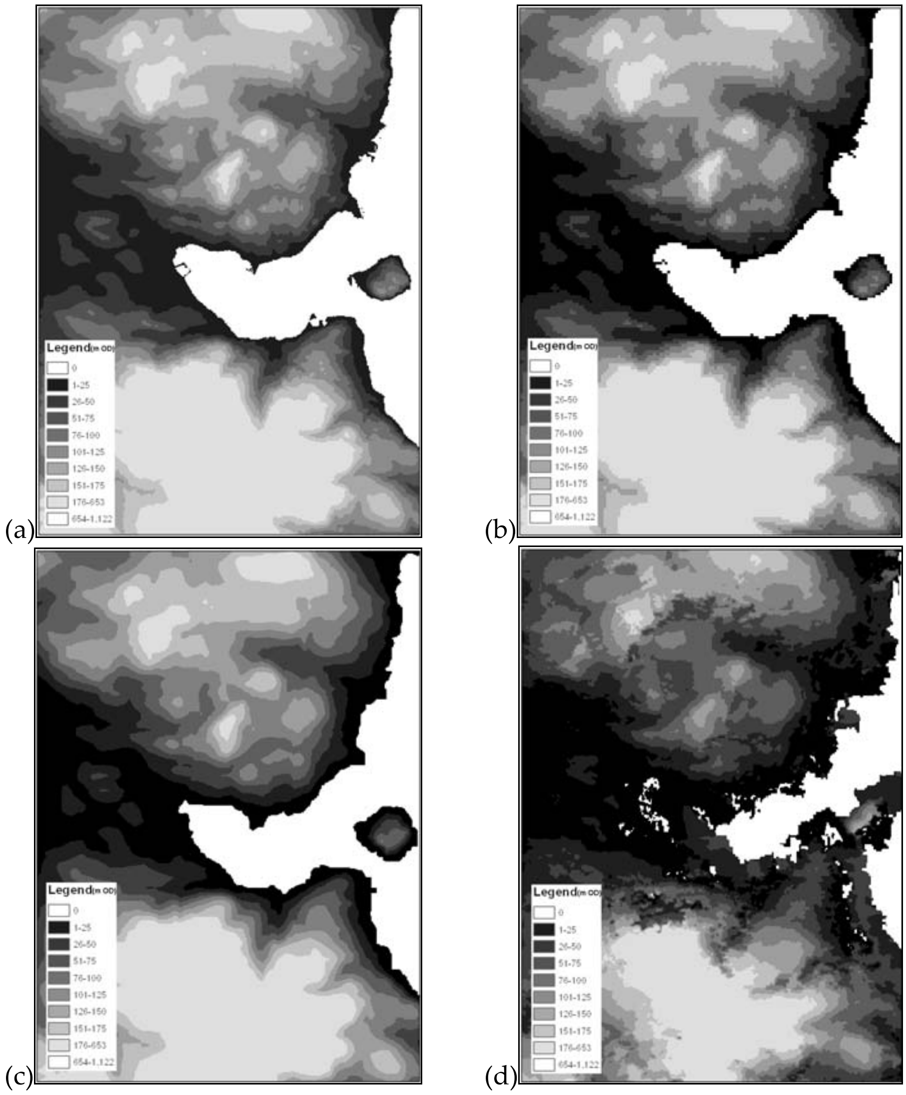


Figure 5.9: Close-up of (a) Original Digimap 10m; (b) Original Digimap 50m; (c) SMRT 10m Bilinear interpolation; (d) Landmap 10m Bilinear Interpolation illustrating the SMRT 10m Bilinear interpolation map better reflects the original Digimap data than the Landmap 10m Bilinear interpolation map.

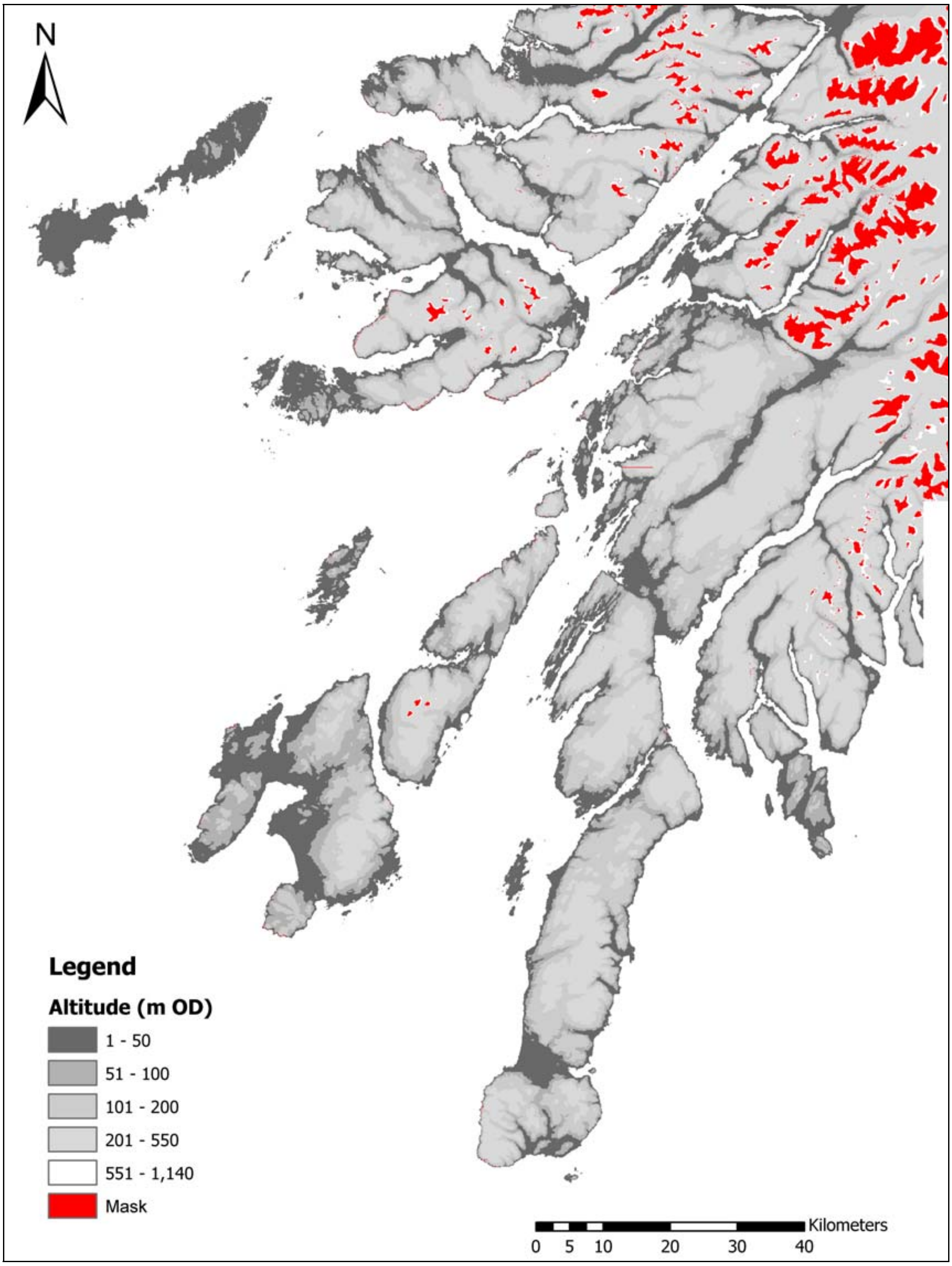


Figure 5.10: Example illustrating the process of defining parameters for the environmental raster maps.

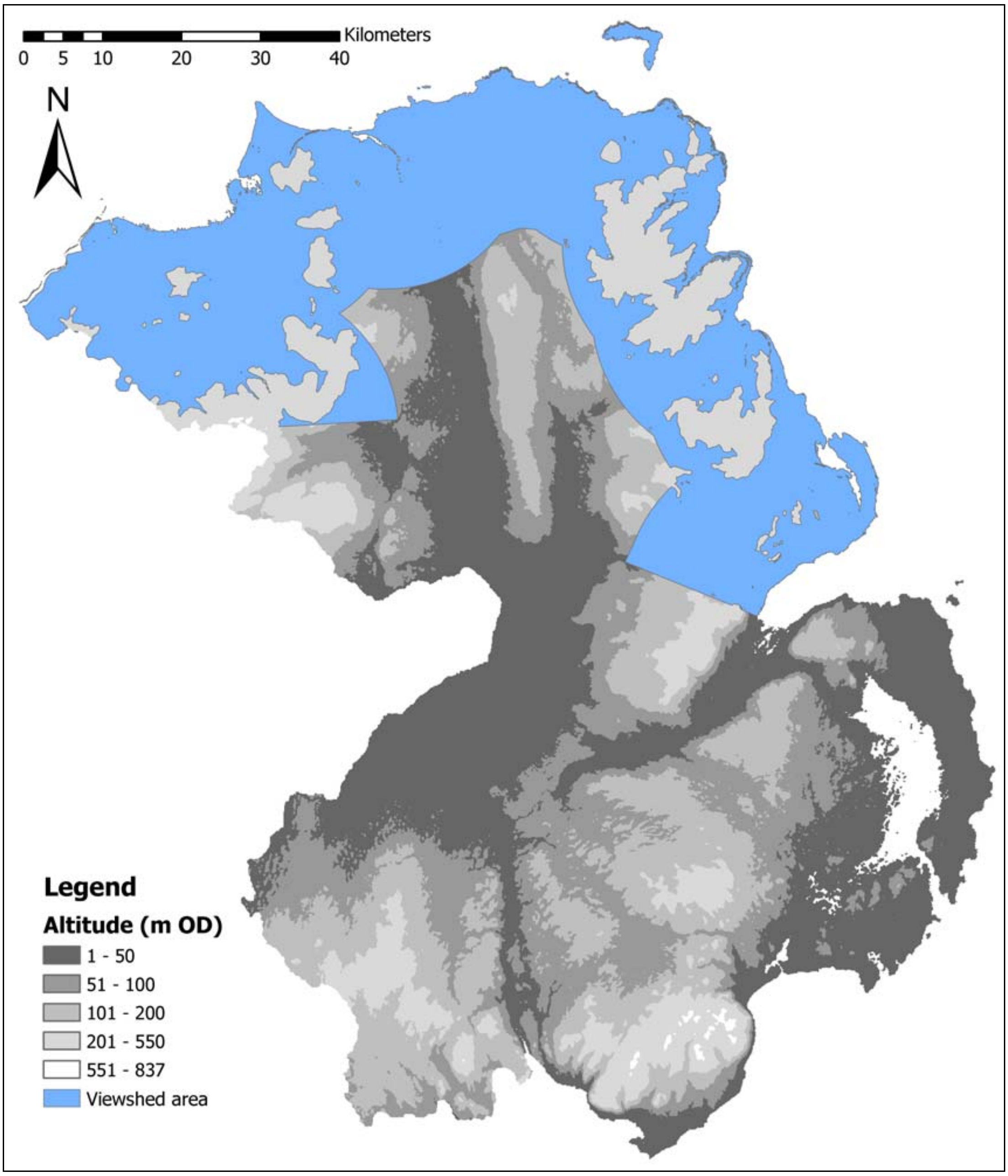


Figure 5.11: Northern Ireland study area. Shaded section indicates the limit of area from which random locations are chosen.

Figure 5.12: Example of reclassified DEM map of Argyll study area. All Land values have been reclassified to contain the value 200 and all Sea values contain the value 100.

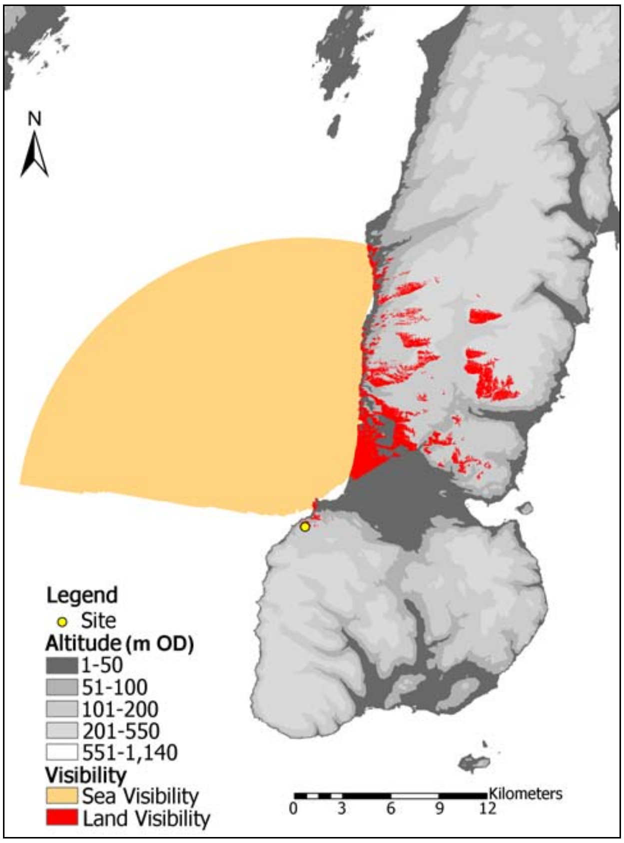


Figure 5.13: Example of Viewshed map indicating visible and non-visible sea area and land area.

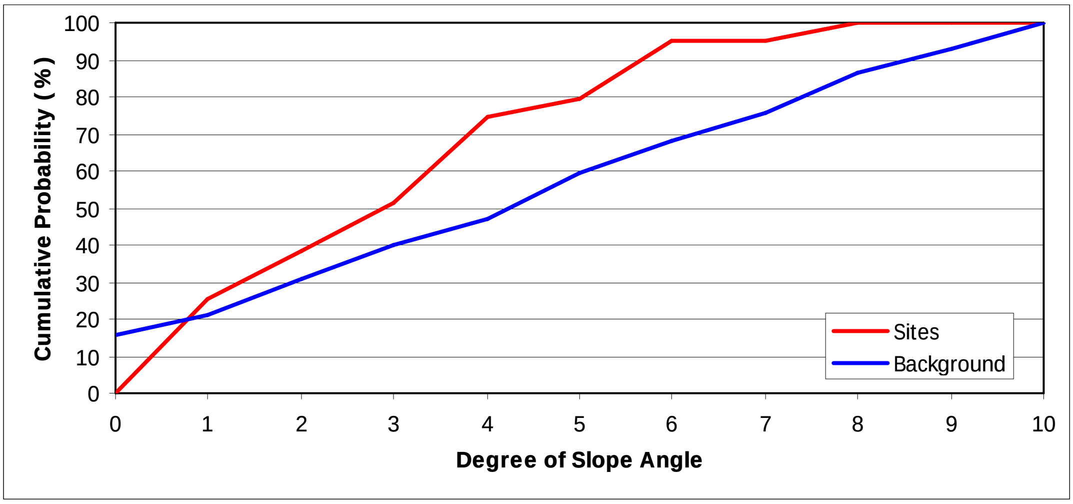


Figure 5.14: Example of cumulative distribution for the background environment (slope data) and the archaeological site locations.

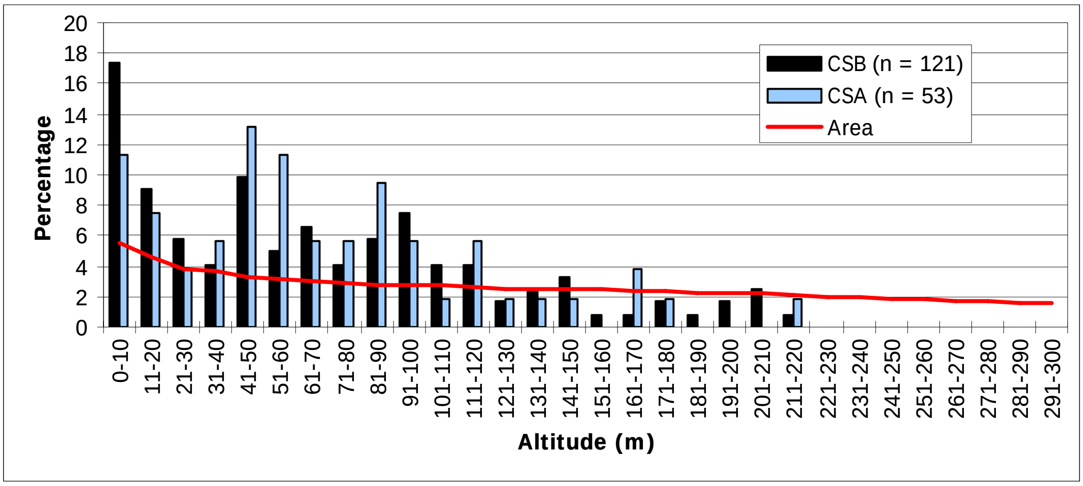


Figure 6.1: Frequency distribution of CSB and CSA sites by altitude in Argyll showing both site types have higher percentages than area on elevations below 120m OD.

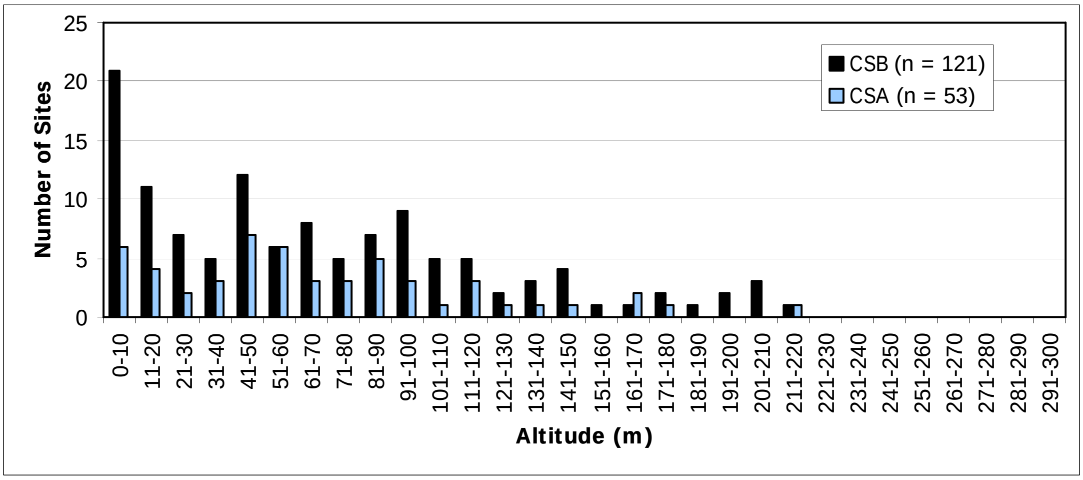


Figure 6.2: Number of sites for the CBA and CSA classes in each altitude band, gradually decreasing the higher the elevation in Argyll. All sites were distributed below 220m OD.

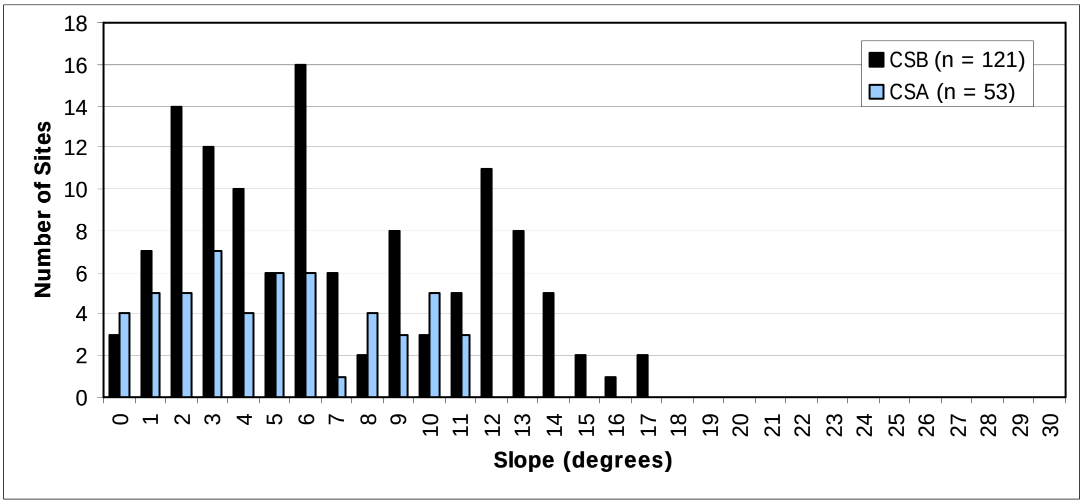


Figure 6.3: Number of CSB and CSA sites by slope in Argyll. Both distributions illustrate low numbers on level surfaces.

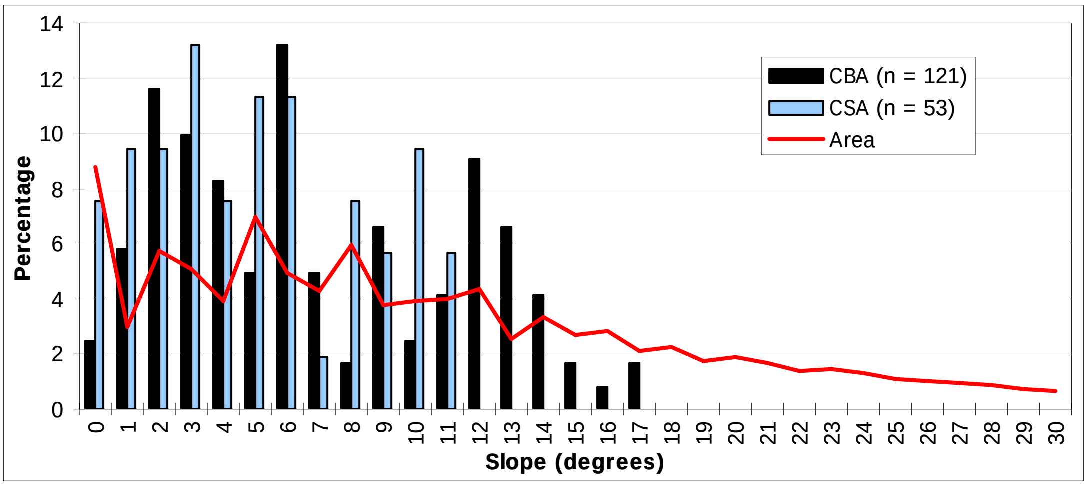


Figure 6.4: Frequency distribution of CSB and CSA sites by slope in Argyll showing avoidance of flat land and preferences for slope inclinations up to 14°.

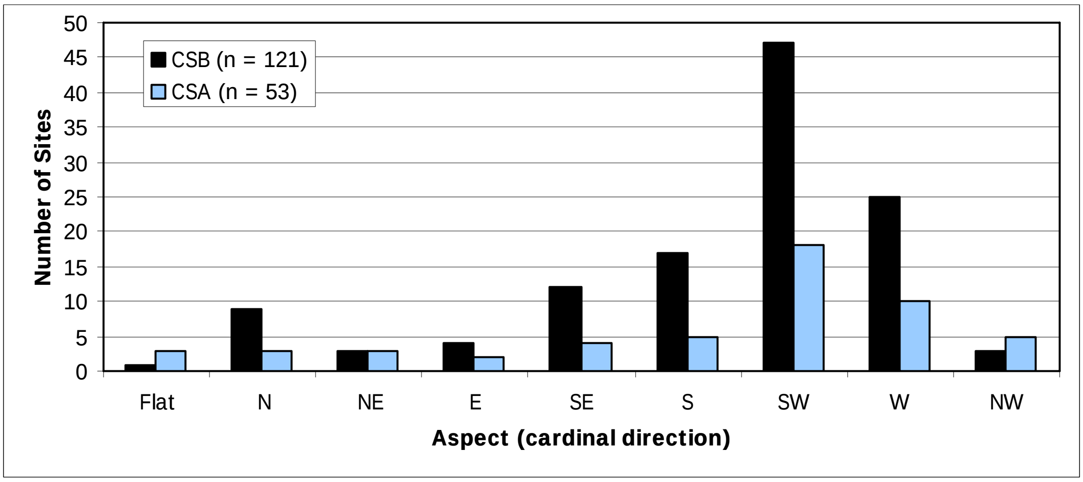


Figure 6.5: Number of CSB and CSA sites by cardinal aspect in Argyll showing a predominate distribution on southern, south-western and western aspects.

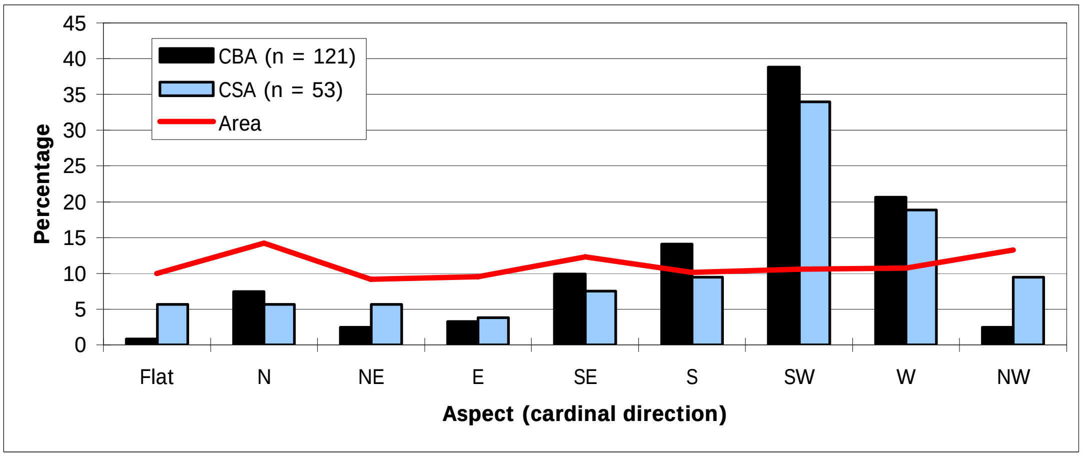


Figure 6.6: Frequency distribution of CSB and CSA sites by cardinal aspect in Argyll illustrating a preference for south-western and western aspects.

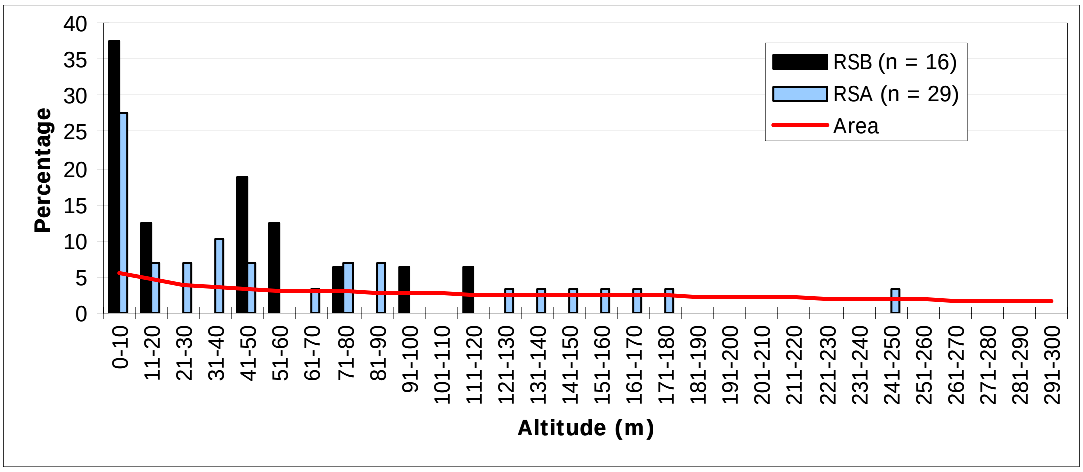


Figure 6.7: Frequency distribution of sites by altitude in Argyll showing higher percentages of RSB sites on elevation below 120m OD and of RSA sites below 90m OD.

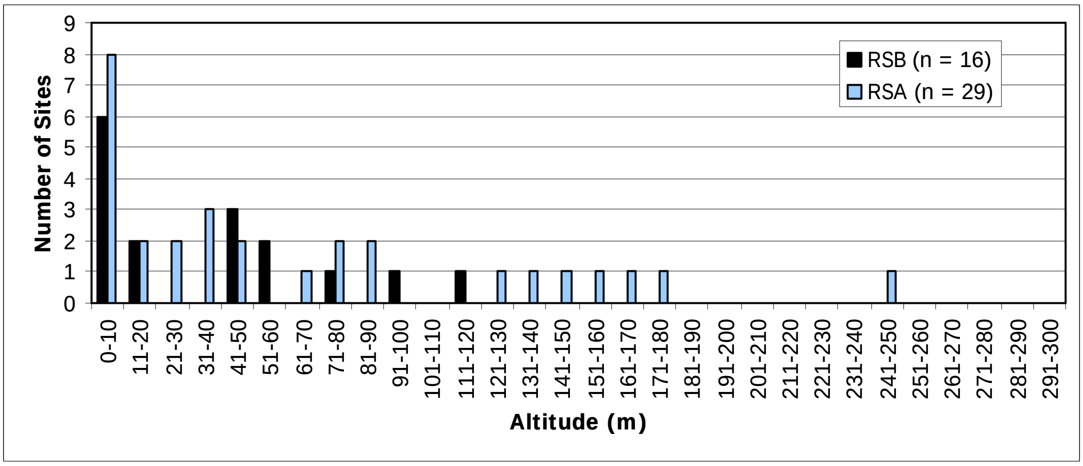


Figure 6.8: Number of RSB and RSA sites by altitude in Argyll showing a predominate distribution on lower elevations.

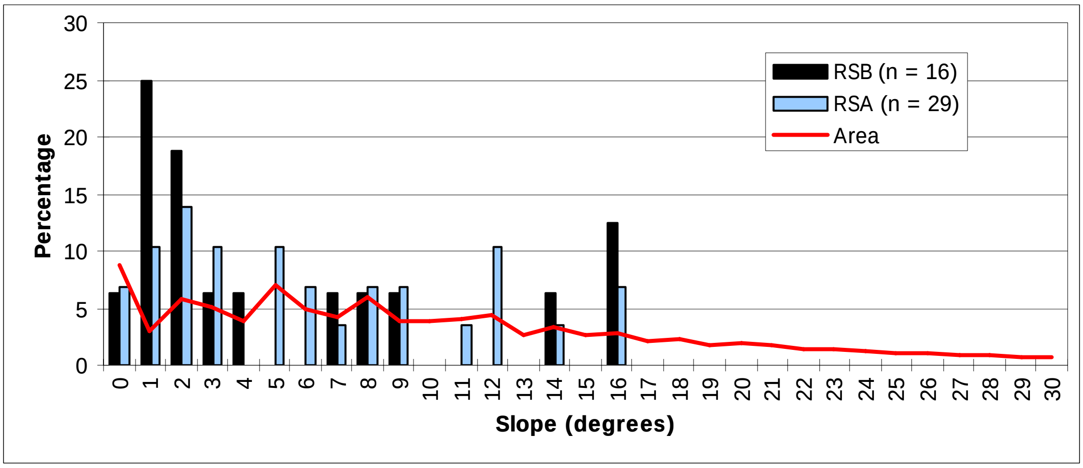


Figure 6.9: Frequency distribution of RSB and RSA sites by slope in Argyll showing higher percentages of sites on level and slightly sloping ground.

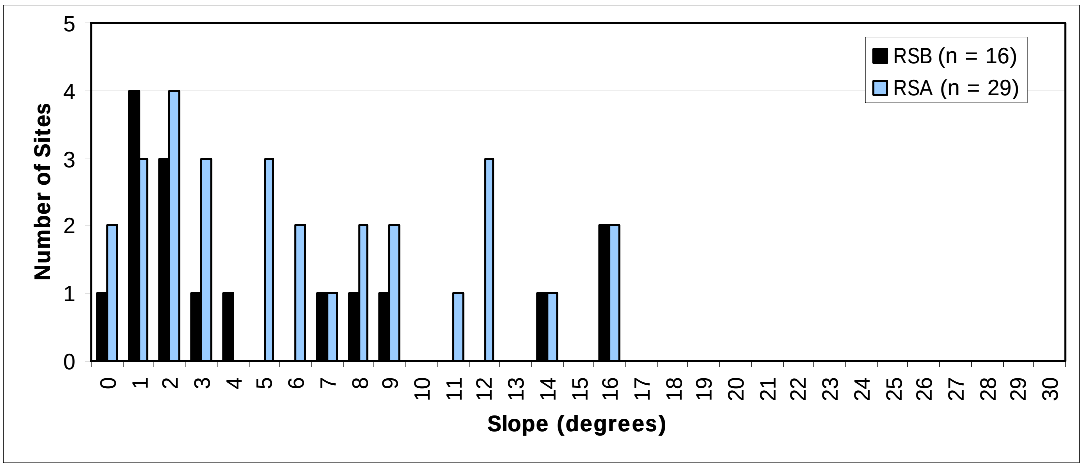


Figure 6.10: Number of RSB and RSA sites by slope in Argyll distributed on land between a 0° and 16° slope.

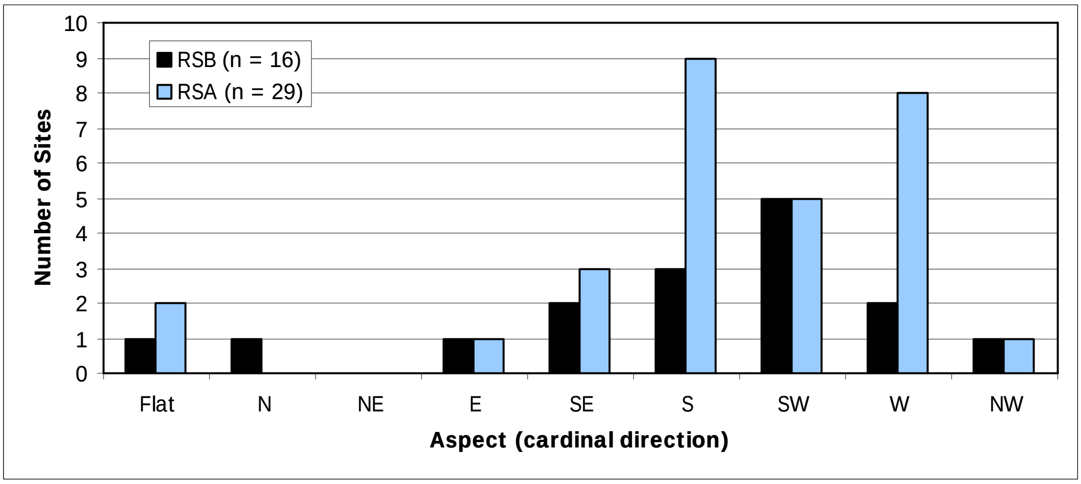


Figure 6.11: Number of RSB and RSA sites by aspect in Argyll showing a prominent distribution on southern, south-western and western hill faces.

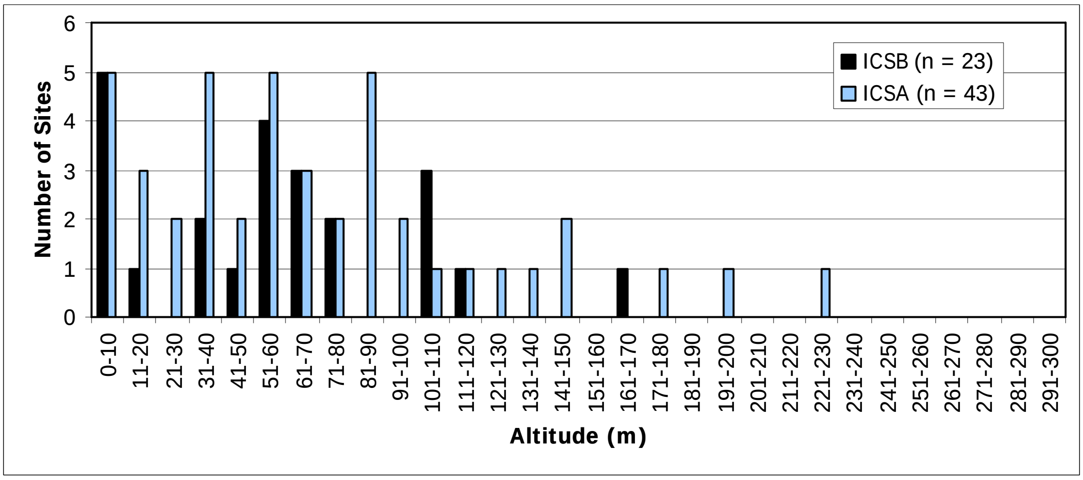


Figure 6.12: Number of sites by altitude in Argyll showing distributions below 170m OD for ICSB sites and 230m OD for ICSA.

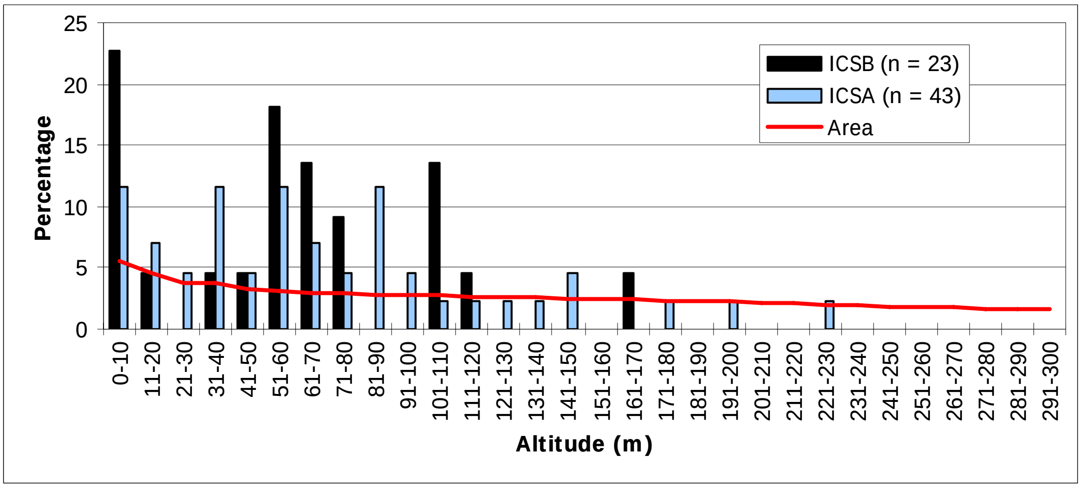


Figure 6.13: Frequency distribution of sites by altitude in Argyll showing higher percentages of ICSB sites on elevations below 120m OD and of ICSA sites below 100m OD.

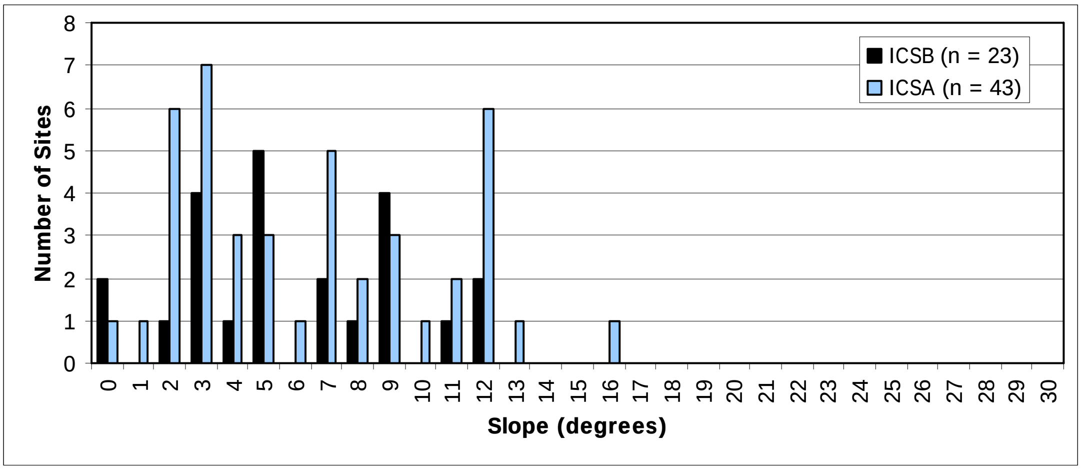


Figure 6.14: Number of sites by slope in Argyll showing ICSB sites distributed on inclinations of 12° or less and ICSA sites on inclinations of 16° or less.

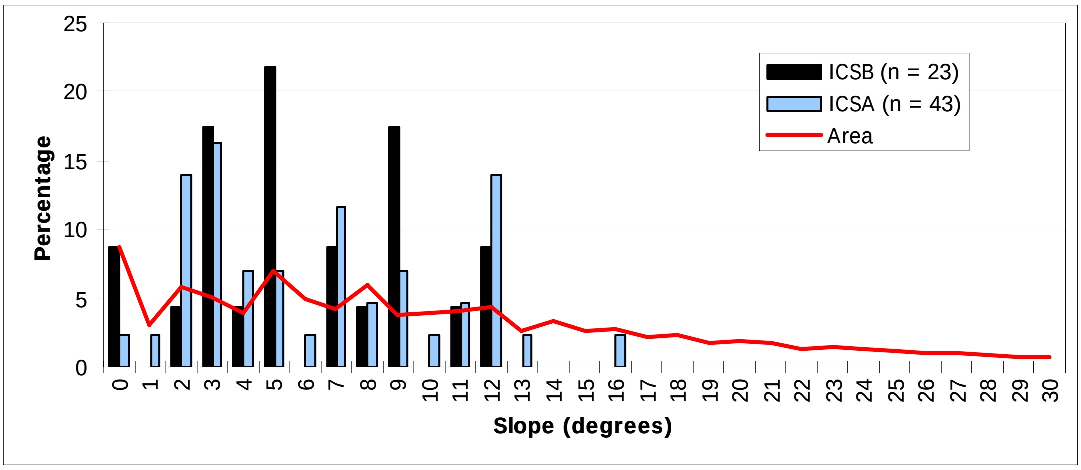


Figure 6.15: Frequency distribution of sites by slope in Argyll showing higher percentages of ICSB sites on inclines between 3° and 12° and of ICSA sites on inclines between 2° and 12°.

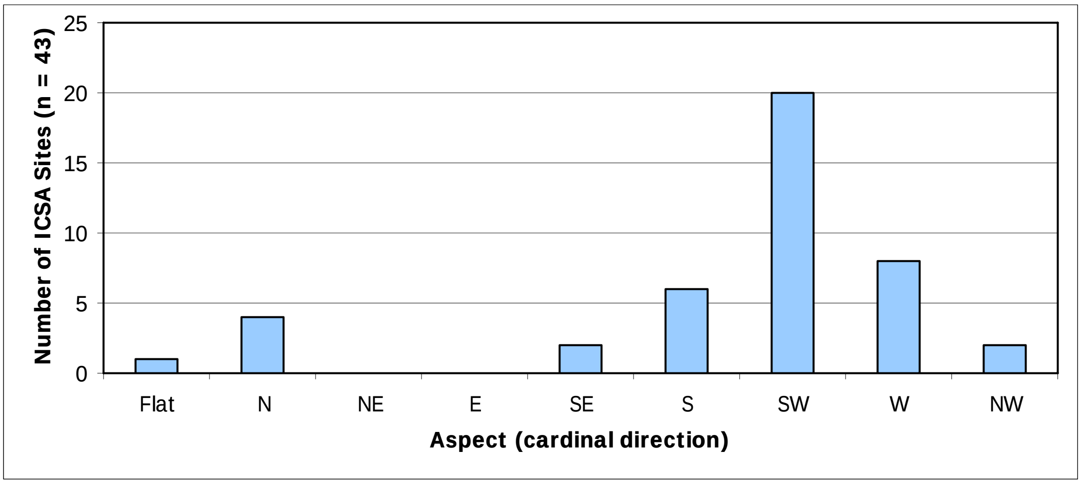


Figure 6.16: Number of ICSA sites by aspect in Argyll showing a prominent distribution on south-western and western hill faces.

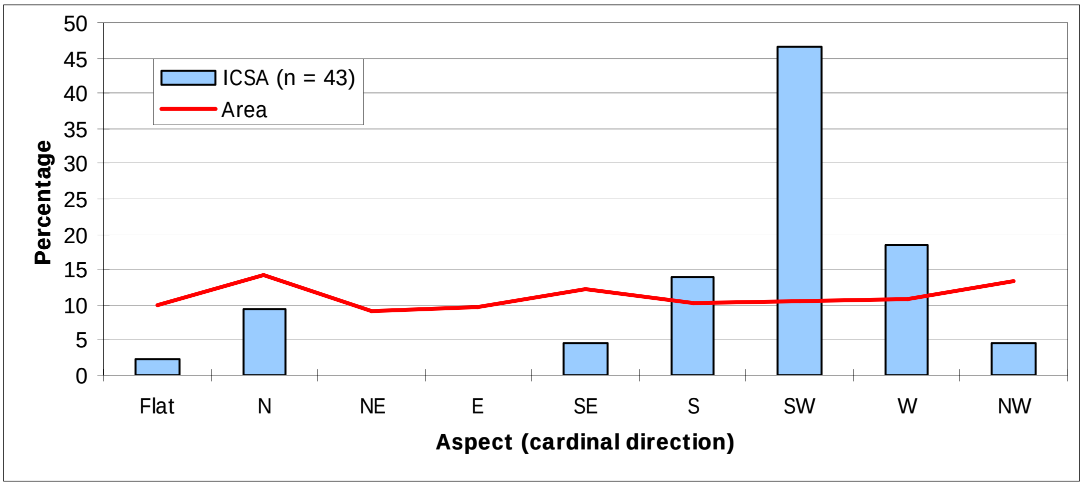


Figure 6.17: Frequency distribution of ICSA sites by cardinal aspect in Argyll illustrating a preference for southern, south-western and western aspects.

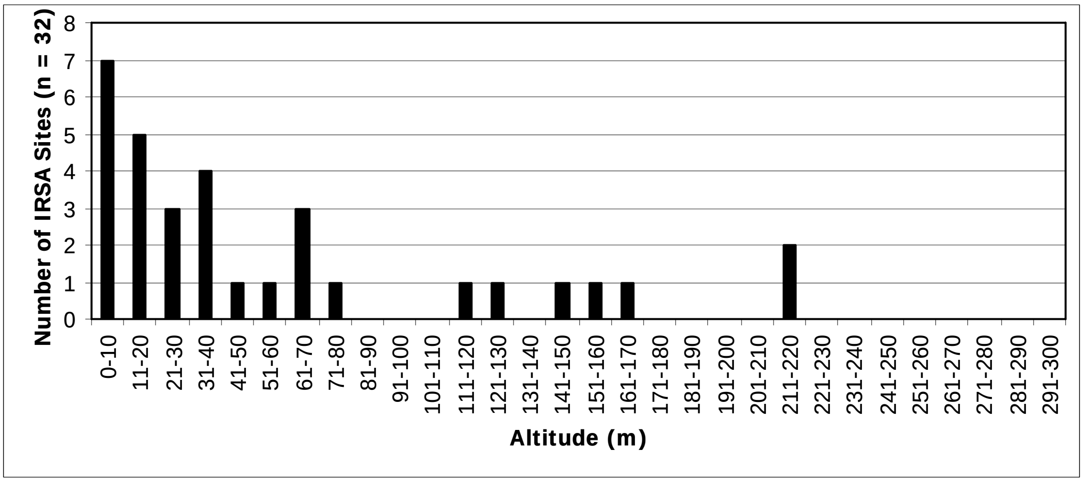


Figure 6.18: Number of sites by altitude in Argyll showing all IRSA sites below 220m OD.

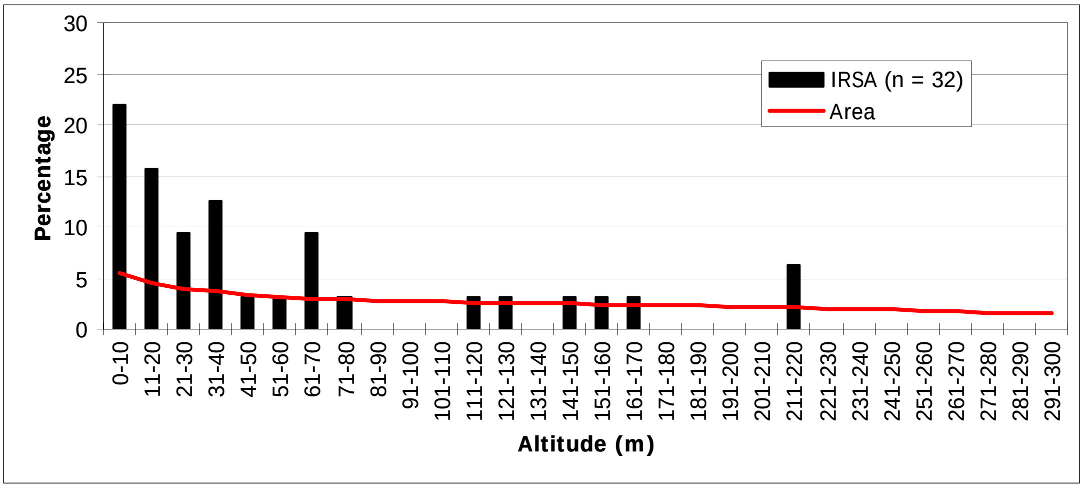


Figure 6.19: Frequency distribution of IRSA sites by altitude in Argyll illustrating higher percentages of sites for elevations below 40m OD.

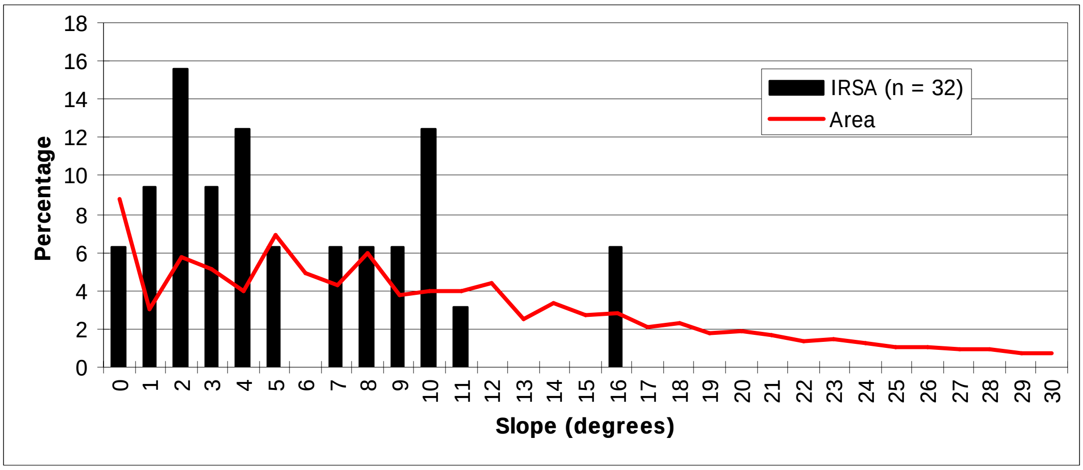


Figure 6.20: Frequency distribution of IRSA sites by slope in Argyll illustrating higher percentages of sites than area on slopes between 1° and 4° incline.

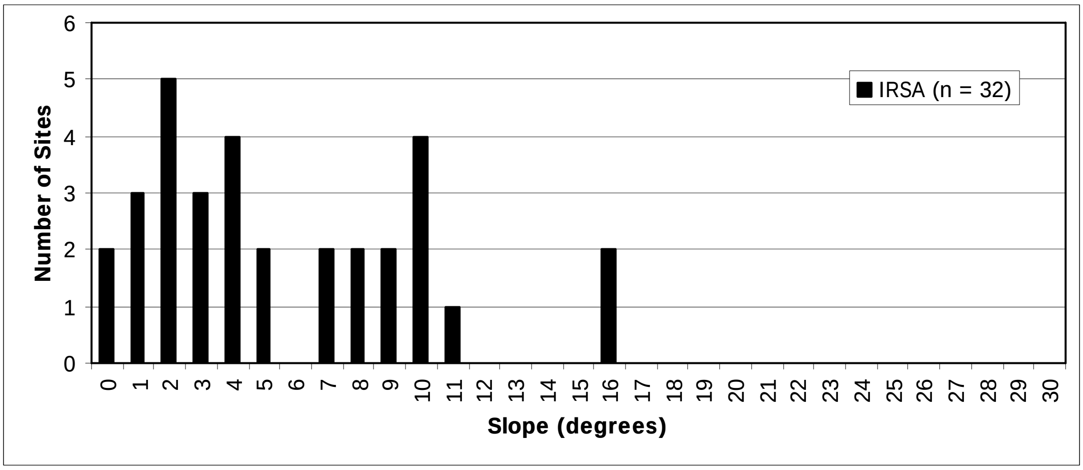


Figure 6.21: Number of IRSA sites by slope in Argyll showing a predominate distribution of sites on slopes of 10° or less.

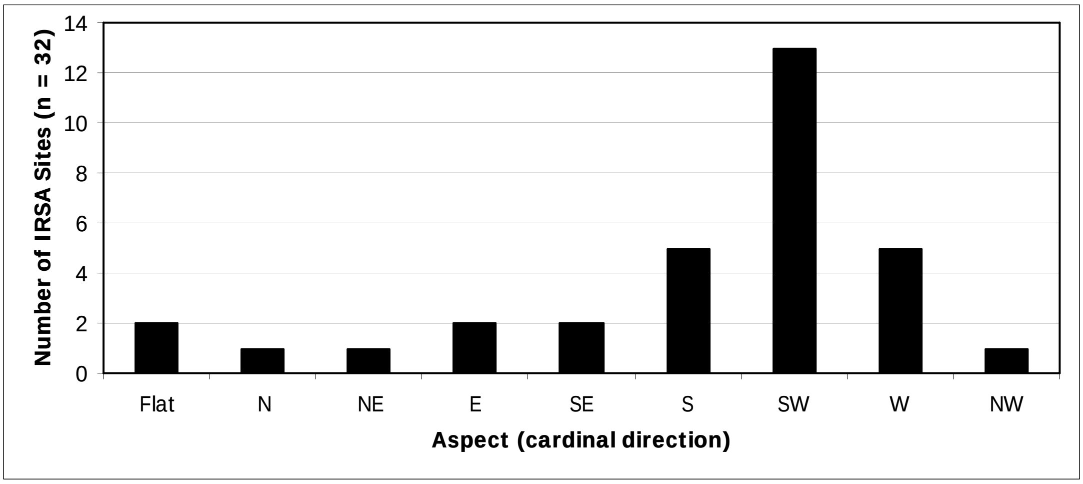


Figure 6.22: Number of IRSA sites by aspect in Argyll showing a predominate distribution of sites on southern, south-western and western hill faces.

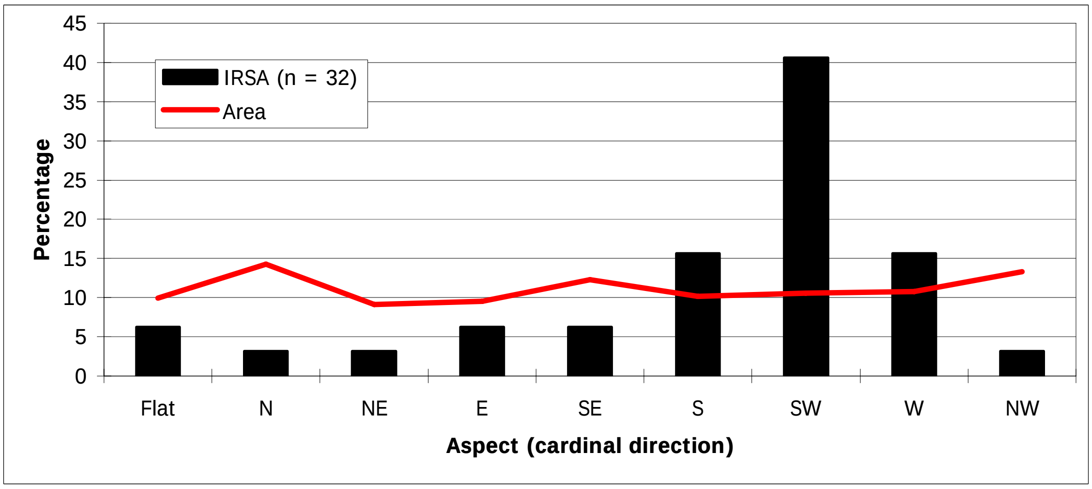


Figure 6.23: Frequency distribution of IRSA sites by aspect in Argyll illustrating higher percentages of sites than area on southern, south-western and western hill faces.

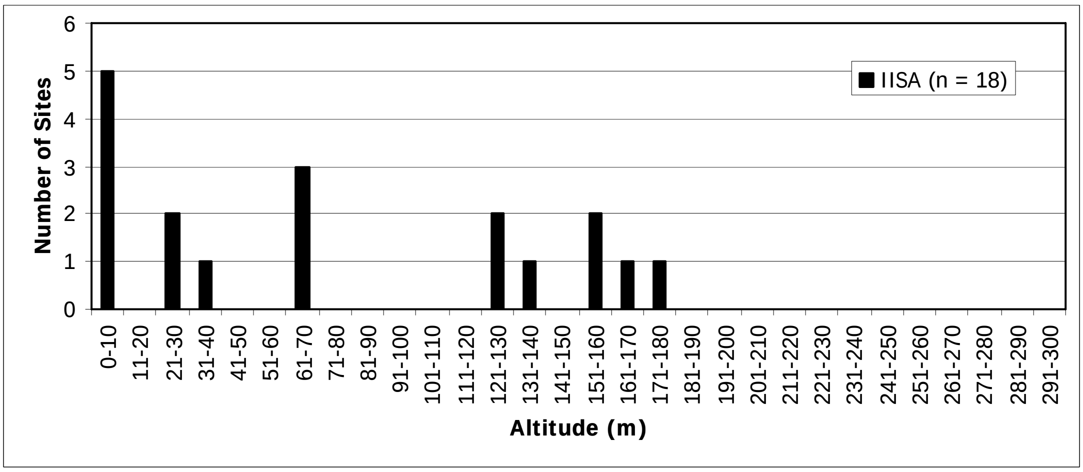


Figure 6.24: Number of IISA sites by altitude in Argyll showing a possible bipolar distribution.

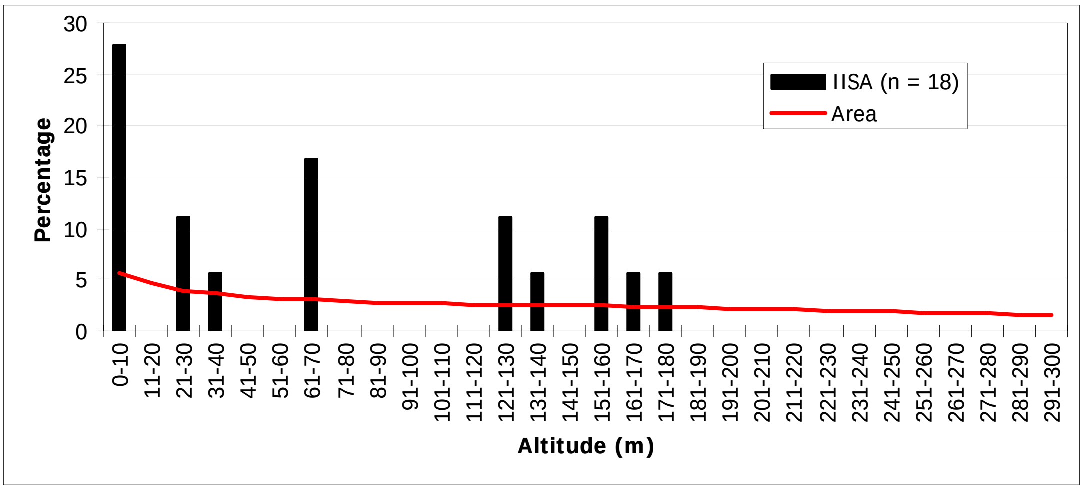


Figure 6.25: Frequency distribution of IISA sites by altitude in Argyll showing higher percentage of sites than land for elevations below 180m OD.

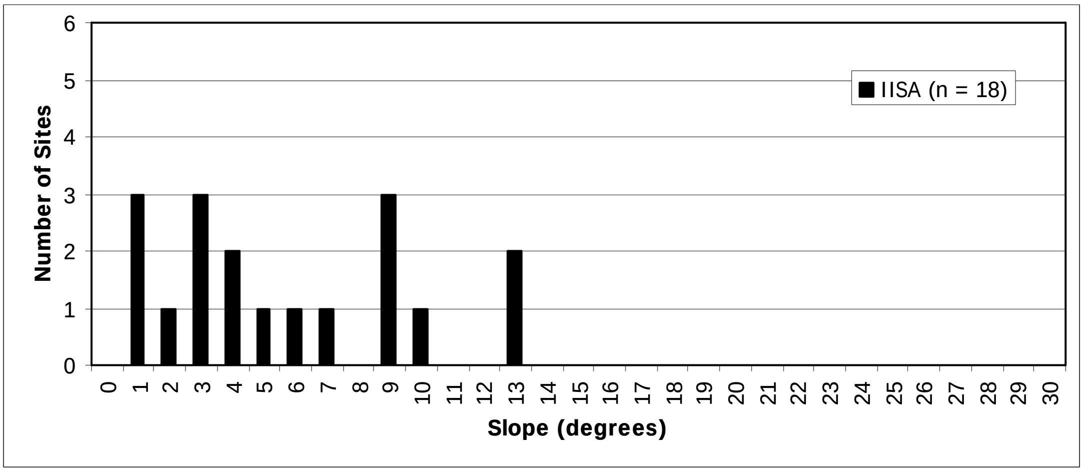


Figure 6.26: Number of IISA sites by slope in Argyll showing a possible bipolar distribution.

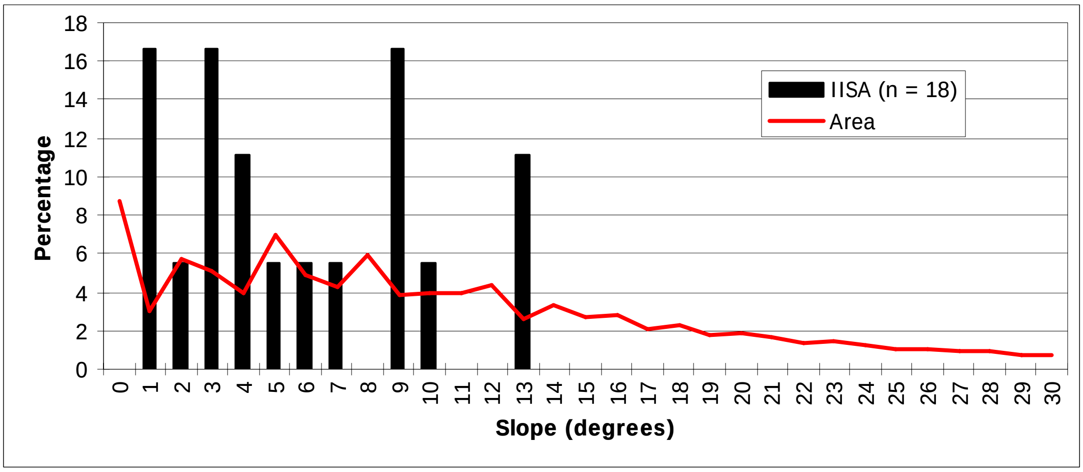


Figure 6.27: Frequency distribution of IISA sites by slope in Argyll showing higher percentages on slopes between 1° and 4° incline and again on slopes steeper than 9° further illustrating a bipolar distribution.

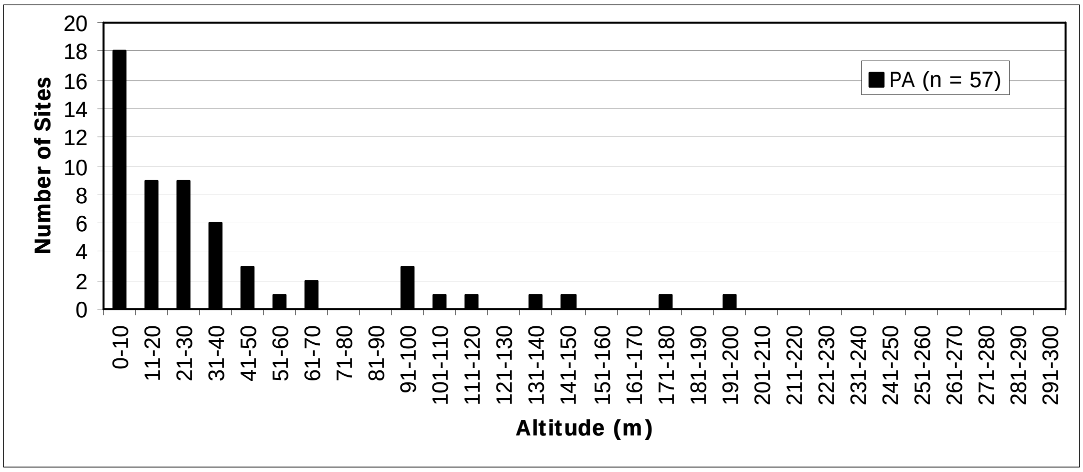


Figure 6.28: Number of PA sites by altitude in Argyll, showing predominate distribution below 40m OD.

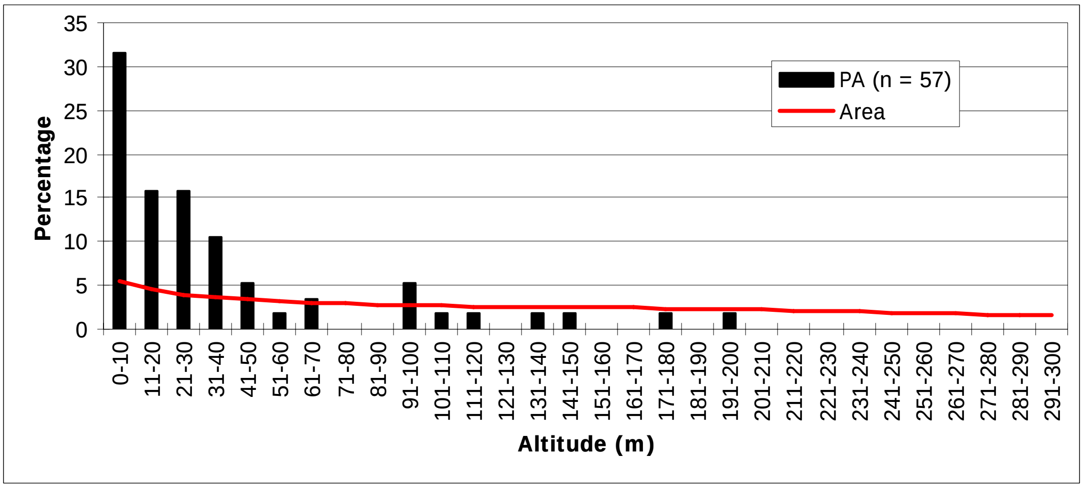


Figure 6.29: Frequency distribution of PA sites by altitude in Argyll illustrating higher percentages of sites than area below 40m OD.

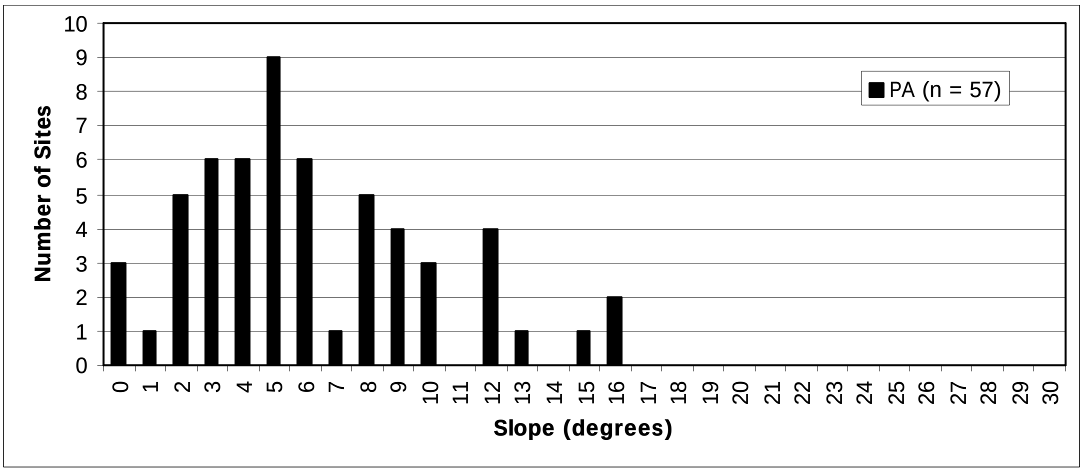


Figure 6.30: Number of sites by slope in Argyll showing all PA sites on flat and gently sloping land and a bell-shape curved distribution for PSA sites.

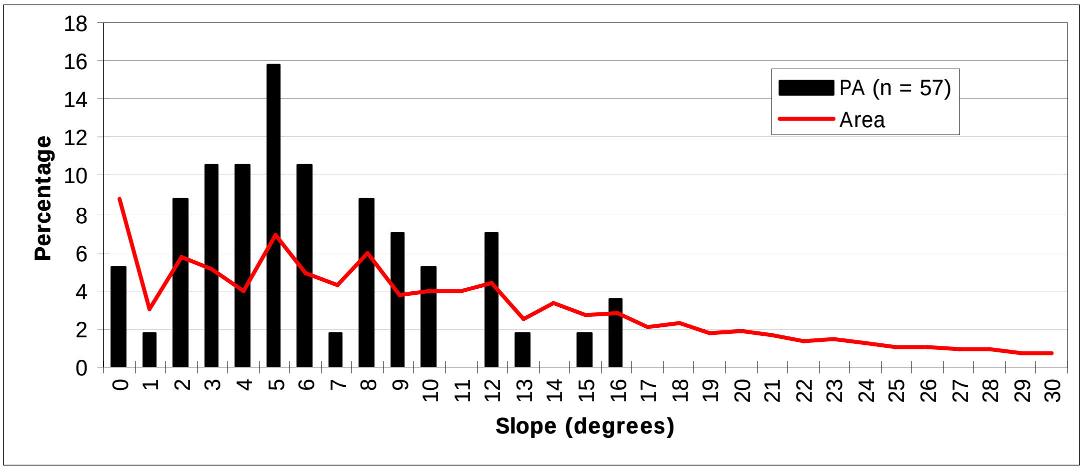


Figure 6.31: Frequency distribution of sites by slope in Argyll showing higher percentages of PA sites on gently sloping ground to slightly steeper slopes.

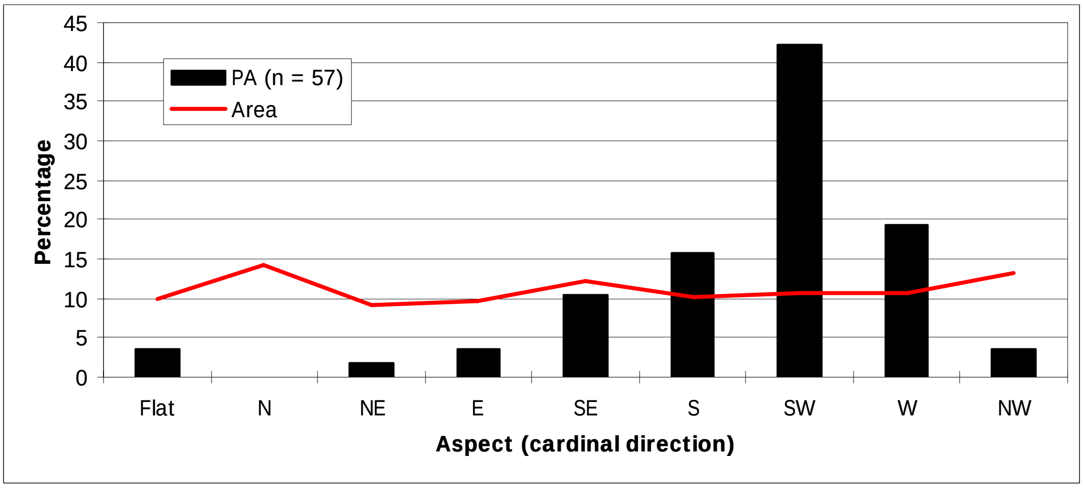


Figure 6.32: Frequency distribution of PA sites by aspect in Argyll illustrating higher percentages of sites than area on southern, south-western and western aspects.

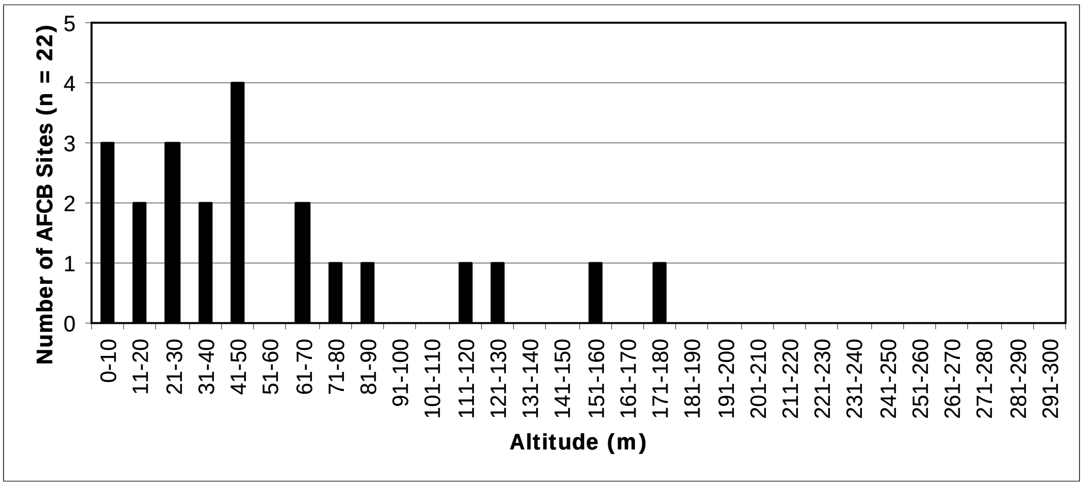


Figure 6.33: Number of AFCB sites by altitude in Argyll showing predominate distribution below 70m OD.

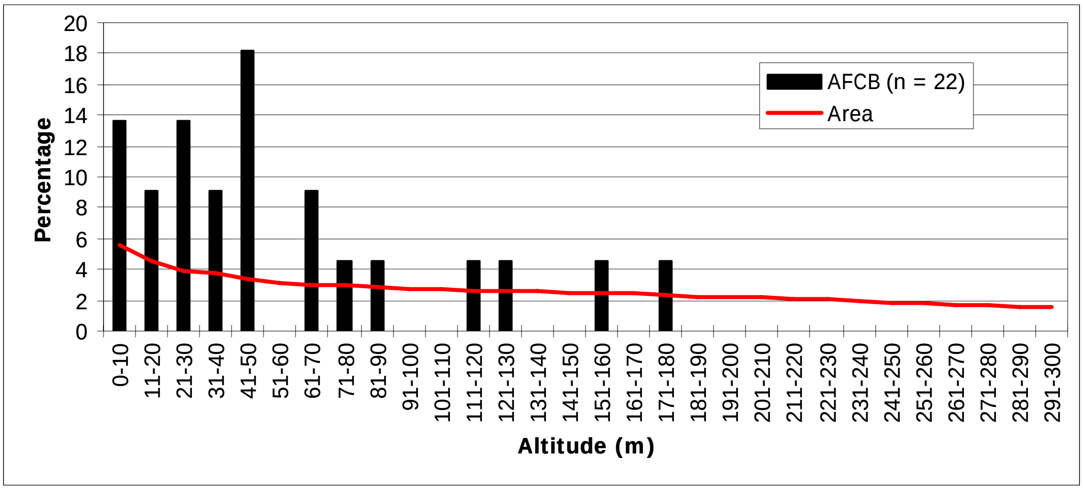


Figure 6.34: Frequency distribution of AFCB sites by altitude in Argyll showing the largest percentage difference between sites and area on altitudes below 70m OD.

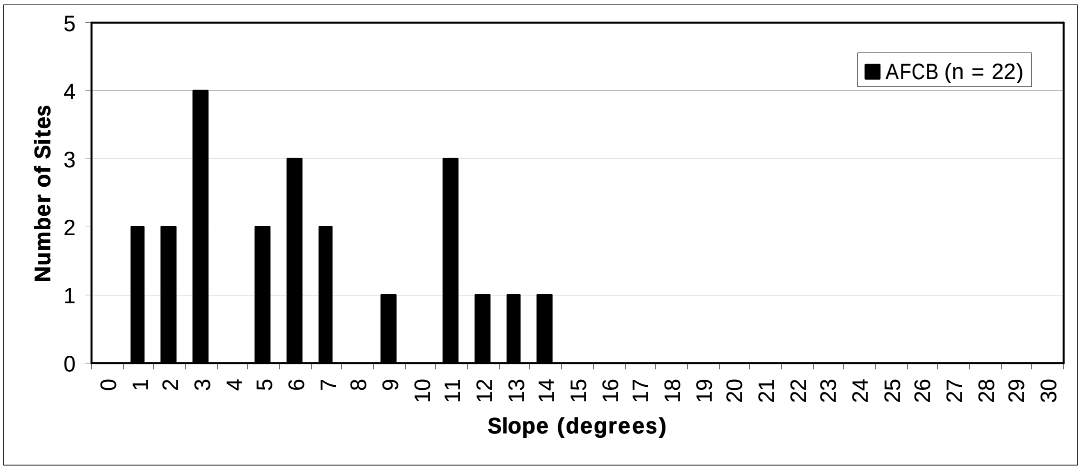


Figure 6.35: Number of AFCB sites by slope in Argyll showing distribution between a 1° and 14° incline.

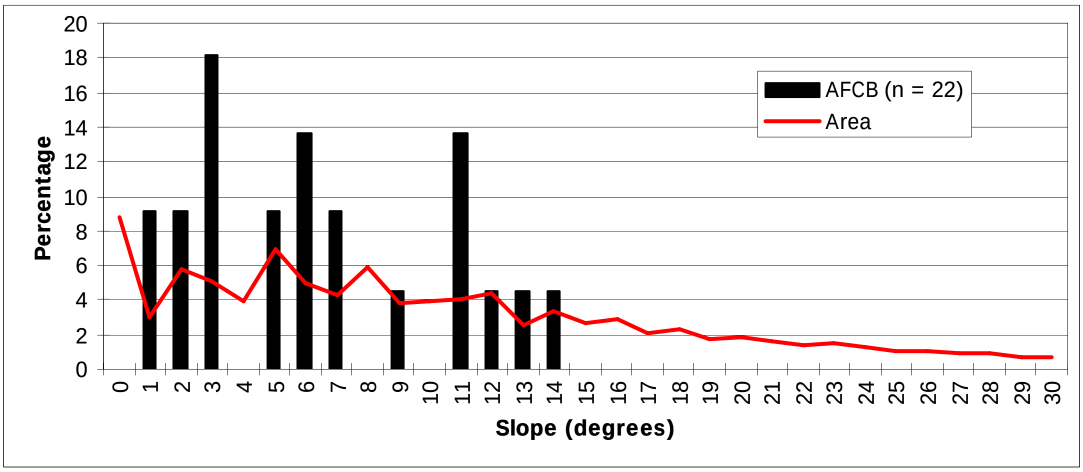


Figure 6.36: Frequency distribution of AFCB sites by slope in Argyll showing higher percentages of sites than area on slopes between a 1° and 11° angle.

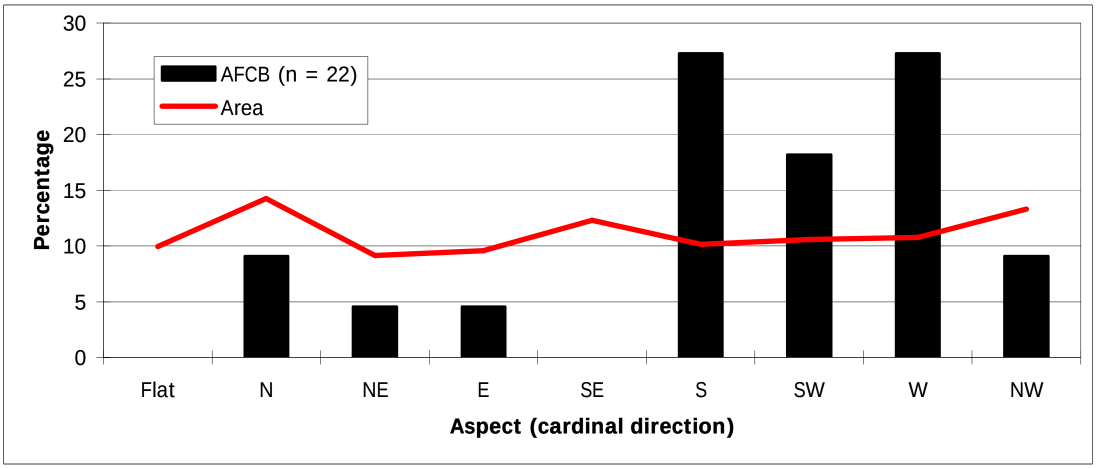


Figure 6.37: Frequency distribution of AFCB sites by aspect in Argyll showing higher percentages of sites than area on southern, south-western and western aspects.

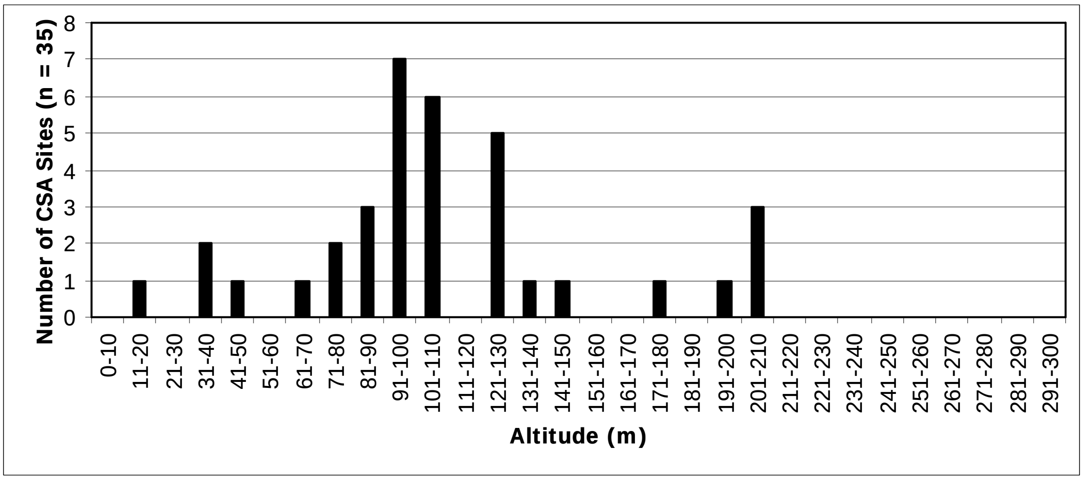


Figure 6.38: Number of CSA sites by altitude in the Northern Ireland study area illustrating a bell-shaped curve distribution between 11m OD and 210m OD.

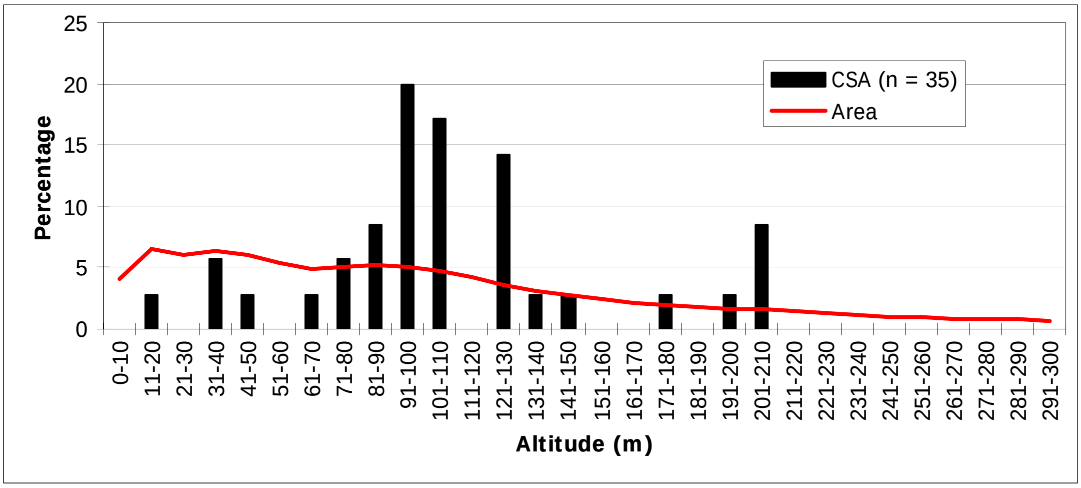


Figure 6.39: Frequency distribution of CSA sites by altitude in the Northern Ireland study area showing higher percentages of sites than area between 81m OD and 130m OD, with an outlier set of sites between 201m OD and 210m OD.

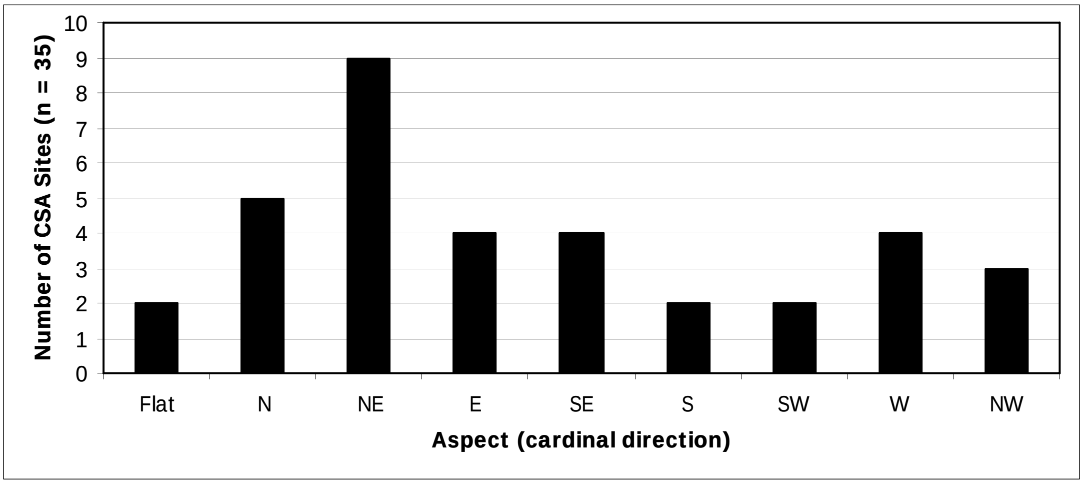


Figure 6.40: Number of CSA sites by aspect in the Northern Ireland study area illustrating a distribution of sites on all aspects with a predominance on north-eastern hill faces.

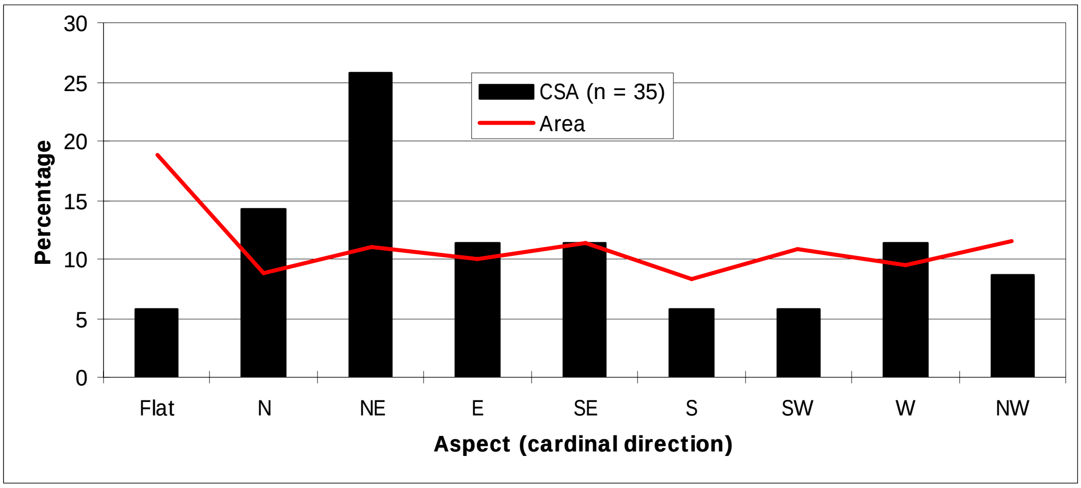


Figure 6.41: Frequency distribution of CSA sites by aspect in the Northern Ireland study area showing higher percentages of sites on northern and north-eastern hill faces.

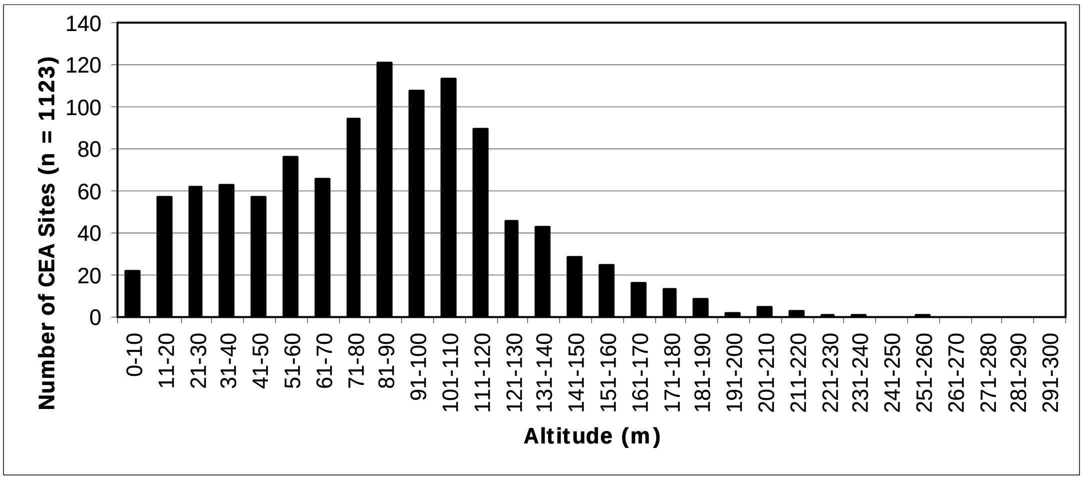


Figure 6.42: Number of CEA sites by altitude in the Northern Ireland study area showing a predominate distribution below 120m OD.

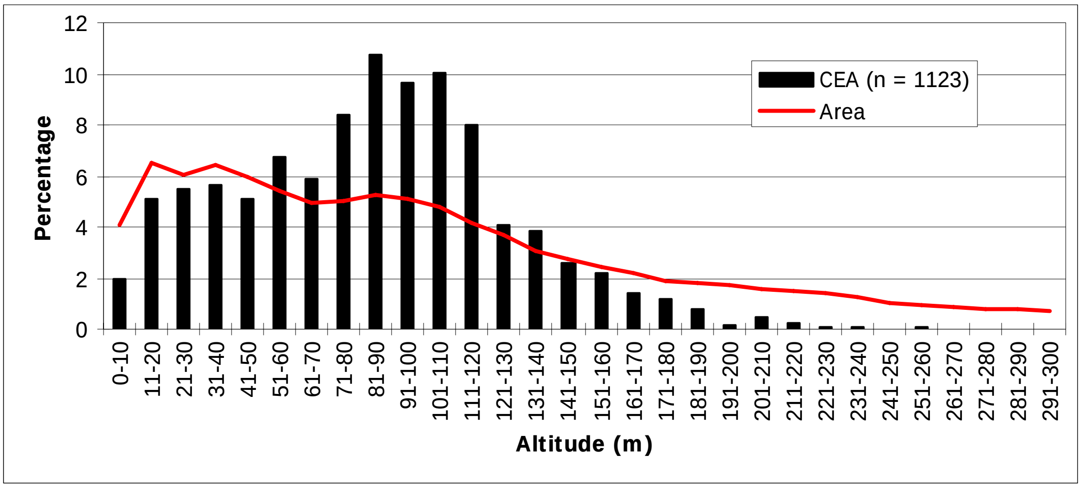


Figure 6.43: Frequency distribution of CEA sites by altitude in the Northern Ireland study area showing higher percentages of sites than area between 51m OD and 120m OD.

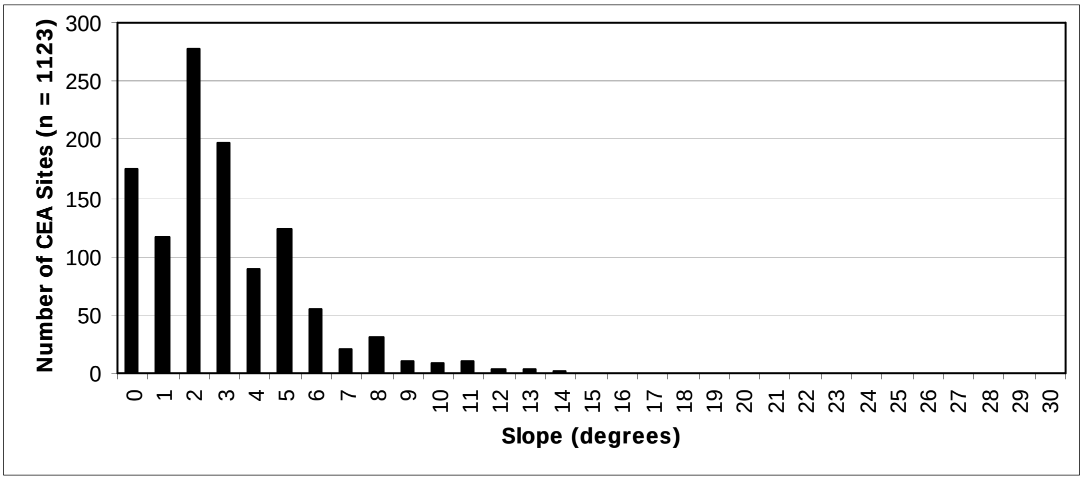


Figure 6.44: Number of CEA sites by slope in the Northern Ireland study area showing a predominate distribution on slopes less than a 6° incline.

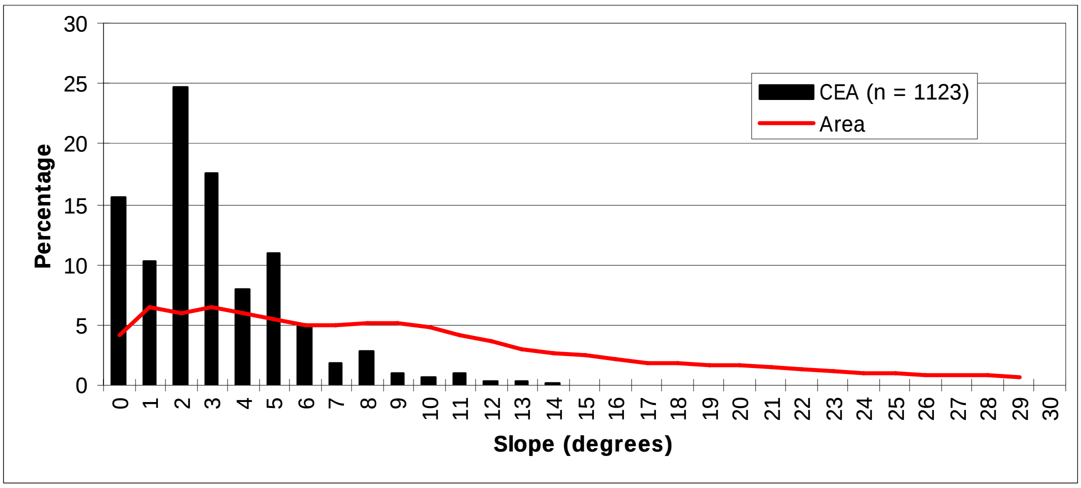


Figure 6.45: Frequency distribution of CEA sites by slope in the Northern Ireland study area illustrating higher percentages of sites than area on slopes below a 5° incline.

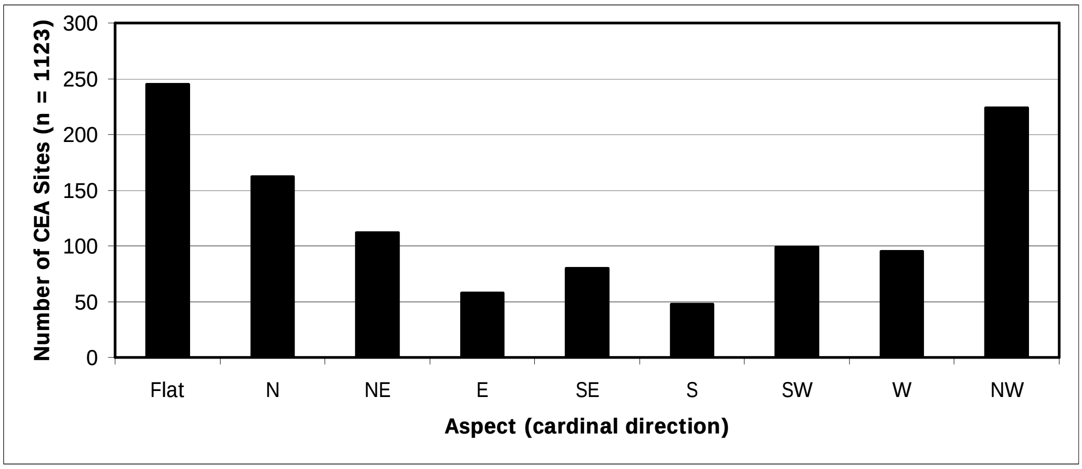


Figure 6.46: Number of CEA sites by aspect in the Northern Ireland study area showing predominate distributions on northern and north-western hill faces and flat ground.

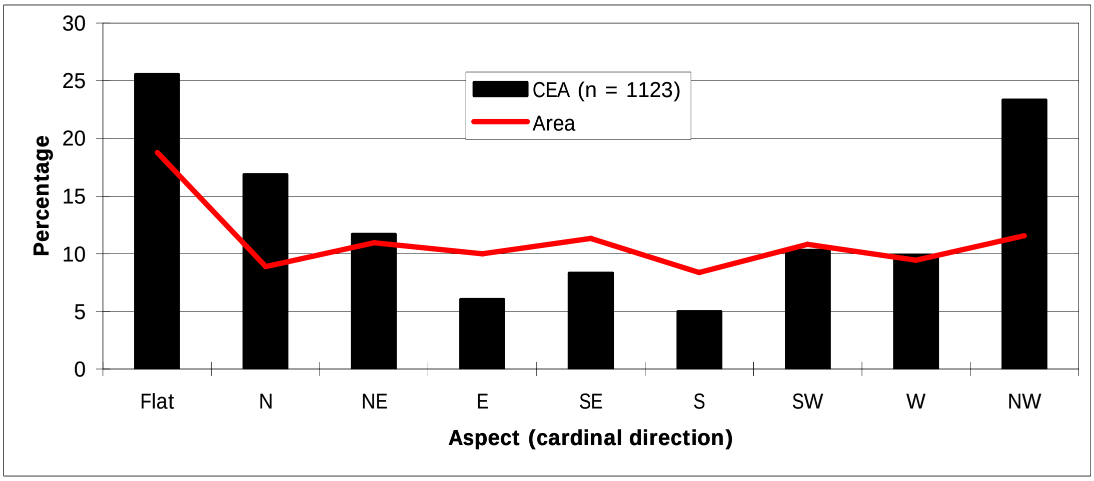


Figure 6.47: Frequency distribution of CEA sites by aspect in the Northern Ireland study area illustrating higher percentages of site than land on northern and north-western hill faces and flat ground.

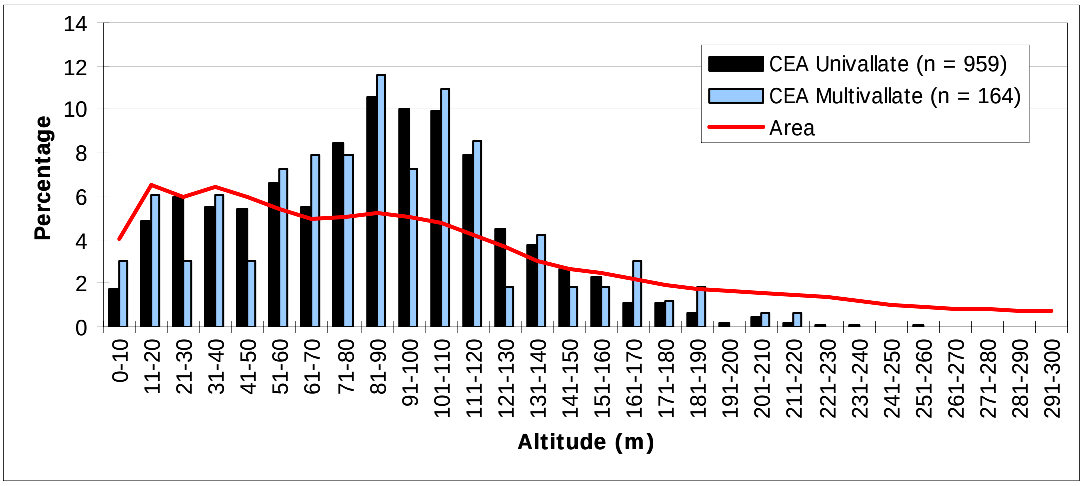


Figure 6.48: Frequency distribution of univallate and multivallate CEA sites by altitude in the Northern Ireland study area illustrating similar distributions.

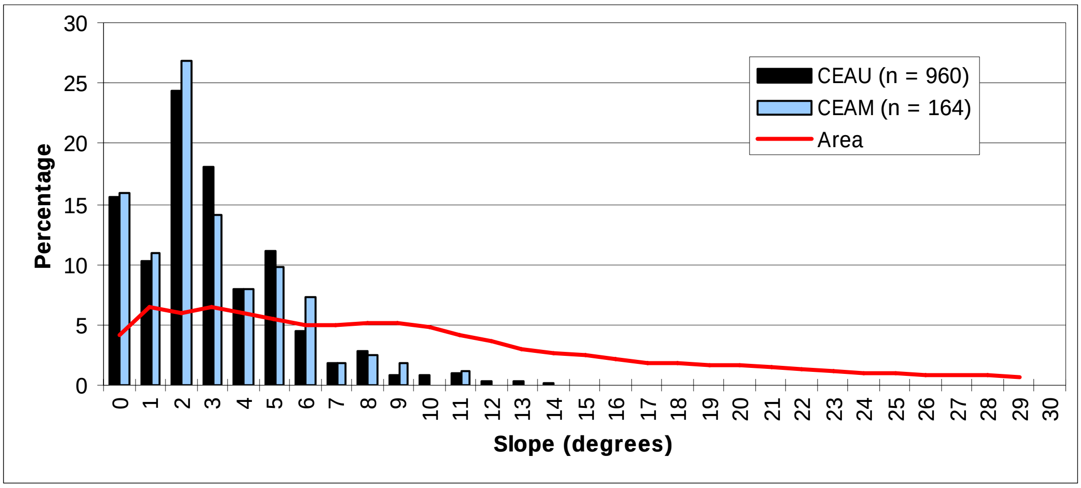


Figure 6.49: Frequency distribution of univallate and multivallate CEA sites by slope in the Northern Ireland study area illustrating similar distributions.

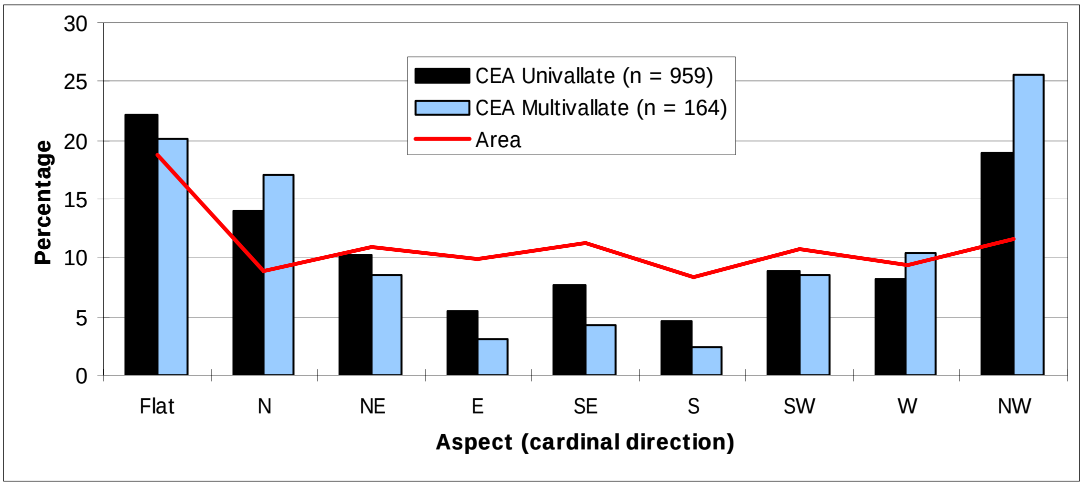


Figure 6.50: Frequency distribution of univallate and multivallate CEA sites by aspect in the Northern Ireland study area illustrating similar distributions.

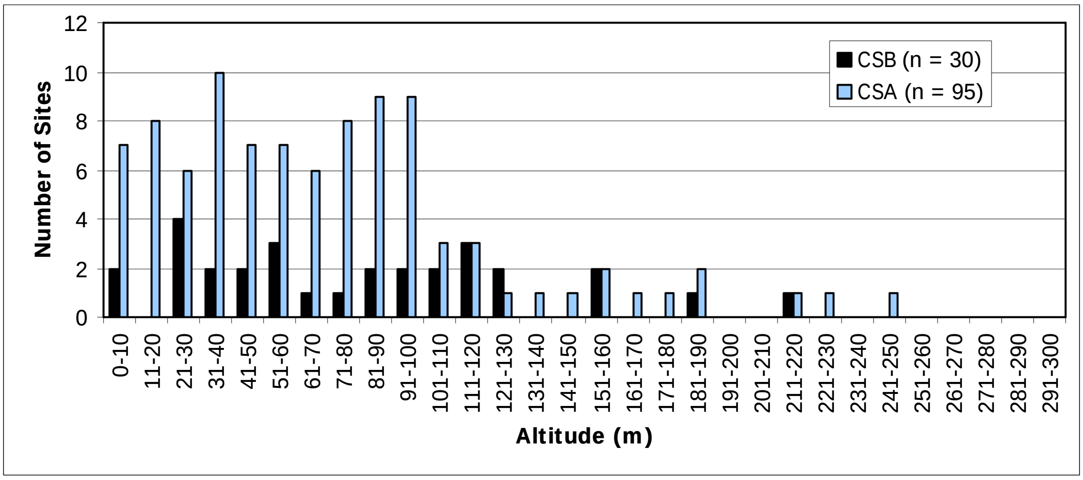


Figure 6.51: Number of sites by altitude in Co. Donegal showing a predominate distribution of CSB sites below 100m OD and a distribution of CSA sites below 250m OD.

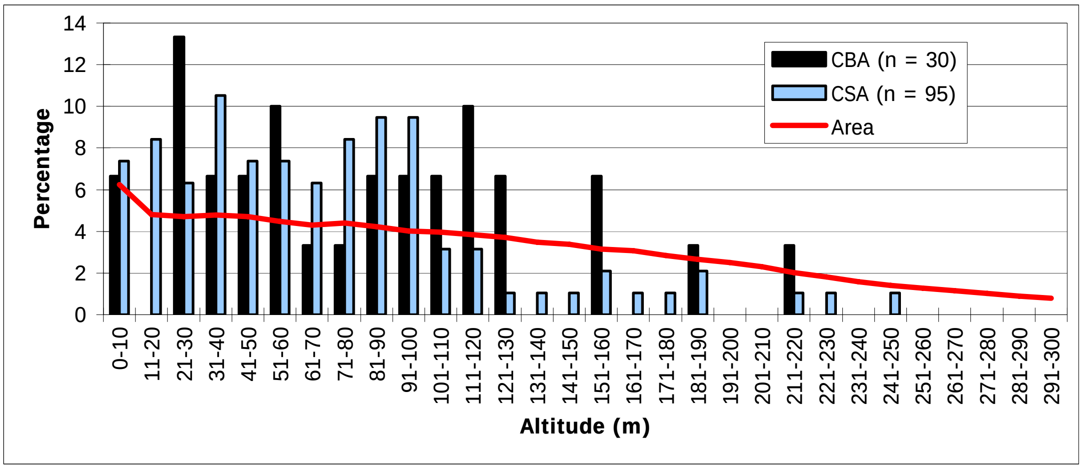


Figure 6.52: Frequency distribution of sites by altitude in Co. Donegal showing higher percentages of CSB sites than area between 21m OD and 130m OD and CSA sites between sea level and 100m OD.

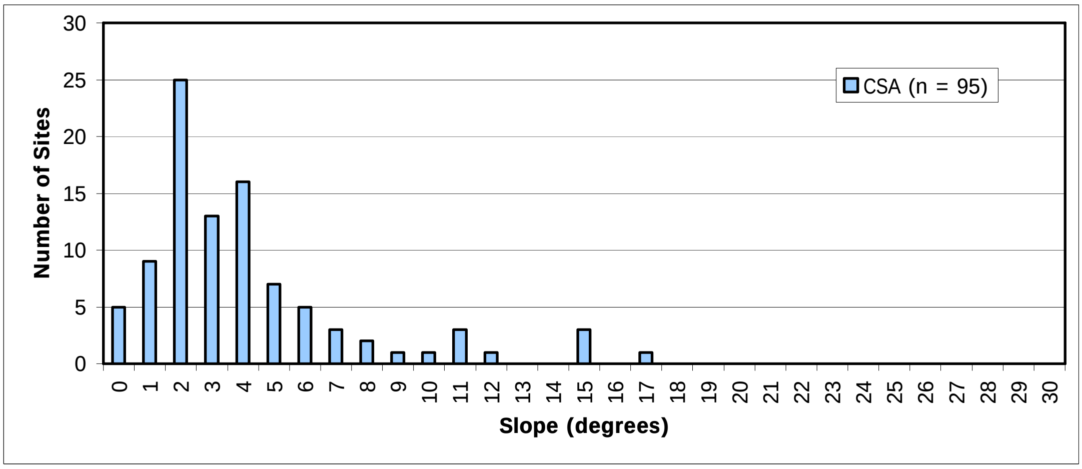


Figure 6.53: Number of CSA sites by slope in Co. Donegal showing a bell-shaped curve between 0° and12° slope

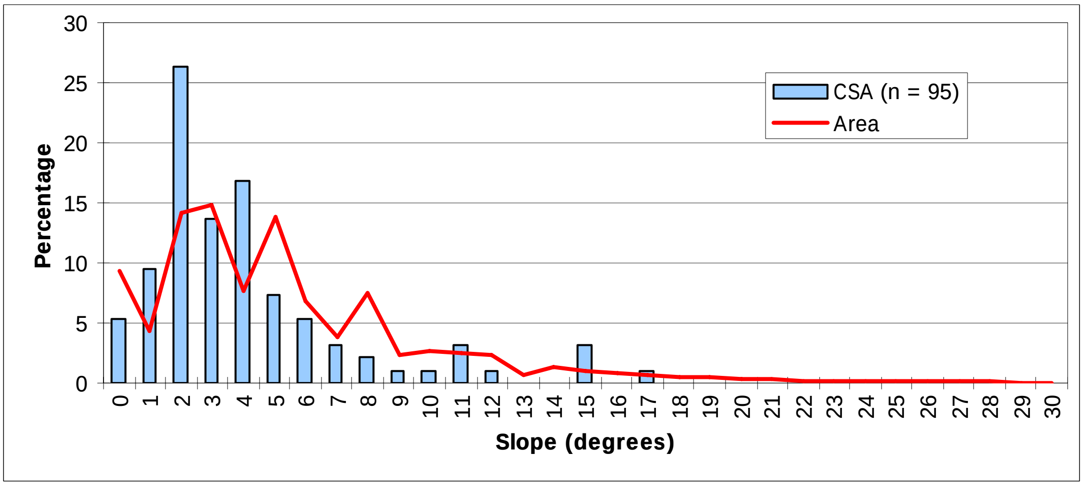


Figure 6.54: Frequency distribution of CSA sites by altitude in Co. Donegal showing higher percentages for sites than area on slopes between 1° and 4° incline.

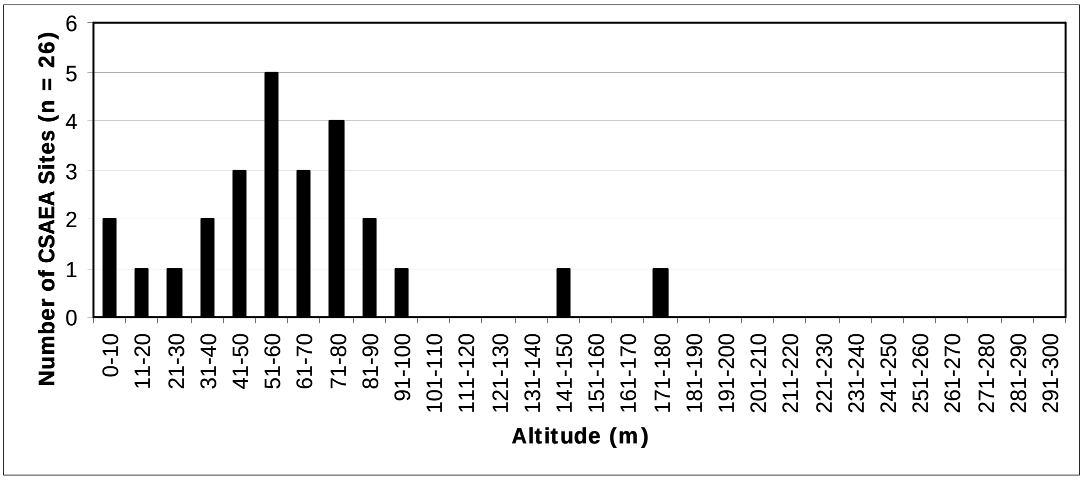


Figure 6.55: Number of CSAEA sites by altitude in Co. Donegal showing a predominate distribution below 100m OD.

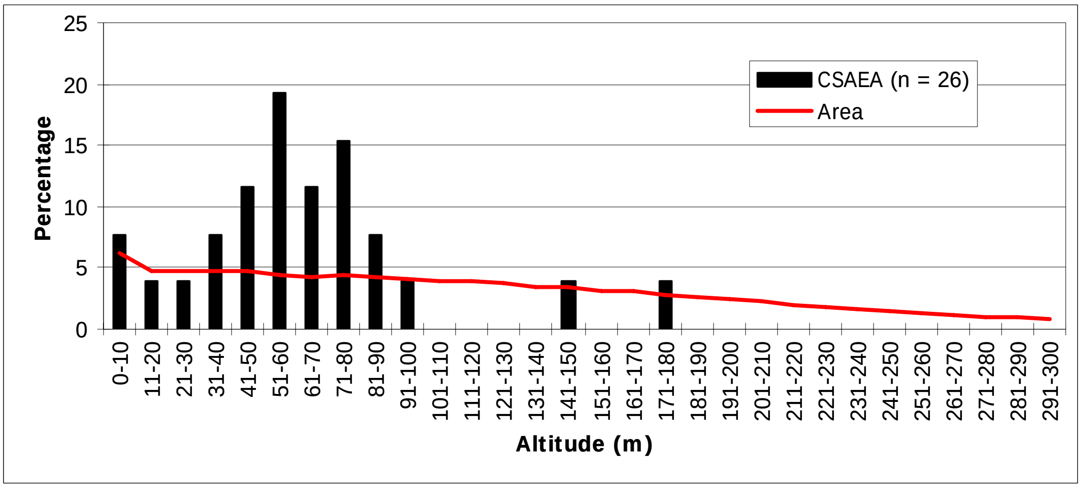


Figure 6.56: Frequency distribution of CSAEA sites by altitude in Co. Donegal showing higher percentages of site than area on elevations between 31m OD and 90m OD.

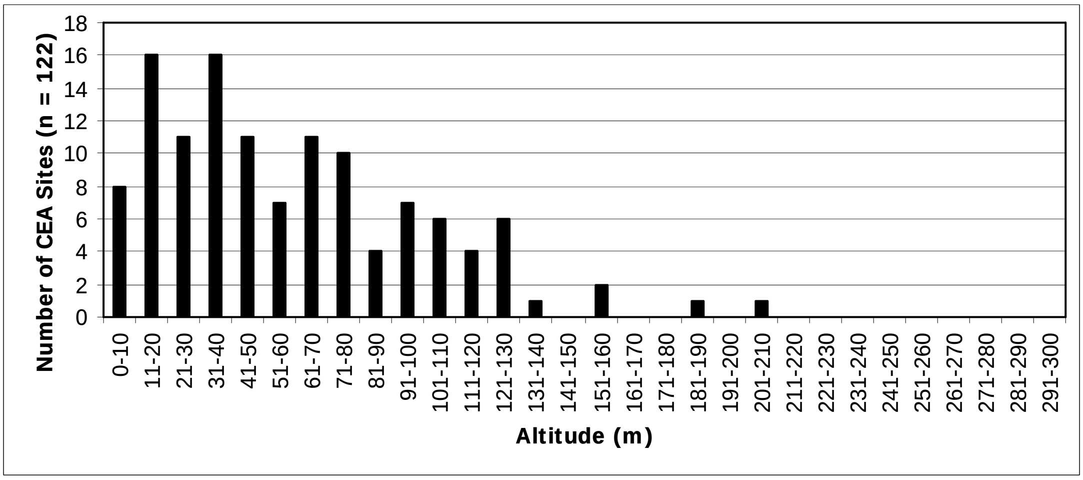


Figure 6.57: Number of CEA sites by altitude in Co. Donegal illustrating a predominate distribution on elevations up to 130m OD.

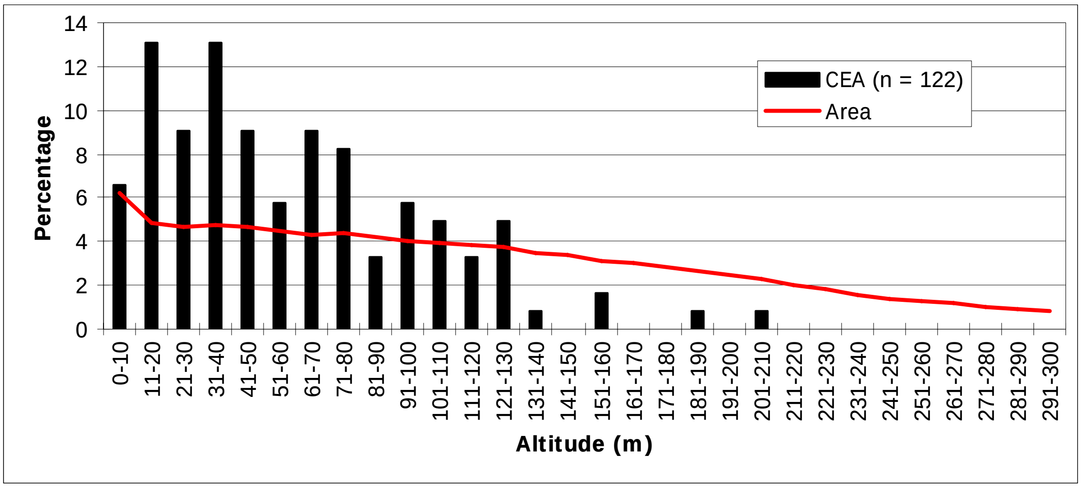


Figure 6.58: Frequency distribution of CEA sites by altitude in Co. Donegal showing significantly higher percentages of sites than area on elevations between 11m OD and 80m OD.

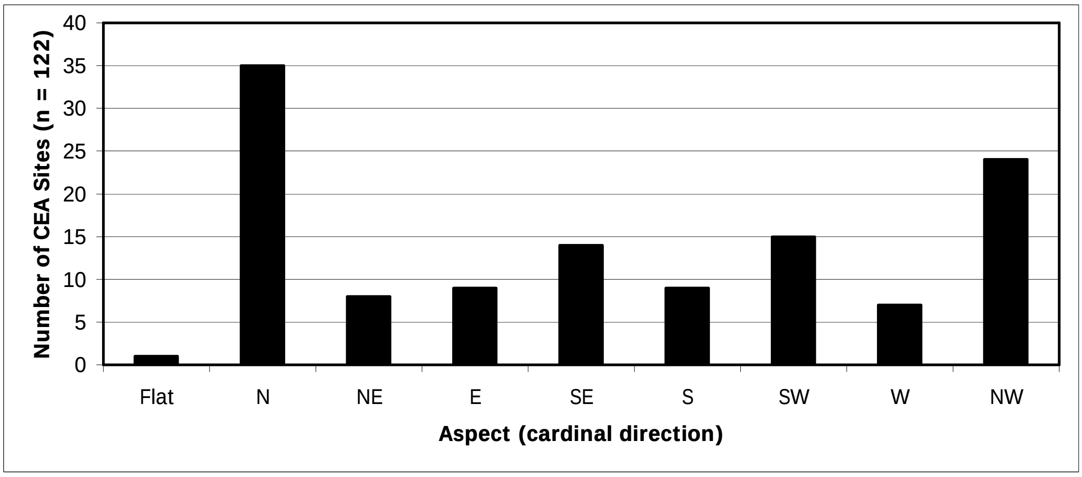


Figure 6.59: Number of CEA sites by aspect in Co. Donegal illustrating a predominate distribution on northern and north-western hillsides.

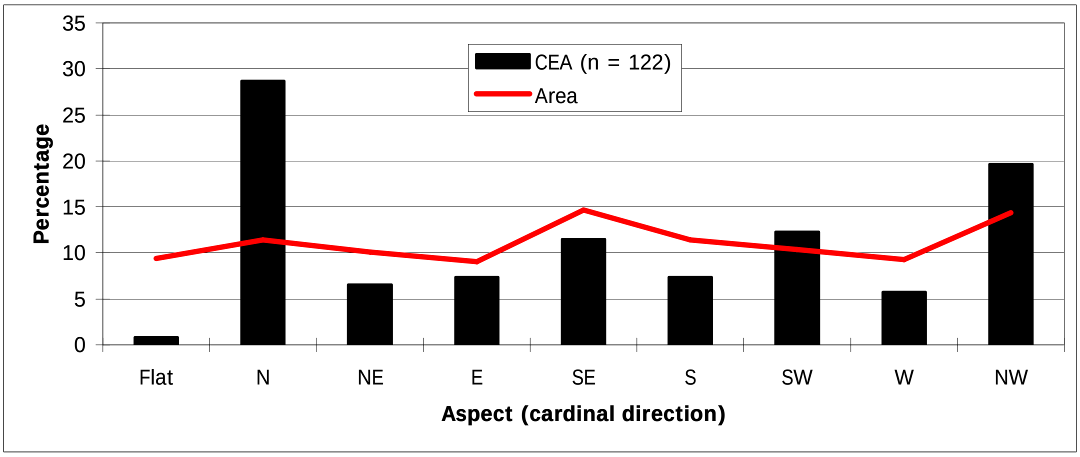


Figure 6.60: Frequency distribution of CEA sites by aspect in Co. Donegal showing higher percentages of sites than area on northern and north-western aspects.

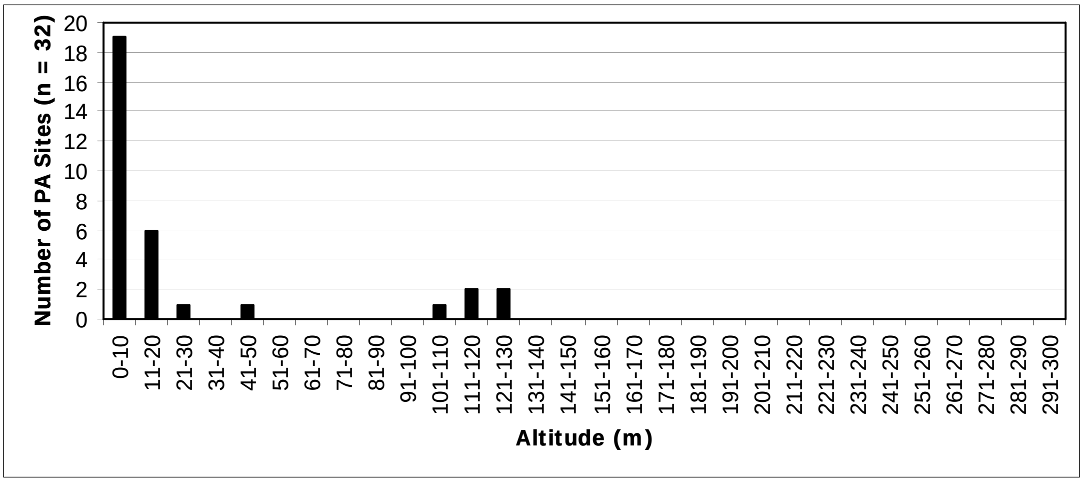


Figure 6.61: Number of PA sites by altitude in Co. Donegal showing a predominate distribution below 20m OD.

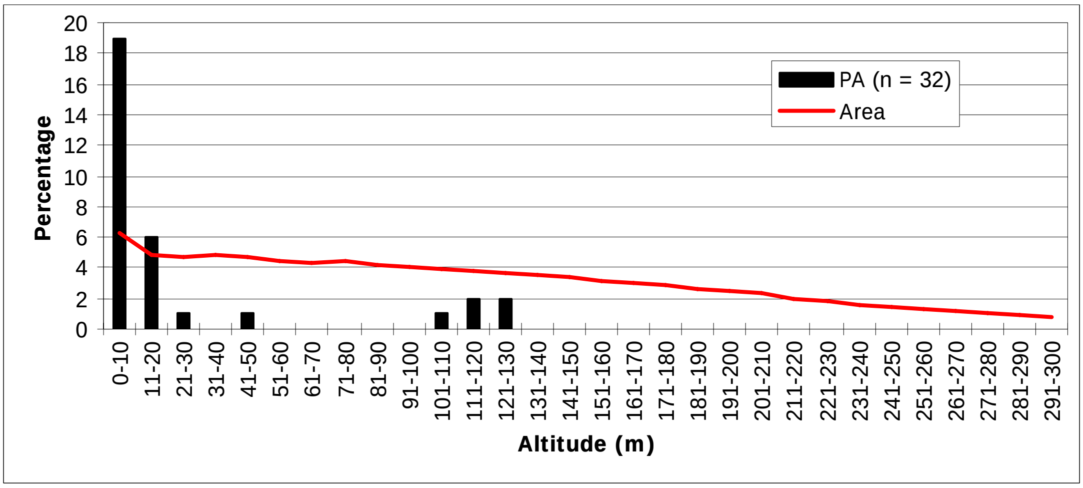


Figure 6.62: Frequency distribution of PA sites by altitude in Co. Donegal showing higher percentages of site than area on elevations between sea level and 10m OD.

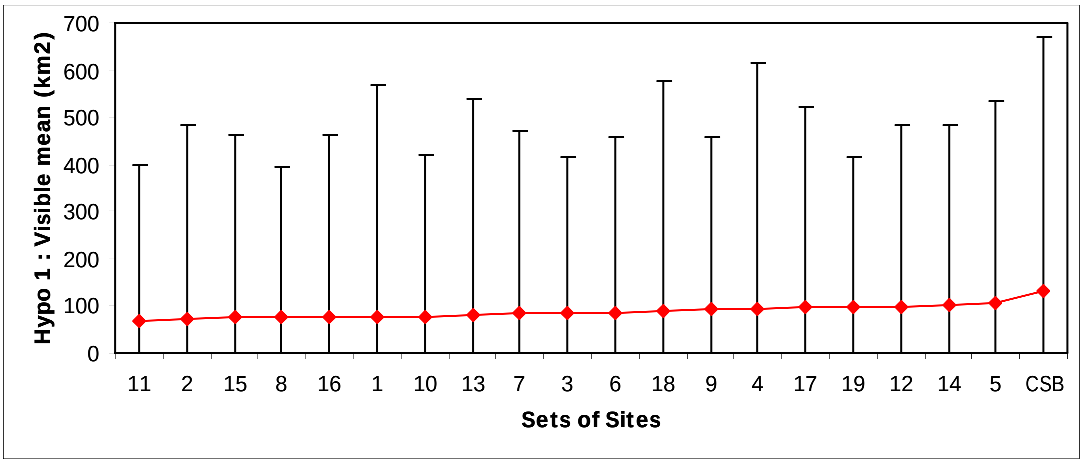


Figure 7.1: Ranking order of sets in Argyll by visible mean, showing CSB sites with the largest value (Y-bars = minimum and maximum value in each set).

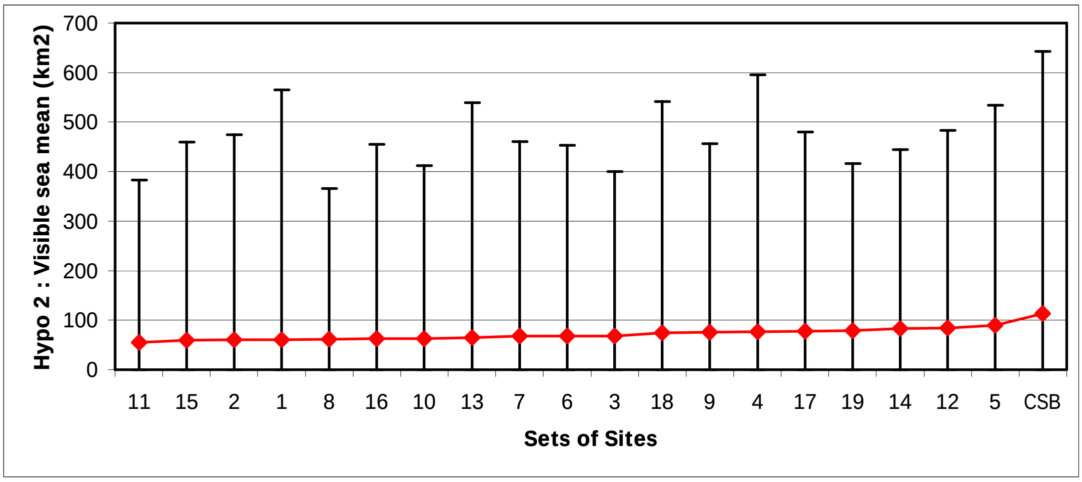


Figure 7.2: Ranking order of sets in Argyll by visible sea mean, showing CSB sites with the largest value (Y-bars = minimum and maximum value in each set).

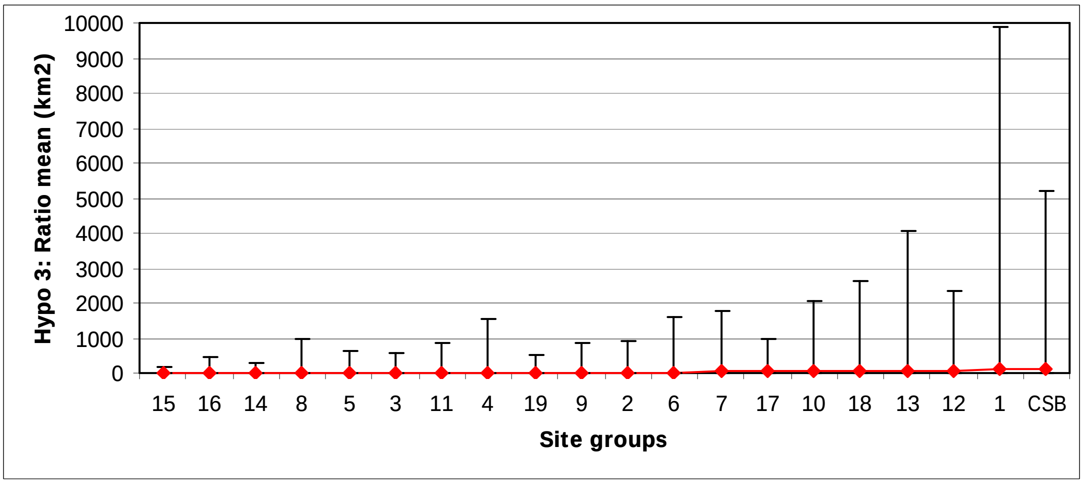


Figure 7.3: Ranking order of sets in Argyll by ratio mean of visible sea to visible land, showing CSB sites with the largest value (Y-bars = minimum and maximum value in each set).

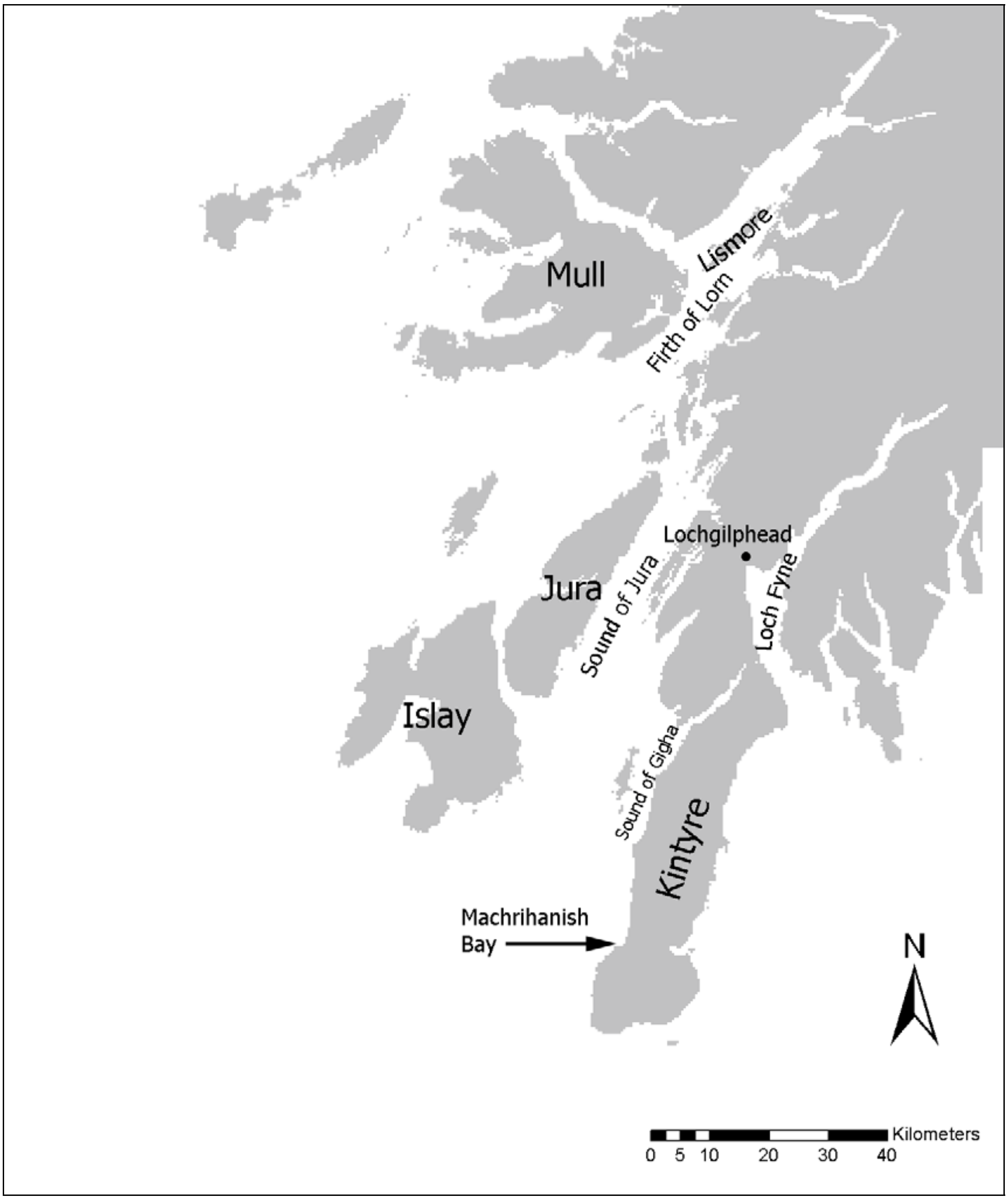


Figure 7.4: Map of Argyll study area. Annotated areas are referred to in the text.

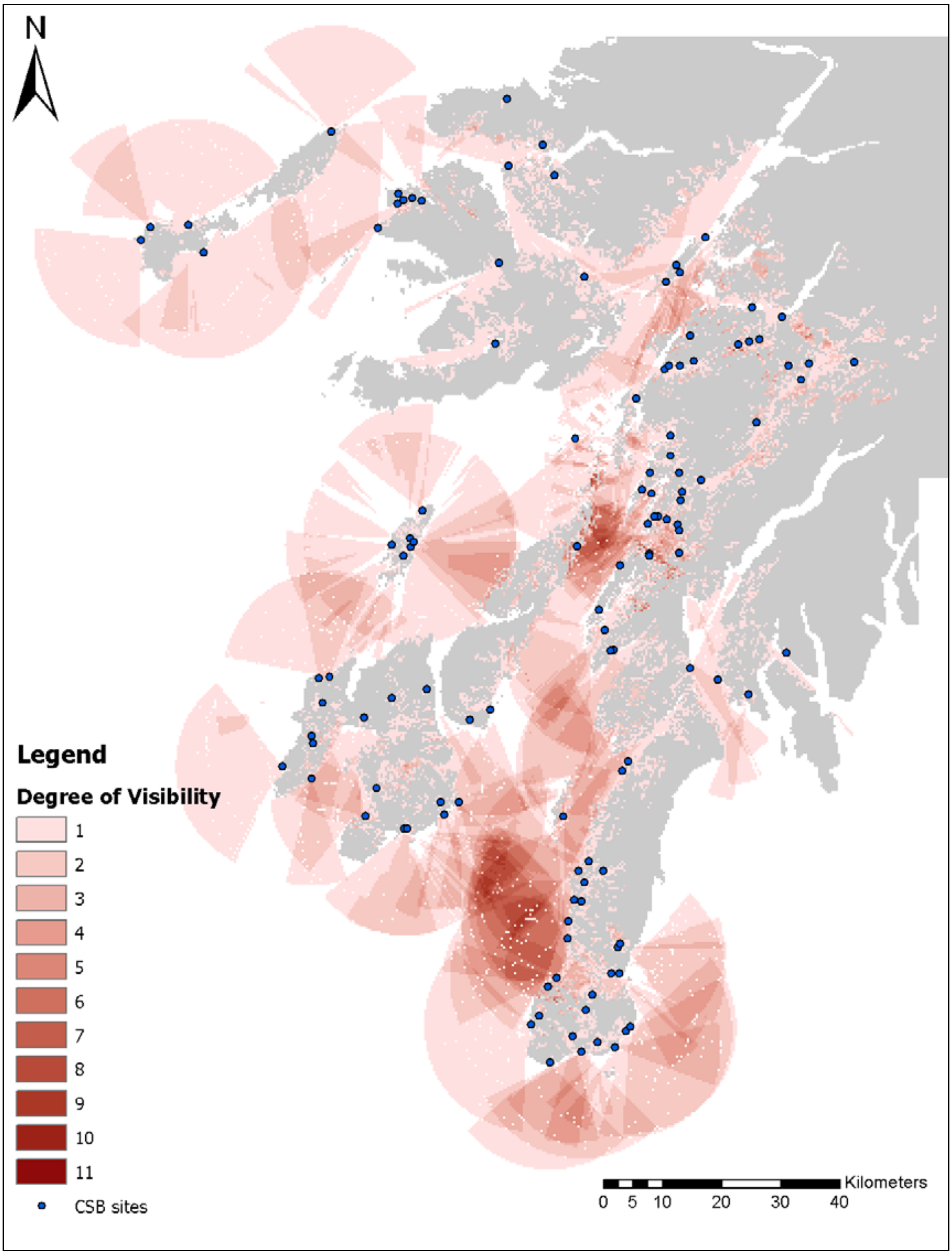


Figure 7.5: Cumulative viewshed from CSB sites in Argyll (m=121), showing areas with the highest frequency of site visibility along the west coast of Kintyre and along the Sound of Jura.

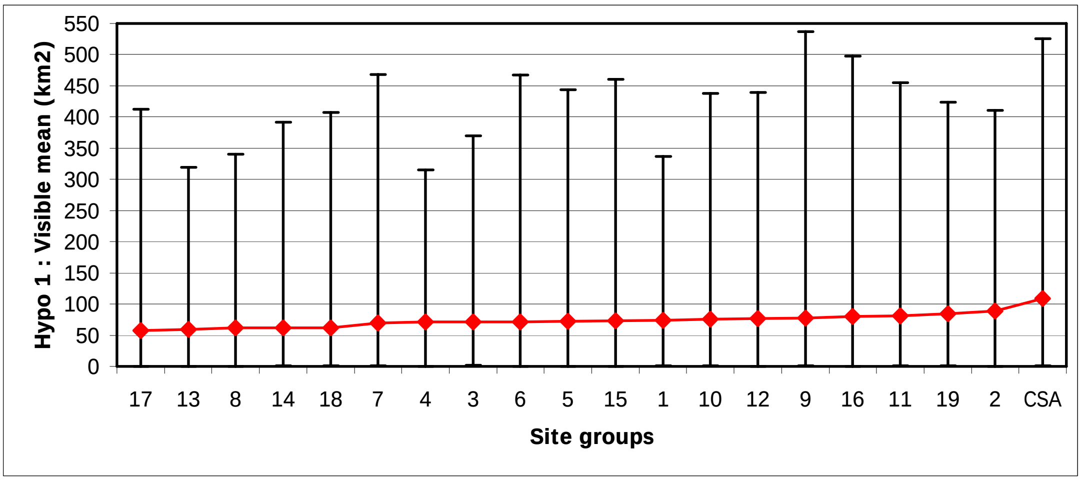


Figure 7.6: Ranking order of sets in Argyll by visible mean, showing CSA sites with the largest value (Y-bars = minimum and maximum value in each set).

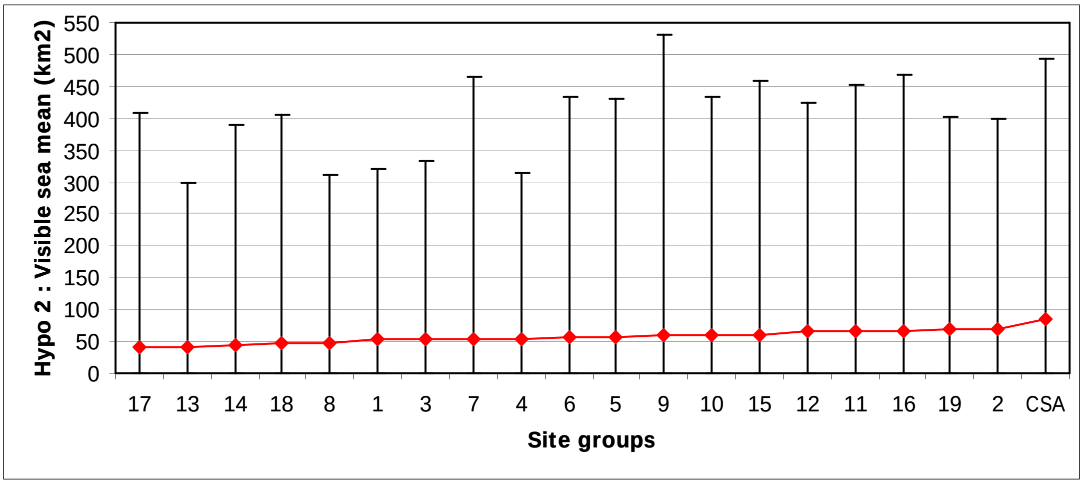


Figure 7.7: Ranking order of sets in Argyll by visible sea mean, showing CSA sites with the largest value (Y-bars = minimum and maximum value in each set).

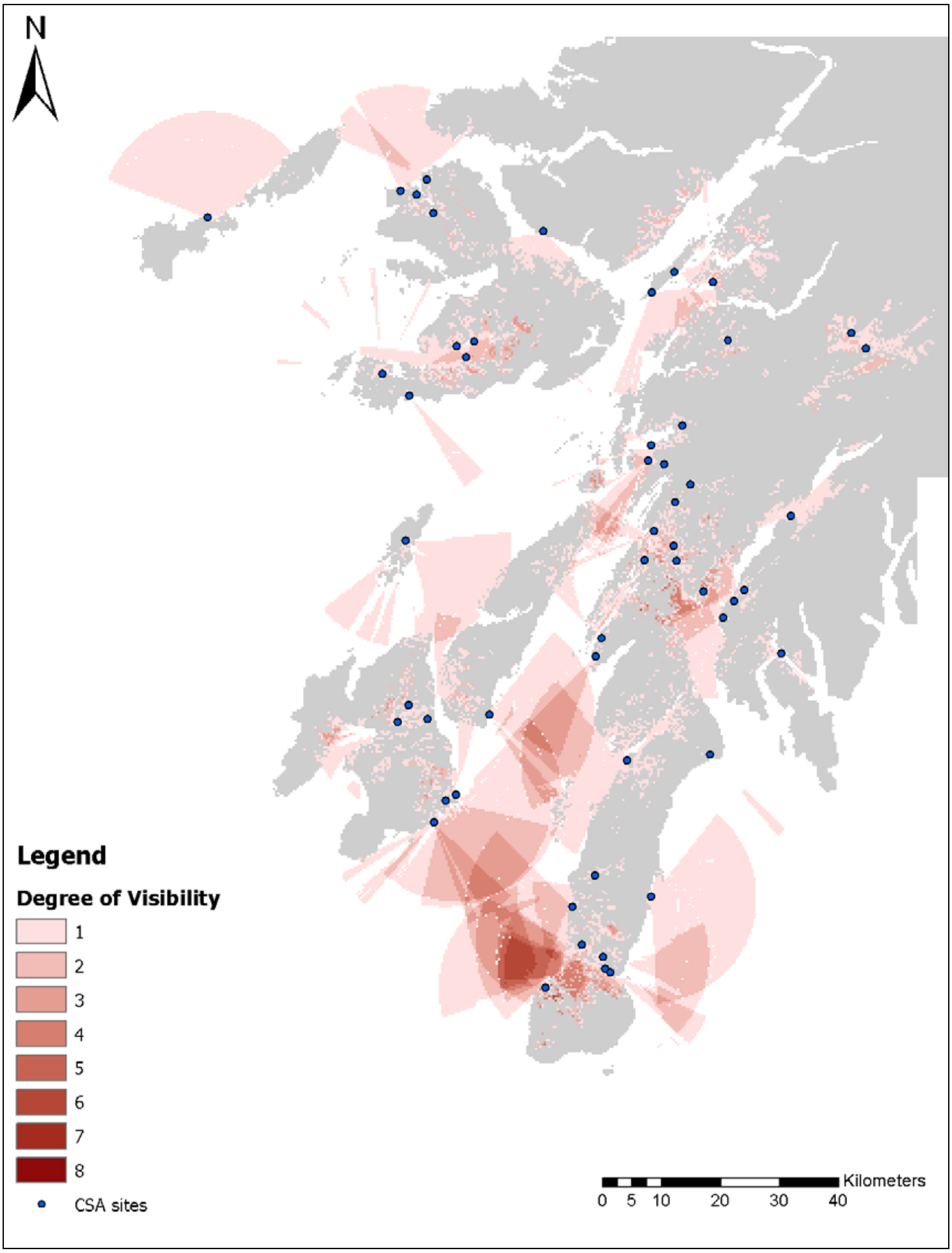


Figure 7.8: Cumulative viewshed from CSA sites in Argyll (m=53), showing areas with the highest frequency of site visibility in between Islay and Kintyre. Darker areas indicate the higher number of sites that are intervisible with that area.

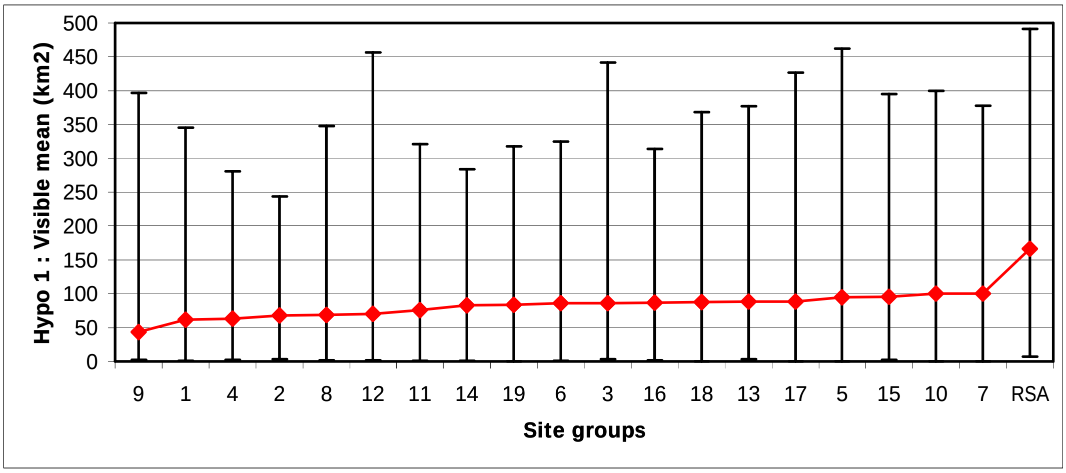


Figure 7.9: Ranking order of sets in Argyll by visible mean, showing RSA sites with the largest value (Y-bars = minimum and maximum value in each set).

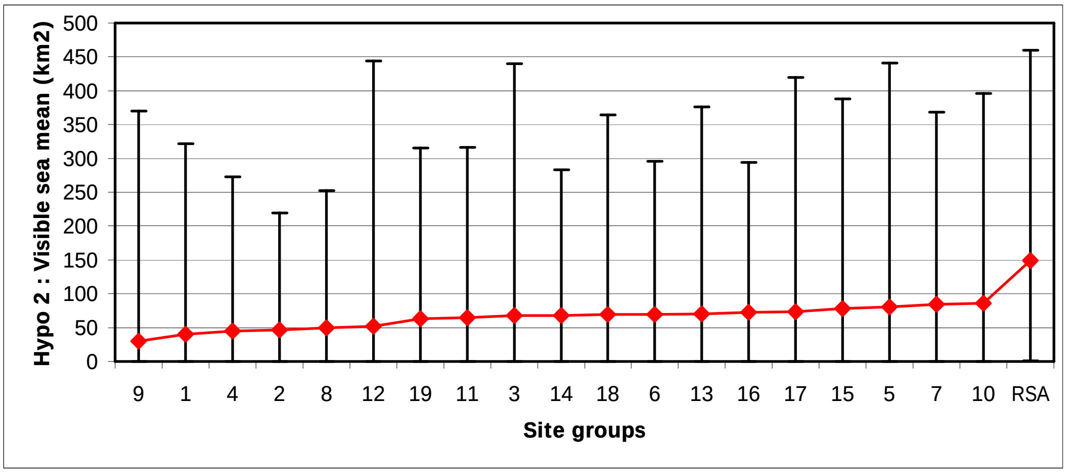


Figure 7.10: Ranking order of sets in Argyll by visible sea mean, showing RSA sites with the largest value (Y-bars = minimum and maximum value in each set).

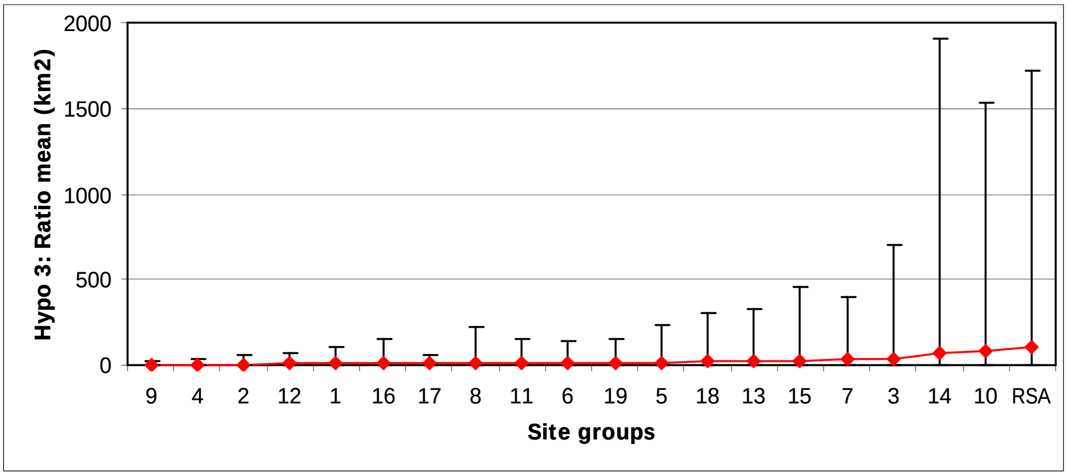


Figure 7.11: Ranking order of sets in Argyll by ratio mean of visible sea to visible land, showing RSA sites with the largest value (Y-bars = minimum and maximum value in each set).

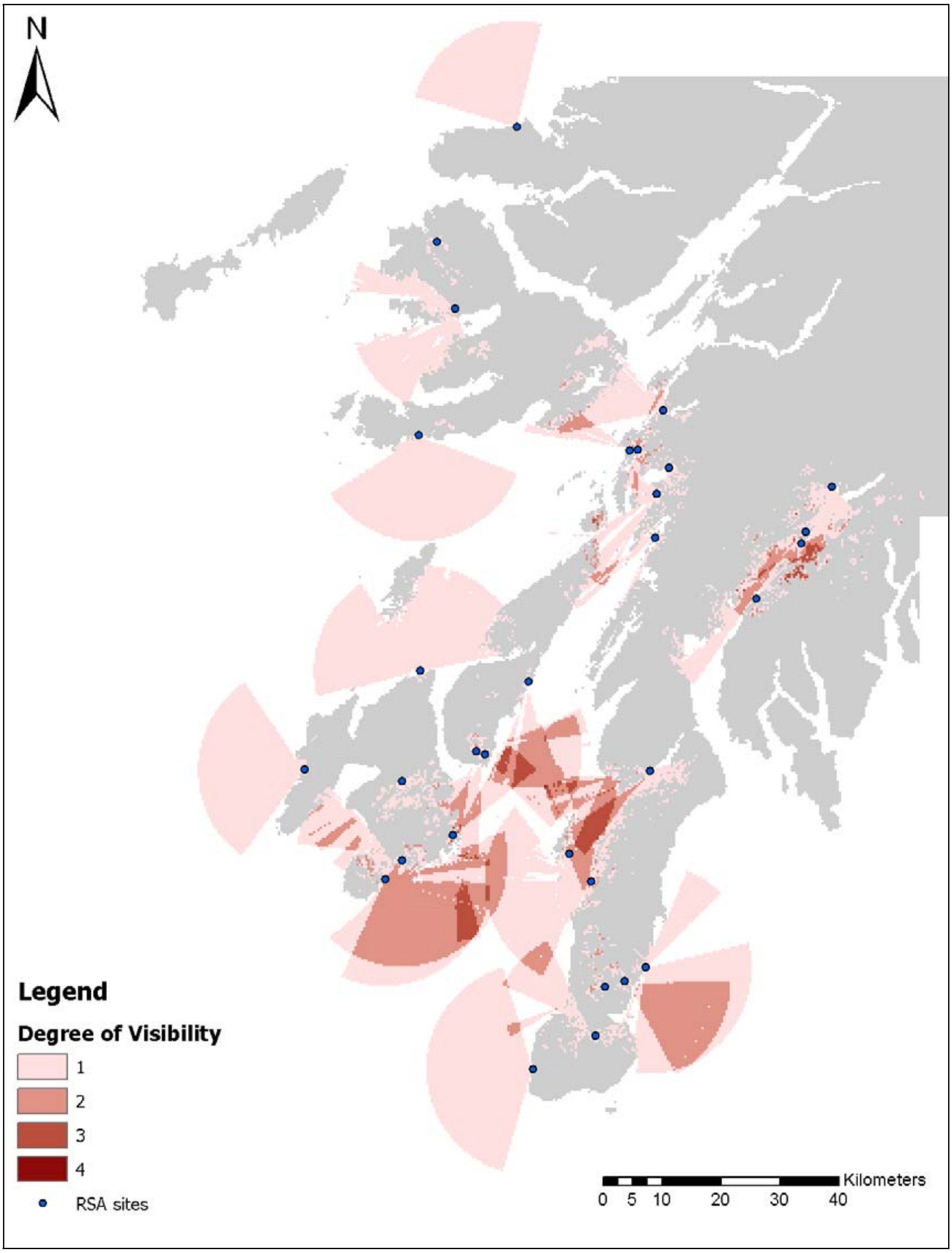


Figure 7.12: Cumulative viewshed from RSA sites in Argyll (m=17), showing large areas of the sea are visible. Darker areas indicate the higher number of sites that are intervisible with that area.

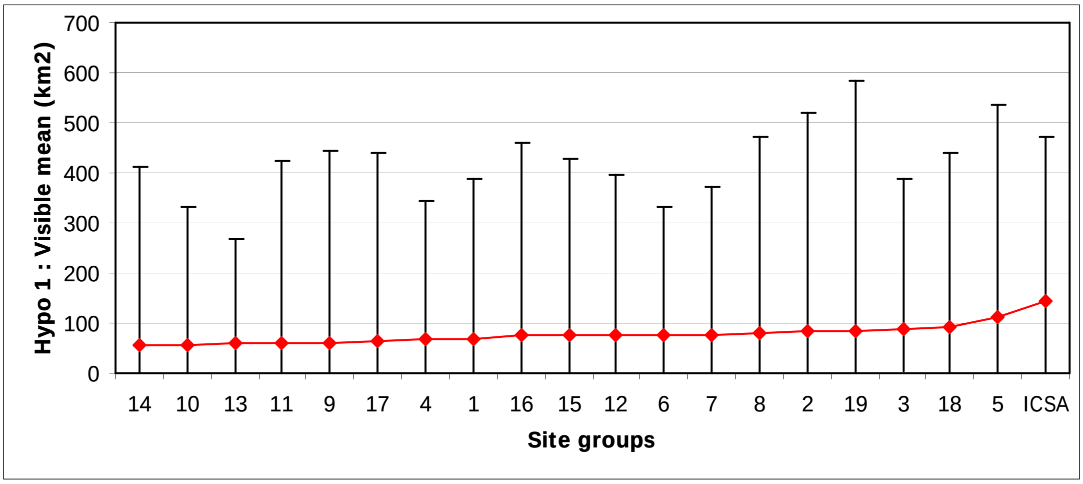


Figure 7.13: Ranking order of sets in Argyll by visible mean, showing ICSA sites with the largest value (Y-bars = minimum and maximum value in each set).

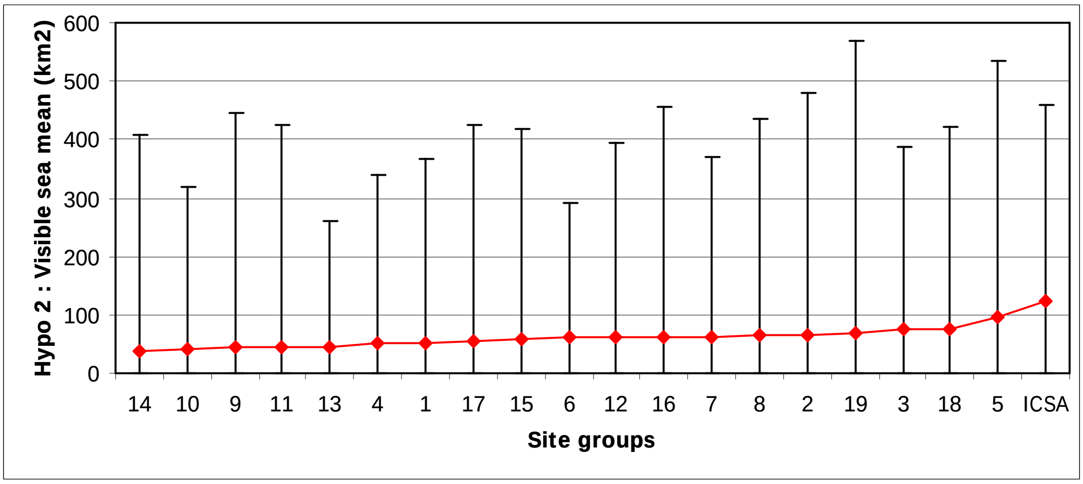


Figure 7.14: Ranking order of sets in Argyll by visible sea mean, showing ICSA sites with the largest value (Y-bars = minimum and maximum value in each set).

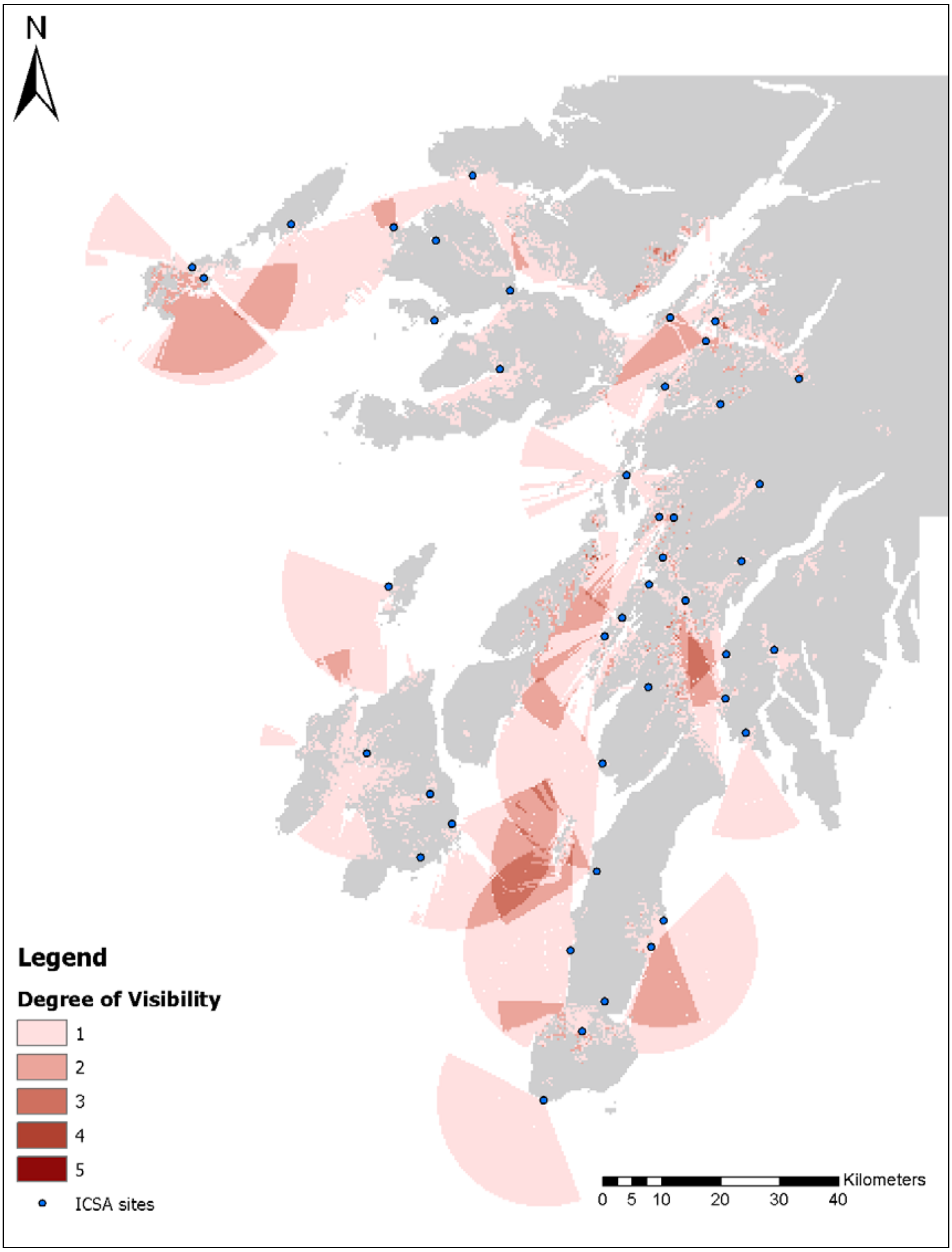


Figure 7.15: Cumulative viewshed from ICSA sites in Argyll (m=43), illustrating large areas of the sea visible from sites throughout study area. Darker areas indicate the higher number of sites that are intervisible with that area.

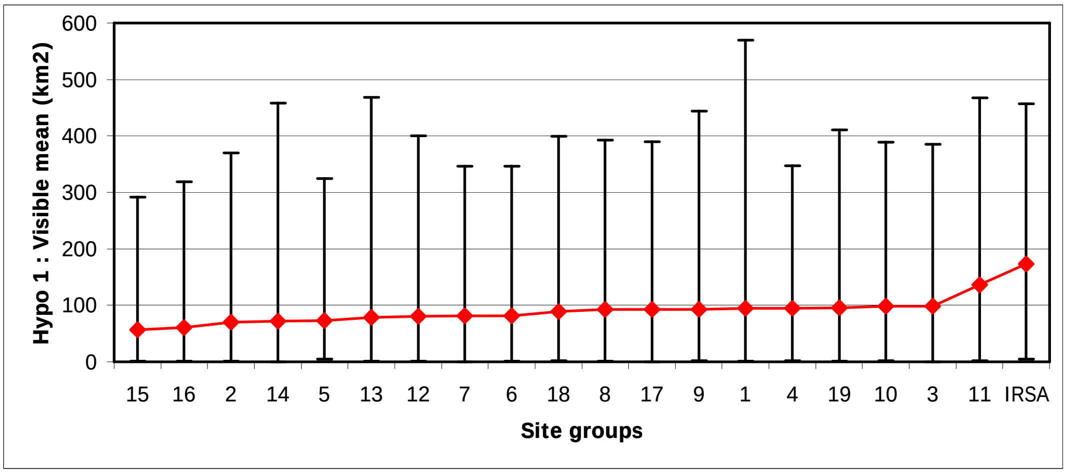


Figure 7.16: Ranking order of sets in Argyll by visible mean, showing IRSA sites with the largest value (Y-bars = minimum and maximum value in each set).

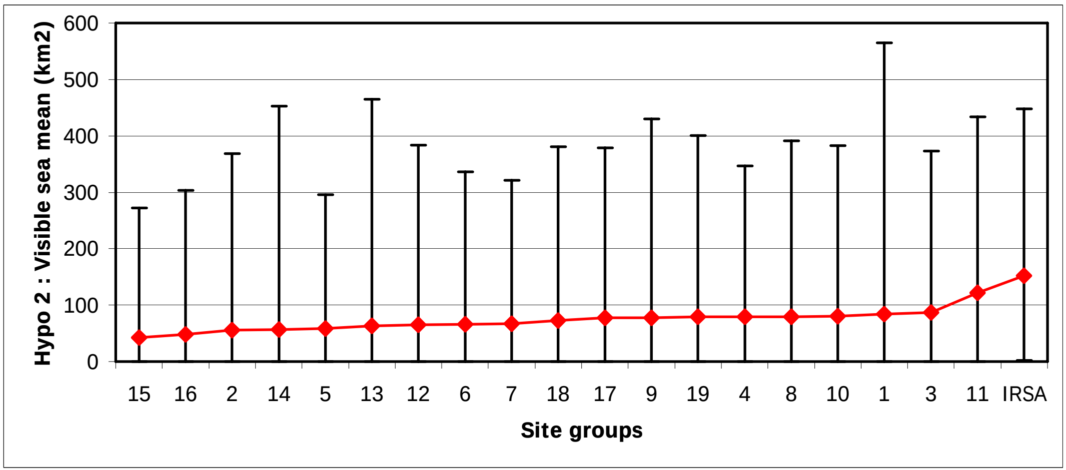


Figure 7.17: Ranking order of sets in Argyll by visible sea mean, showing IRSA sites with the largest value (Y-bars = minimum and maximum value in each set).

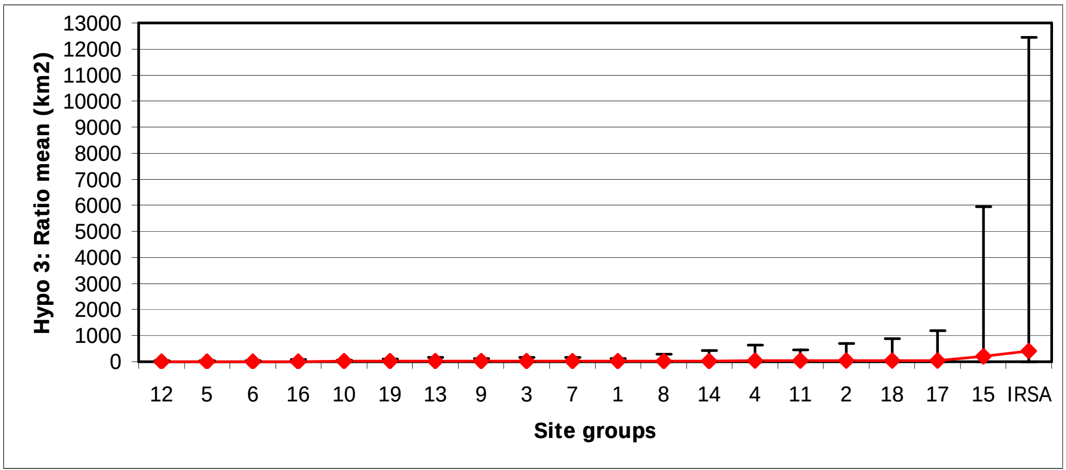


Figure 7.18: Ranking order of sets in Argyll by ratio mean of visible sea to visible land, showing IRSA sites with the largest value and an extreme maximum value (Y-bars = minimum and maximum value in each set).

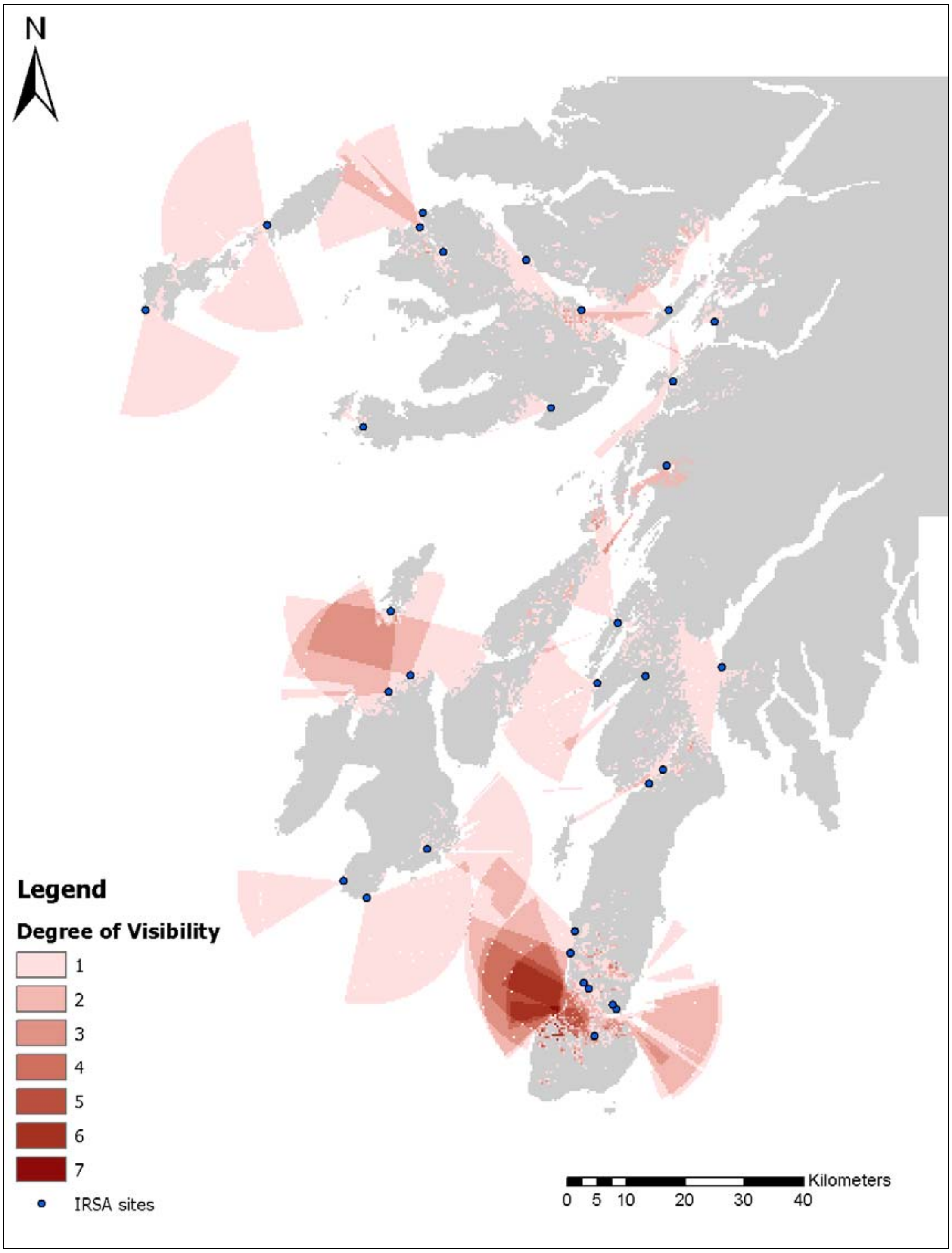


Figure 7.19: Cumulative viewshed from IRSA sites in Argyll (m=32), illustrating possible visual control over Machrihanish Bay. Darker areas indicate the higher number of sites that are intervisible with that area.

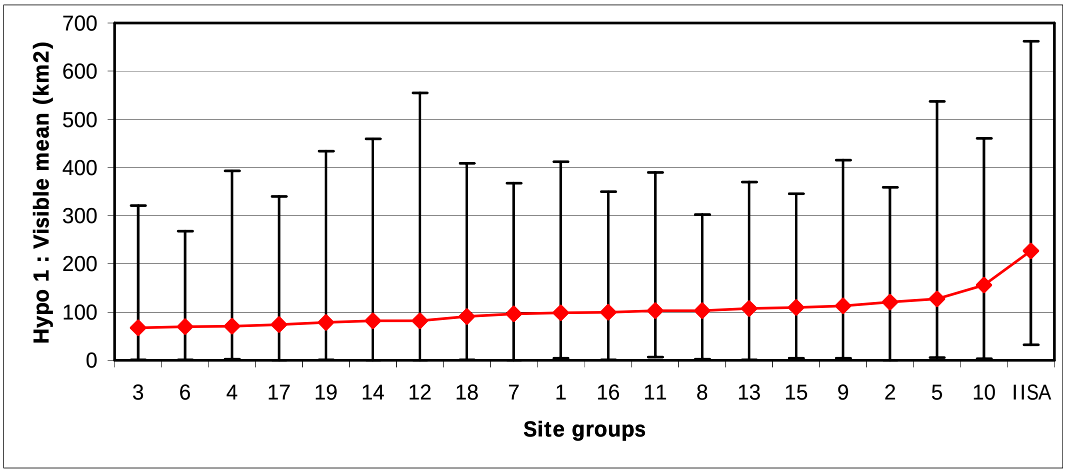


Figure 7.20: Ranking order of sets in Argyll by visible mean, showing IISA sites with the largest value (Y-bars = minimum and maximum value in each set).

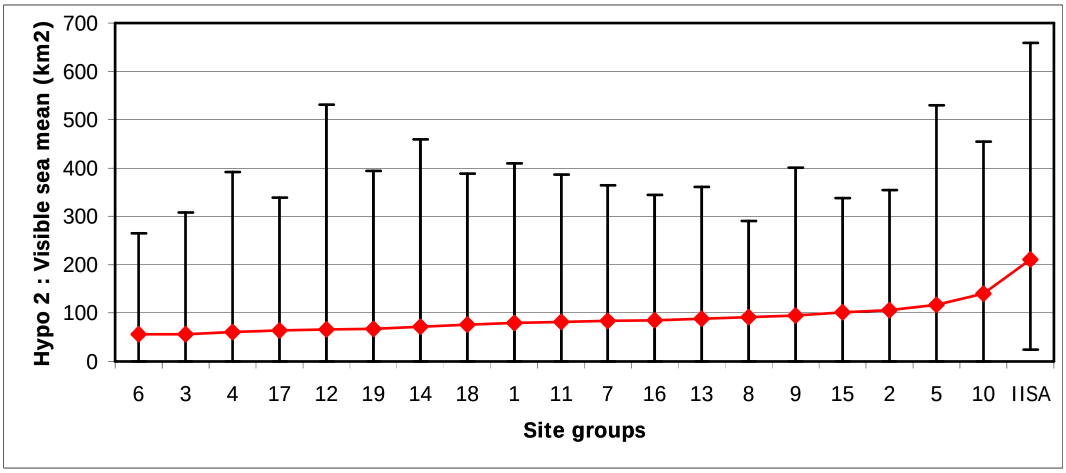


Figure 7.21: Ranking order of sets in Argyll by visible sea mean, showing IISA sites with the largest value (Y-bars = minimum and maximum value in each set).

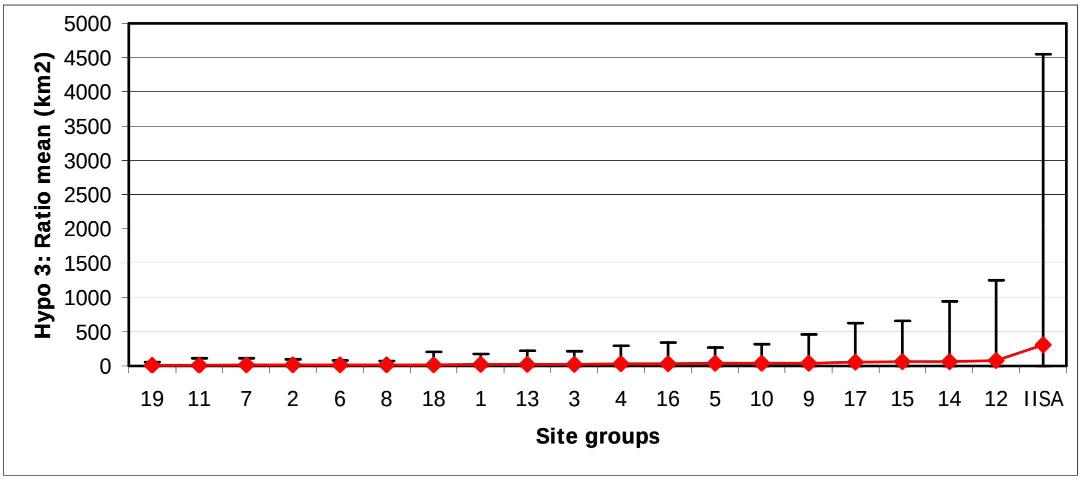


Figure 7.22: Ranking order of sets in Argyll by ratio mean of visible sea to visible land, showing IISA sites with the largest value and an extreme maximum value (Y-bars = minimum and maximum value in each set).

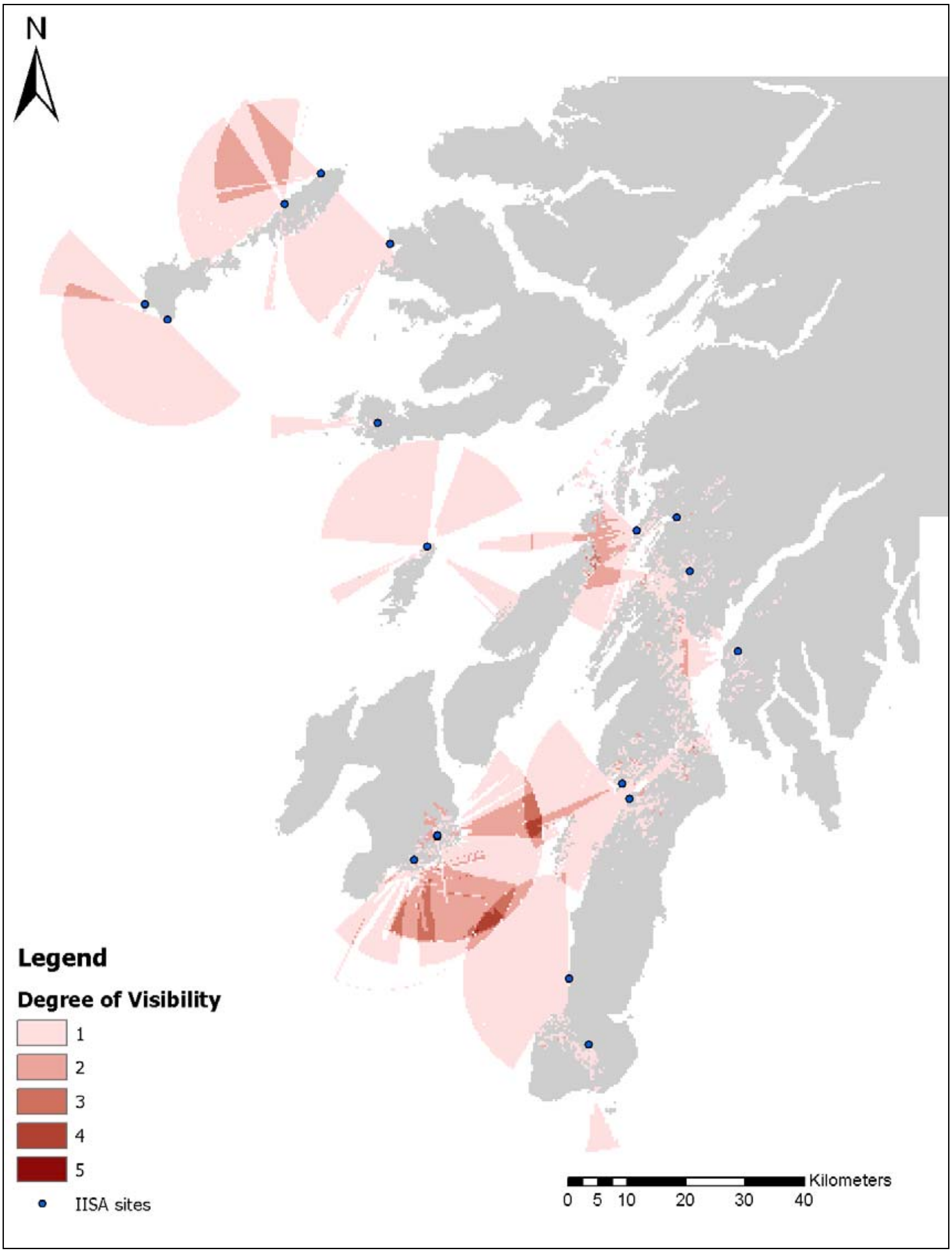


Figure 7.23: Cumulative viewshed from IISA sites in Argyll (m=18), showing areas with the highest frequency of site visibility in between Islay and Kintyre. Darker areas indicate the higher number of sites that are intervisible with that area.

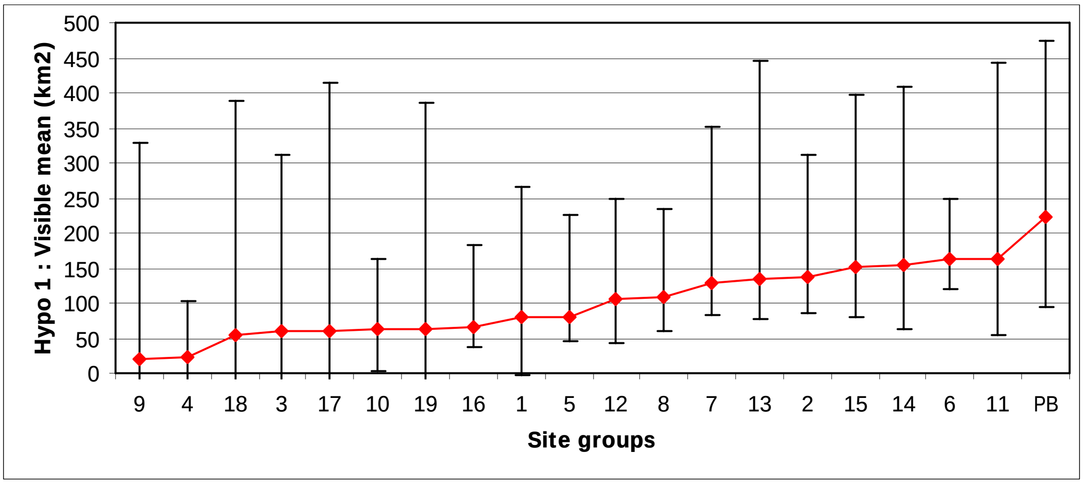


Figure 7.24: Ranking order of sets in Argyll by visible mean, showing PB sites with the largest value (Y-bars = minimum and maximum value in each set).

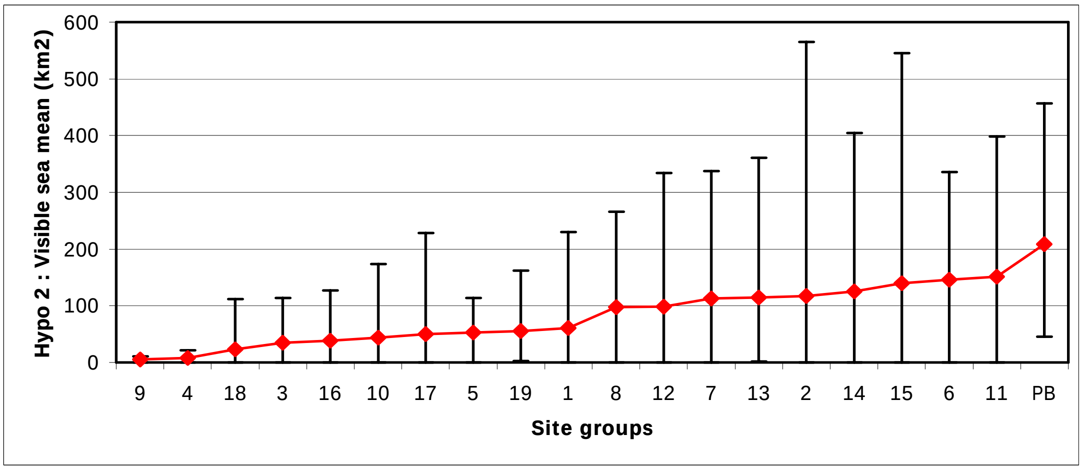


Figure 7.25: Ranking order of sets in Argyll by visible sea mean, showing PB sites with the largest value (Y-bars = minimum and maximum value in each set).

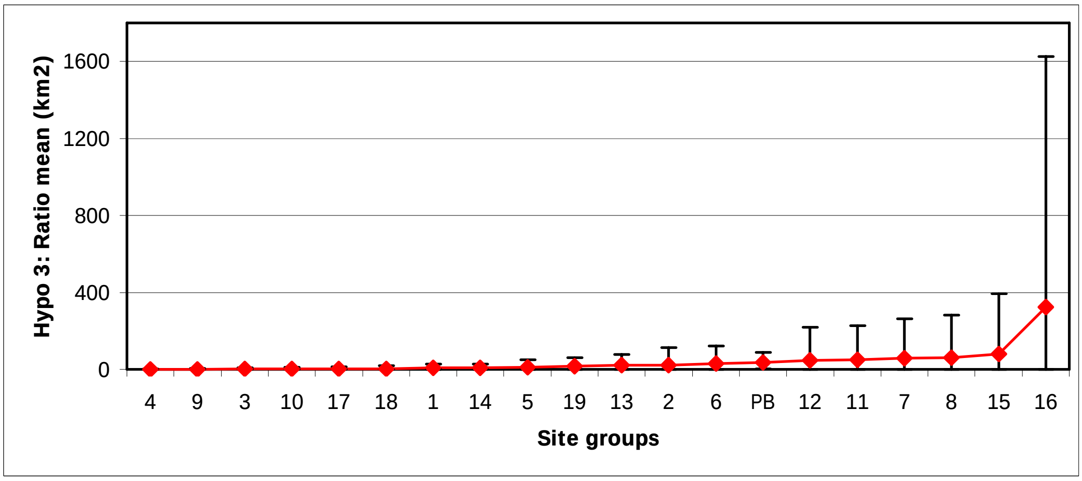


Figure 7.26: Ranking order of sets in Argyll by ratio mean of visible sea to visible land, showing PB sites with the largest value (Y-bars = minimum and maximum value in each set).

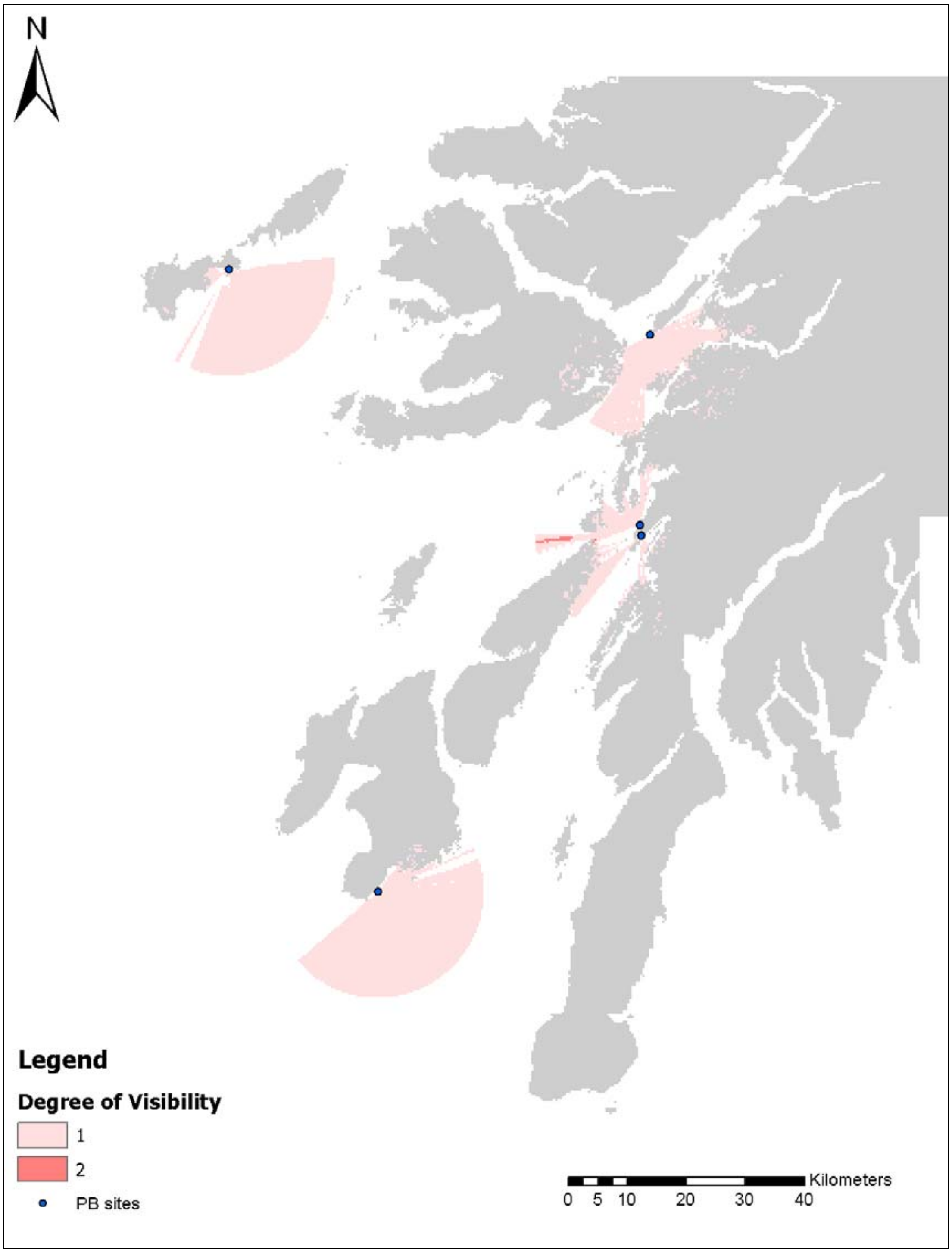


Figure 7.27: Cumulative viewshed from PB sites in Argyll (m=5), illustrating large viewsheds. Darker areas indicate the higher number of sites that are intervisible with that area.

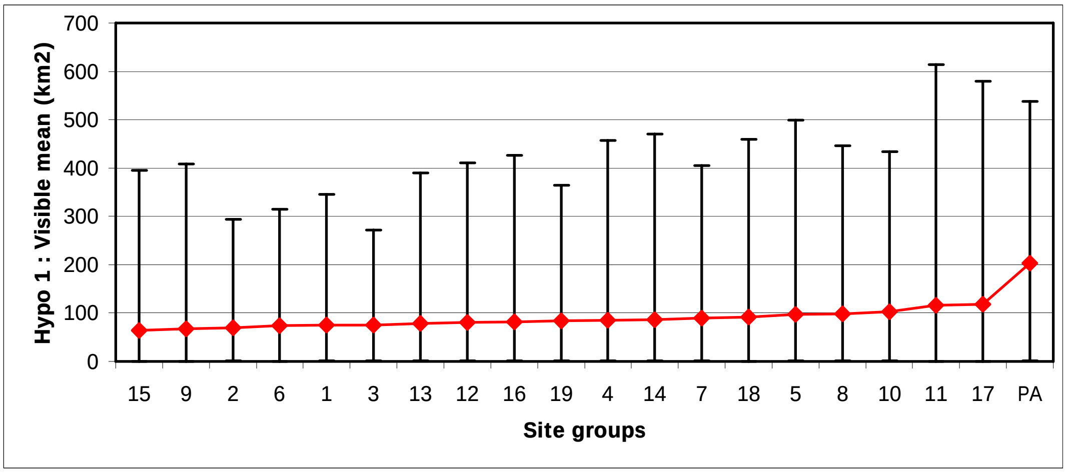


Figure 7.28: Ranking order of sets in Argyll by visible mean, showing PA sites with the largest value (Y-bars = minimum and maximum value in each set).

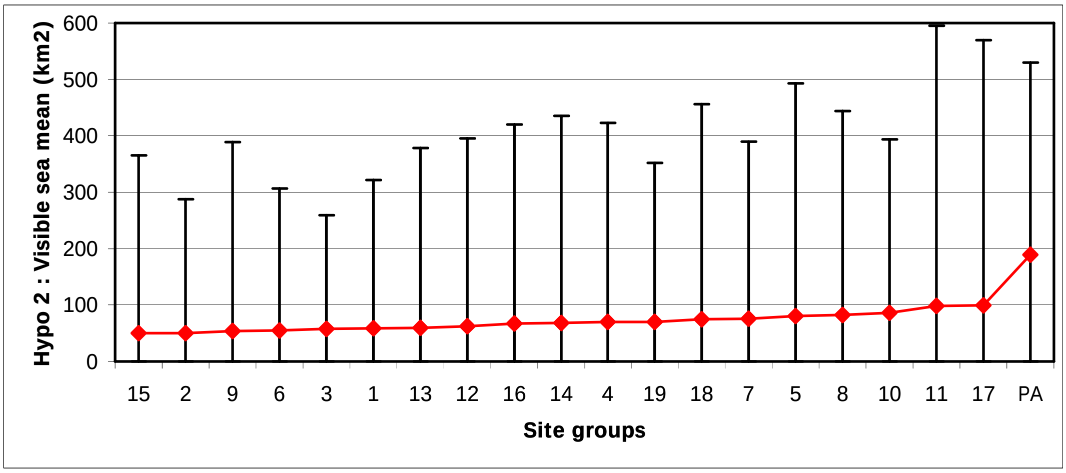


Figure 7.29: Ranking order of sets in Argyll by visible sea mean, showing PA sites with the largest value (Y-bars = minimum and maximum value in each set).

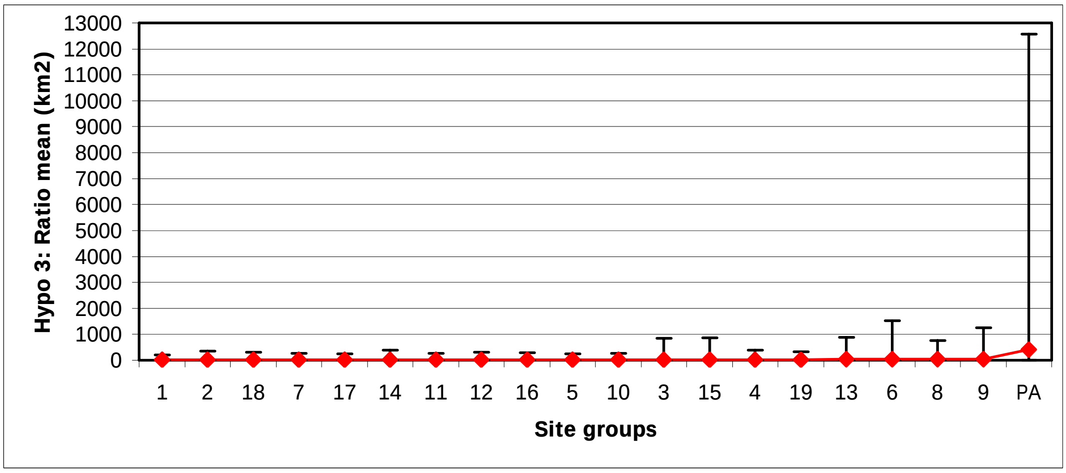


Figure 7.30: Ranking order of sets in Argyll by ratio mean of visible sea to visible land, showing PA sites with the largest value and an extreme maximum value (Y-bars = minimum and maximum value in each set).

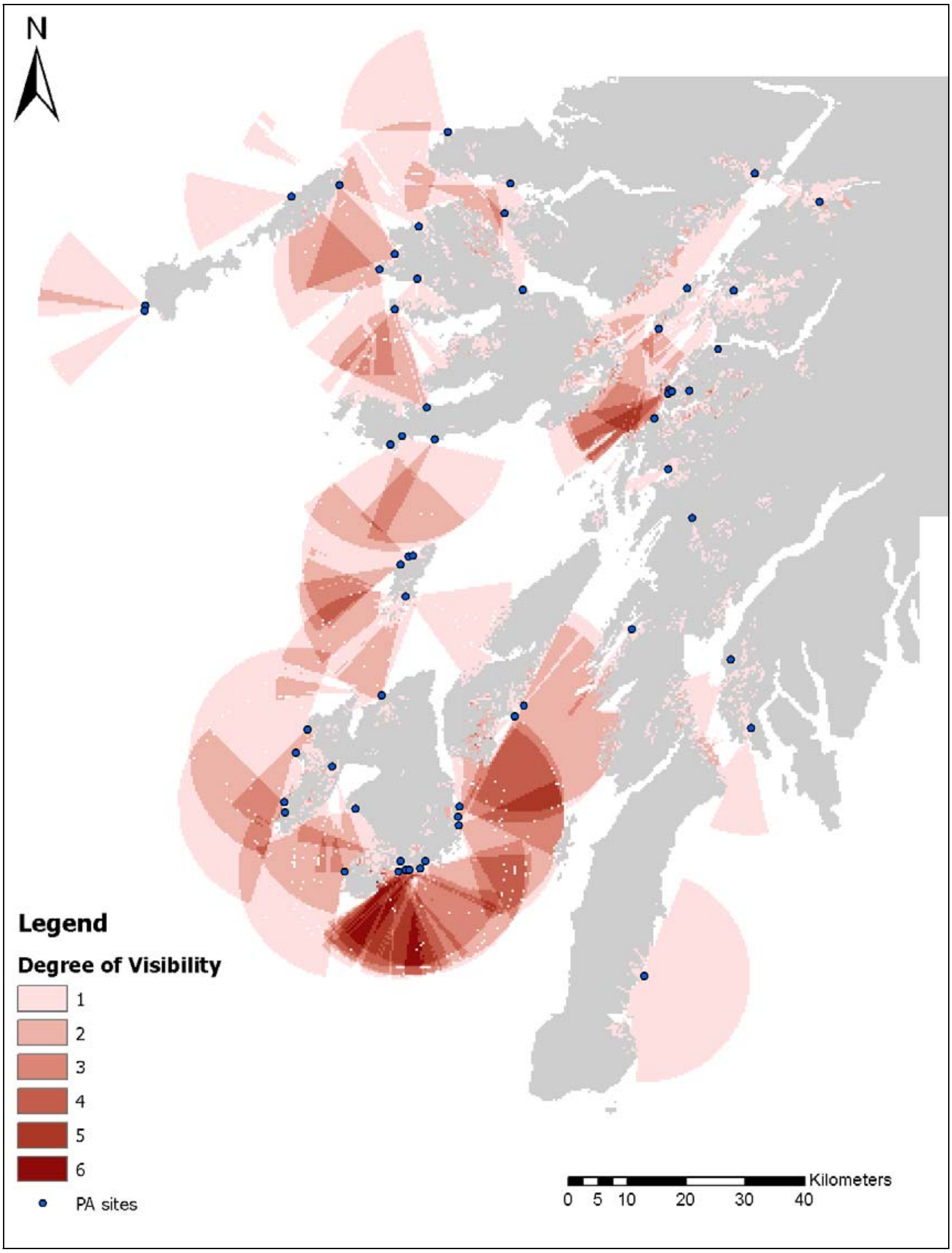


Figure 7.31: Cumulative viewshed from PA sites in Argyll (m=57), showing areas with the highest frequency of site visibility along the coastlines of the larger islands and the Firth of Lorn. Darker areas indicate the higher number of sites that are intervisible with that area.

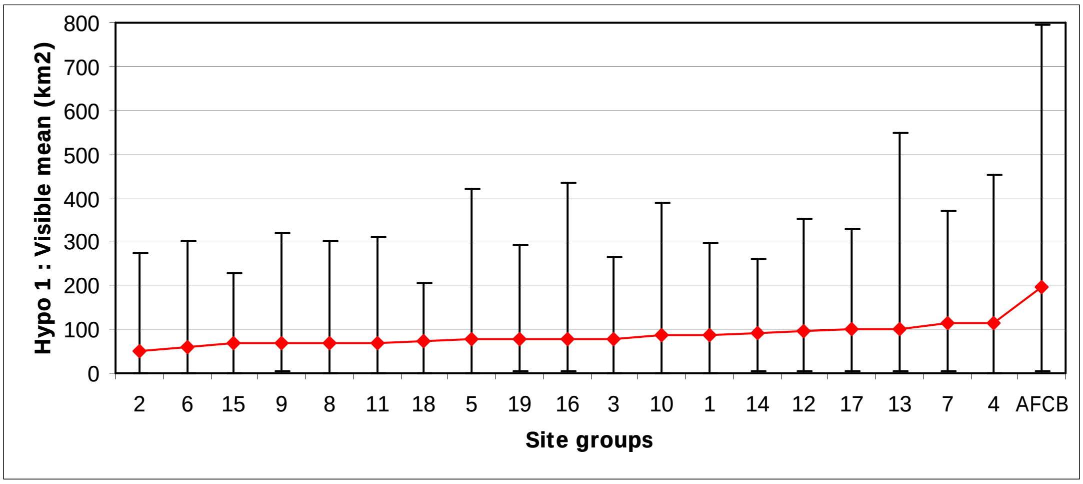


Figure 7.32: Ranking order of sets in Argyll by visible mean, showing AFCB sites with the largest value (Y-bars = minimum and maximum value in each set).

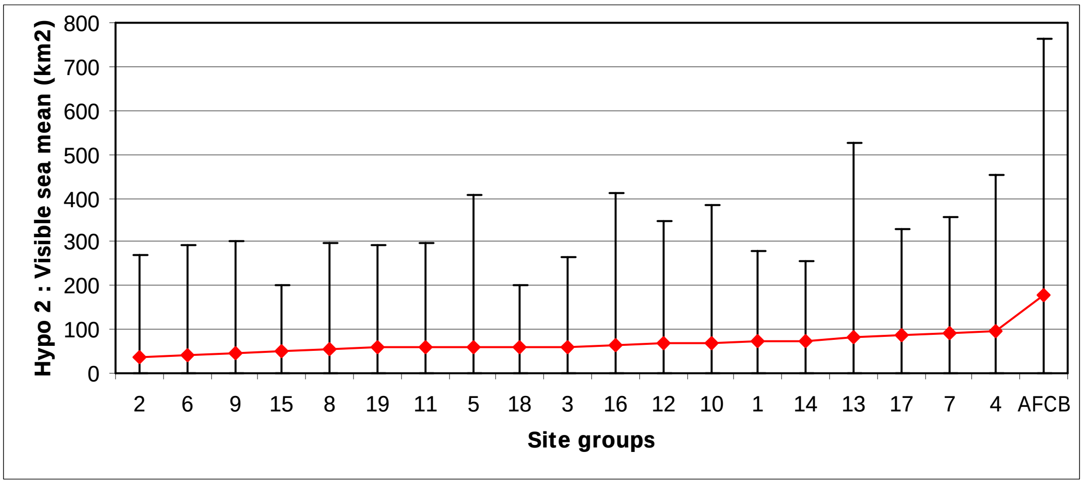


Figure 7.33: Ranking order of sets in Argyll by visible sea mean, showing AFCB sites with the largest value (Y-bars = minimum and maximum value in each set).

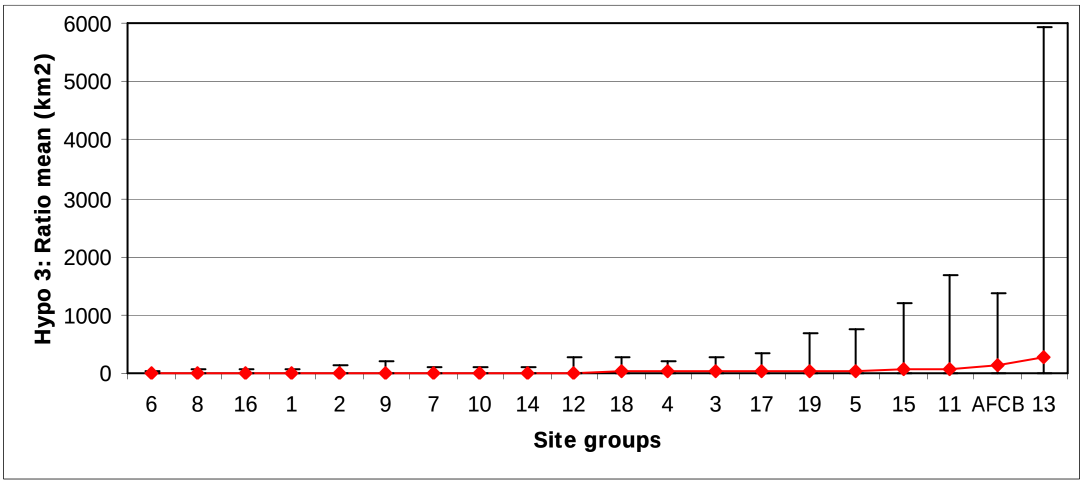


Figure 7.34: Ranking order of the ratio mean of visible sea and visible land of AFCB sites in Argyll (Y-bars = minimum and maximum value in each set).

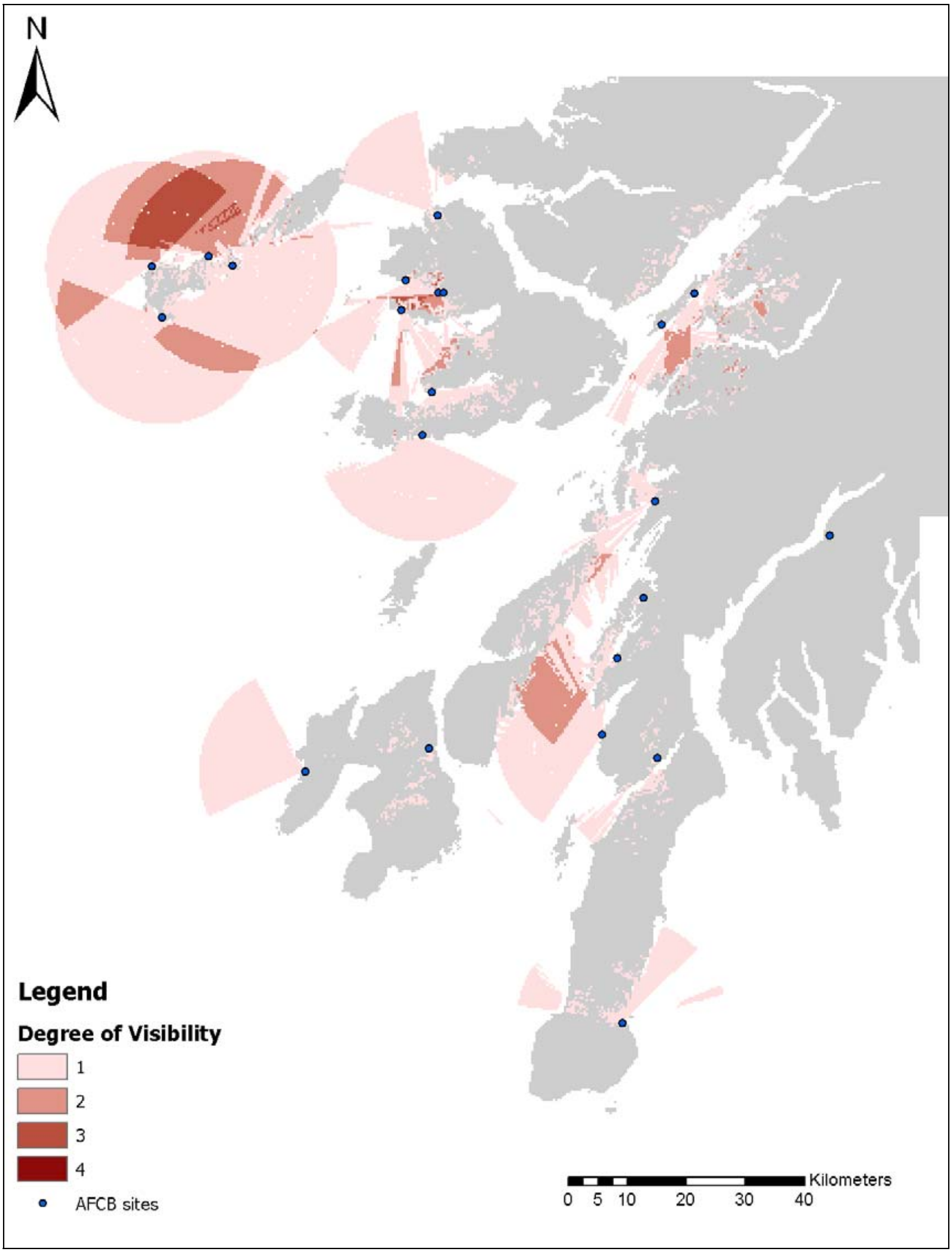


Figure 7.35: Cumulative viewshed from AFCB sites in Argyll (m=22), showing sites with the largest visibilities on Tiree. Darker areas indicate the higher number of sites that are intervisible with that area.

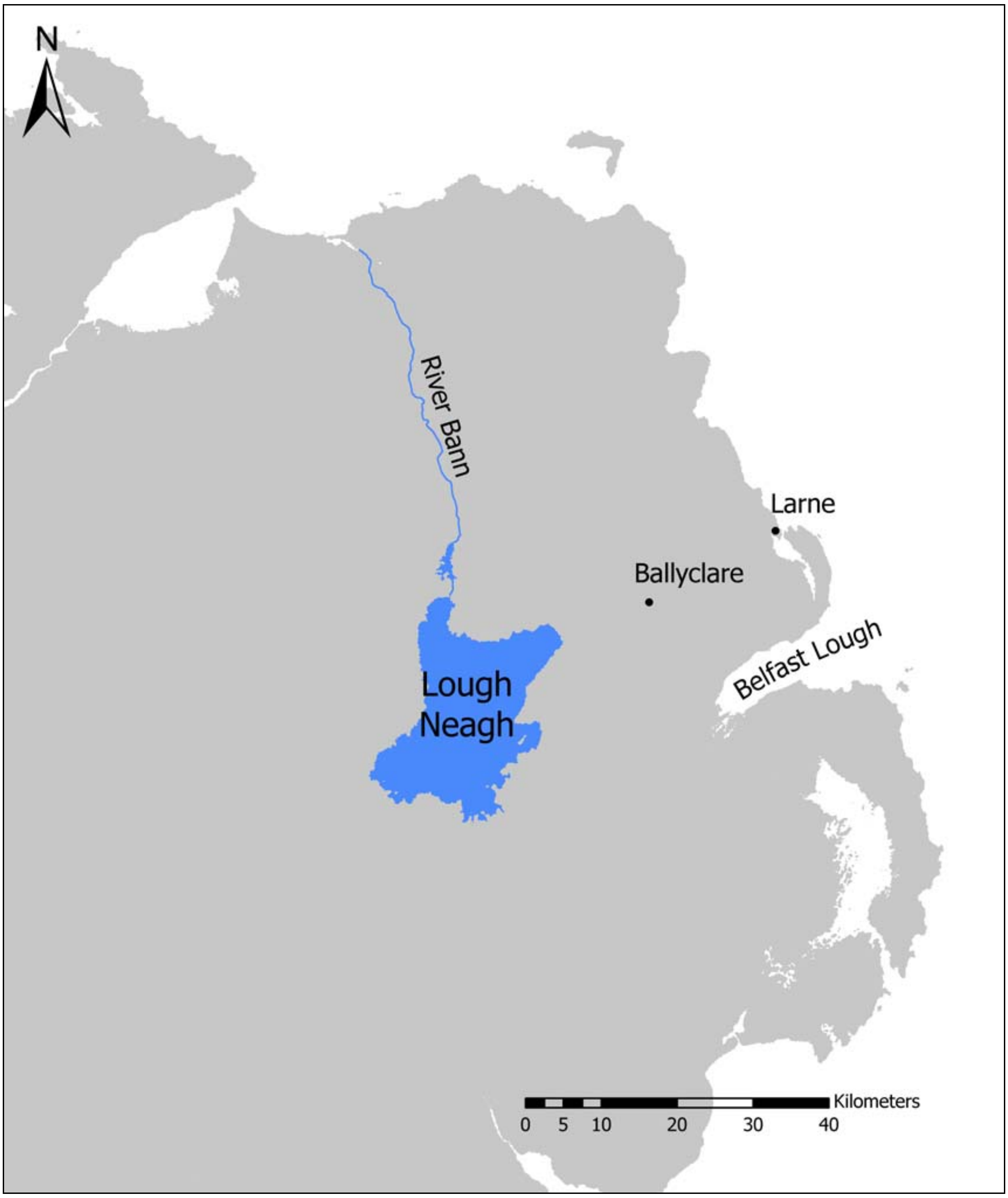


Figure 7.36: Map of Northern Ireland study area included in the viewshed analysis. Annotated areas are referred to in the text.

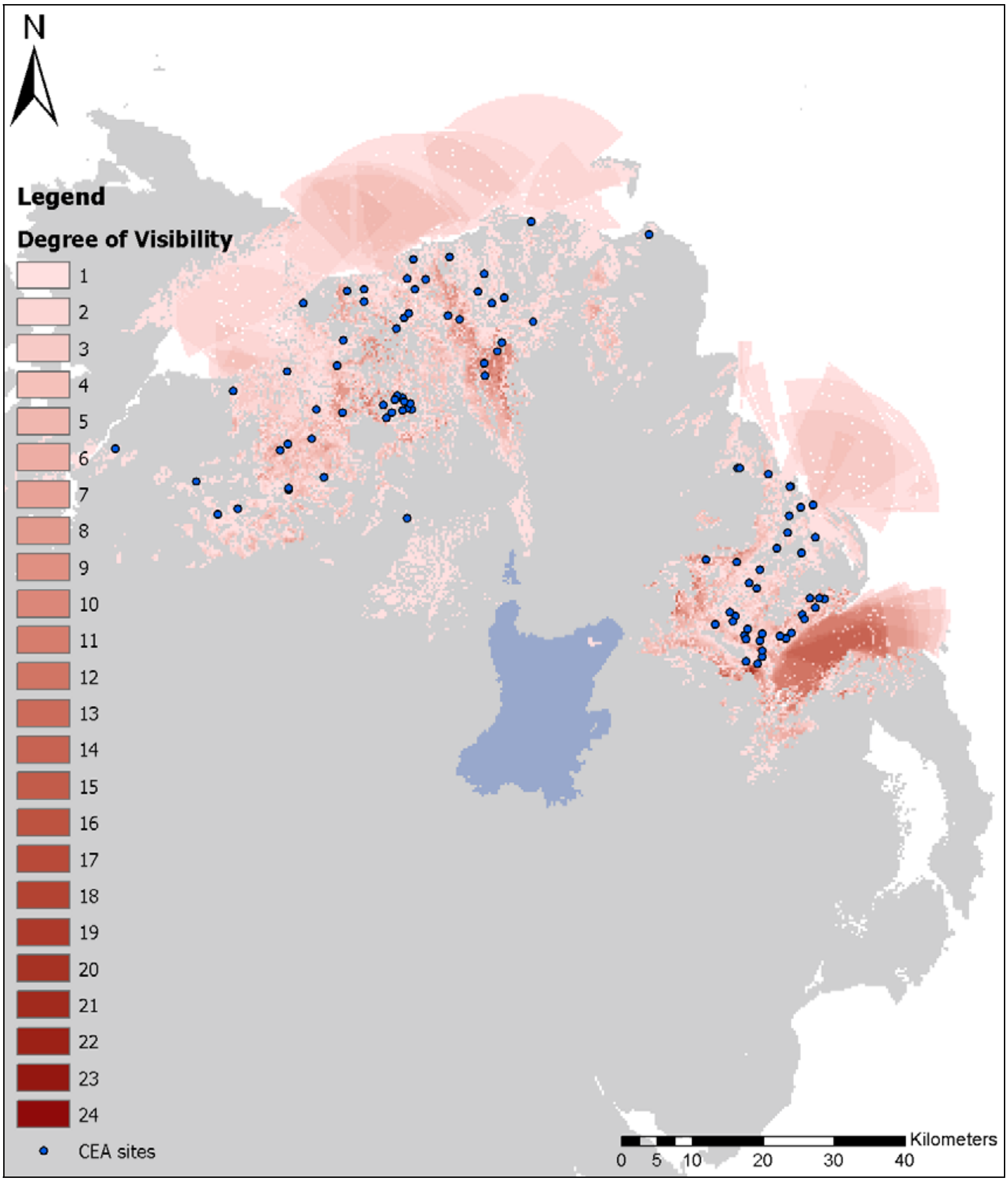


Figure 7.37: Cumulative viewshed from CEA sites along the northern coastline of Northern Ireland (m=4) showing areas with the highest frequency of site visibility occurring in slightly inland in the north and along Belfast Lough. Darker areas indicate the higher number of sites that are intervisible with that area.

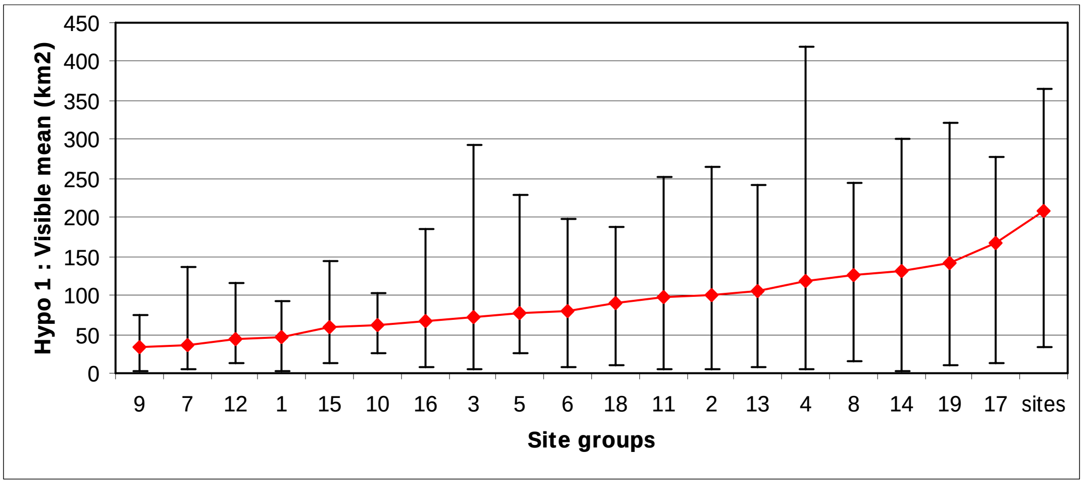


Figure 7.38: Ranking order of sets along the northern coastline of Northern Ireland by visible mean, showing all irregular sites with the largest value (Y-bars = minimum and maximum value in each set).

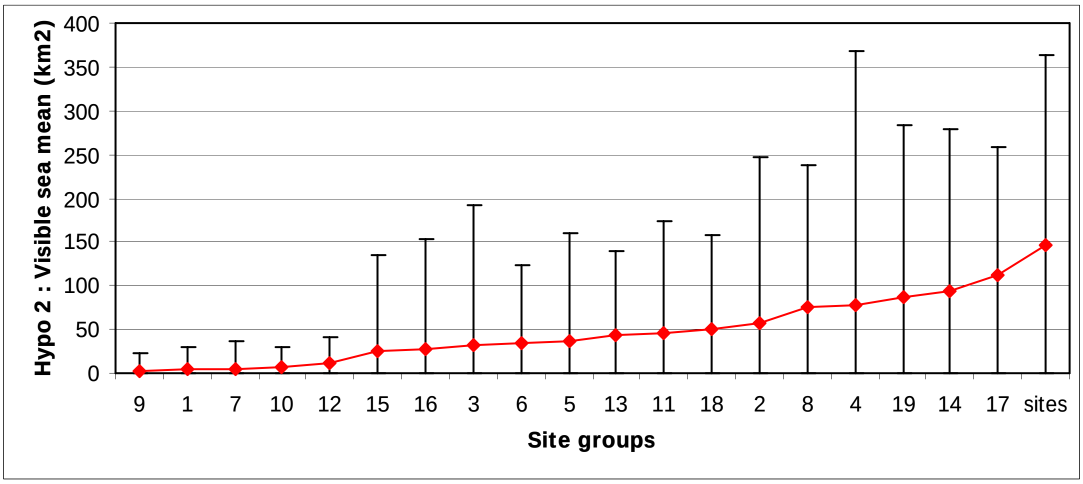


Figure 7.39: Ranking order of sets along the northern coastline of Northern Ireland by visible sea mean, showing all irregular sites with the largest value (Y-bars = minimum and maximum value in each set).

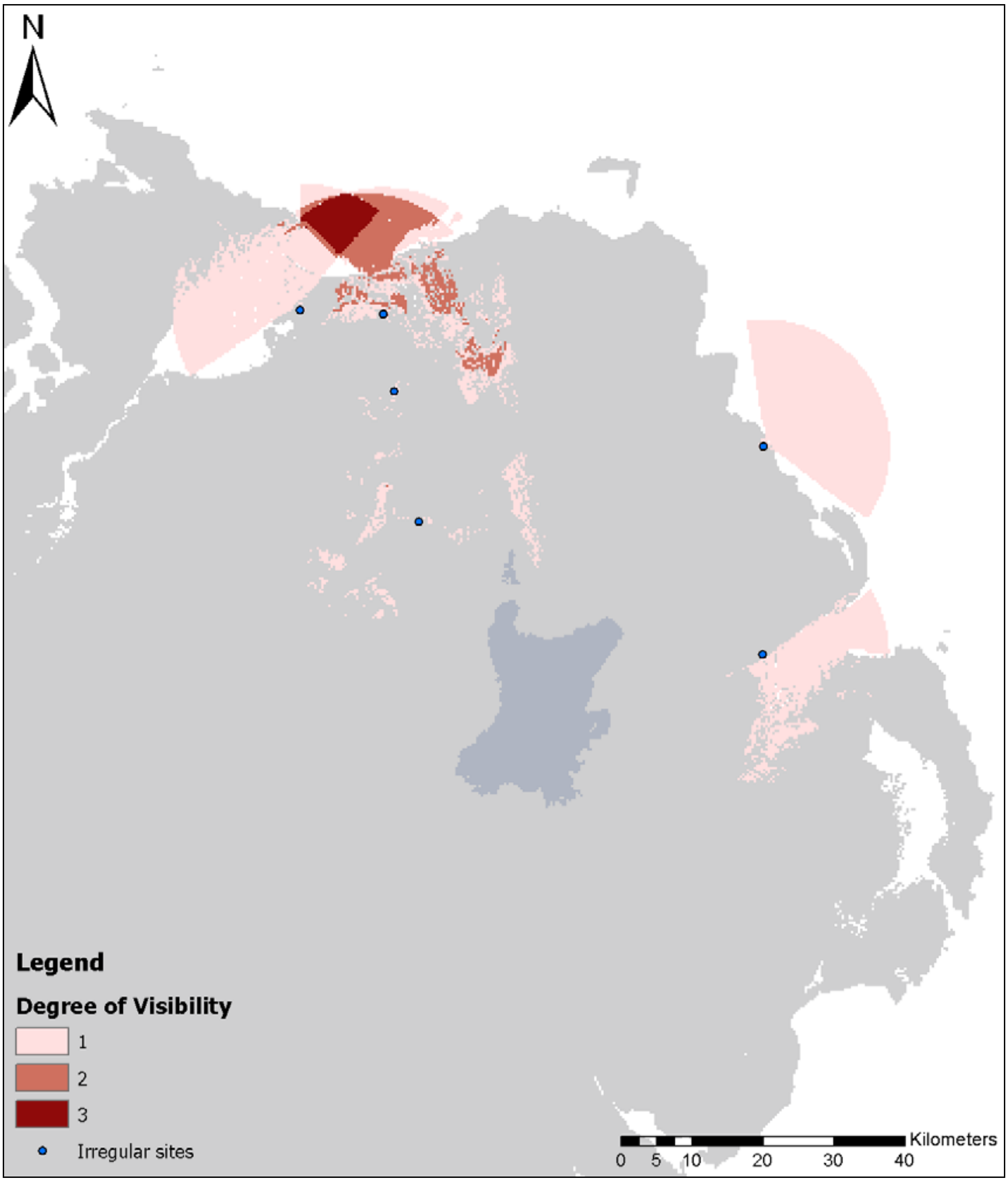


Figure 7.40: Cumulative viewshed from all irregular sites along the northern coastline of Northern Ireland (m=5). Darker areas indicate the higher number of sites that are intervisible with that area.

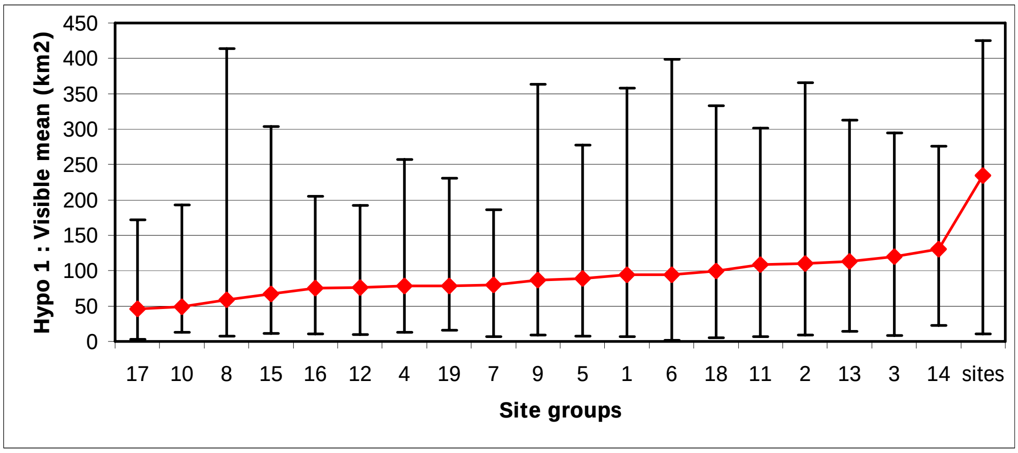


Figure 7.41: Ranking order of sets along the northern coastline of Northern Ireland by visible mean, showing all promontory sites with the largest value (Y-bars = minimum and maximum value in each set).

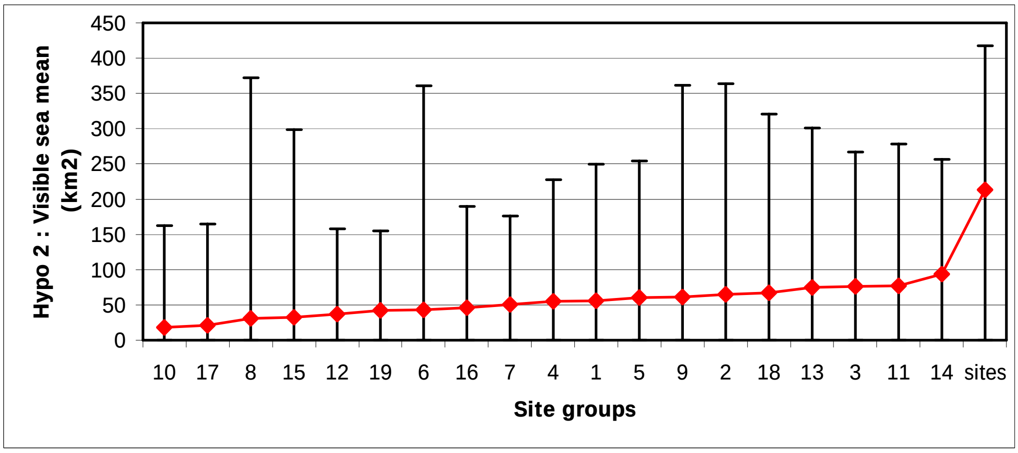


Figure 7.42: Ranking order of sets along the northern coastline of Northern Ireland by sea mean, showing all promontory sites with the largest value (Y-bars = minimum and maximum value in each set).

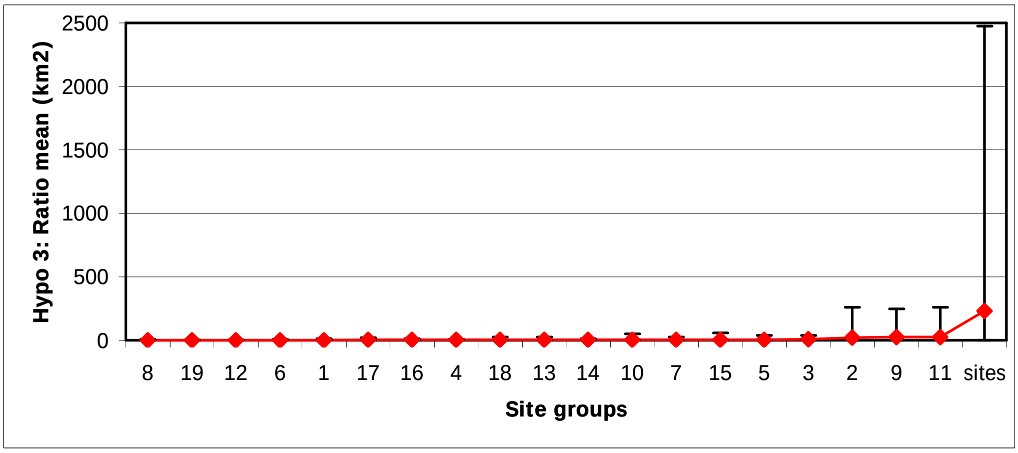


Figure 7.43: Ranking order of sets along the northern coastline of Northern Ireland by ratio mean of visible sea to visible land, showing all promontory sites with the largest value (Y-bars = minimum and maximum value in each set).

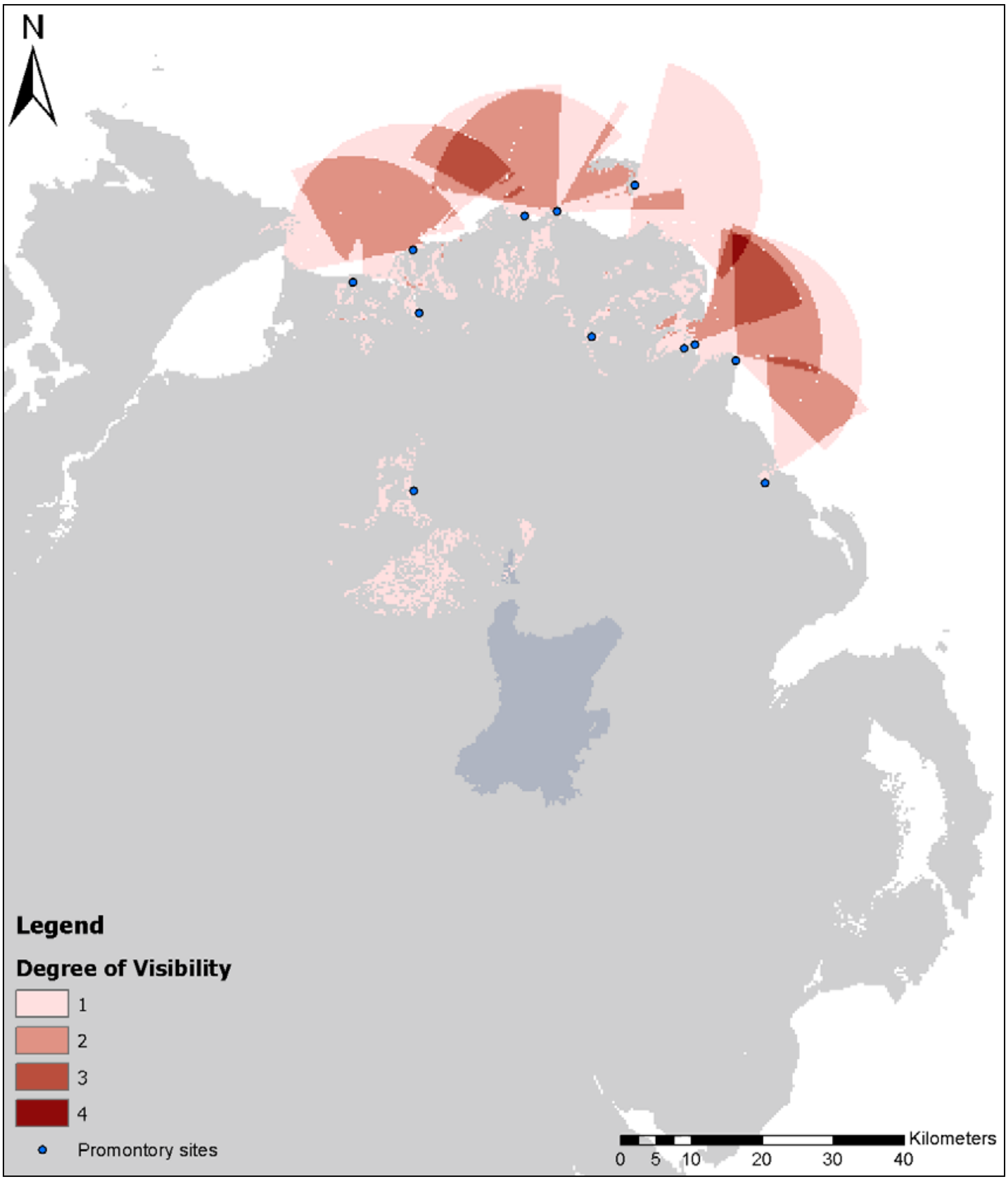


Figure 7.44: Cumulative viewshed from all promontory sites along the northern coastline of Northern Ireland (m=12), illustrating visibility coverage of the northern and north-western coastline. Darker areas indicate the higher number of sites that are intervisible with that area.

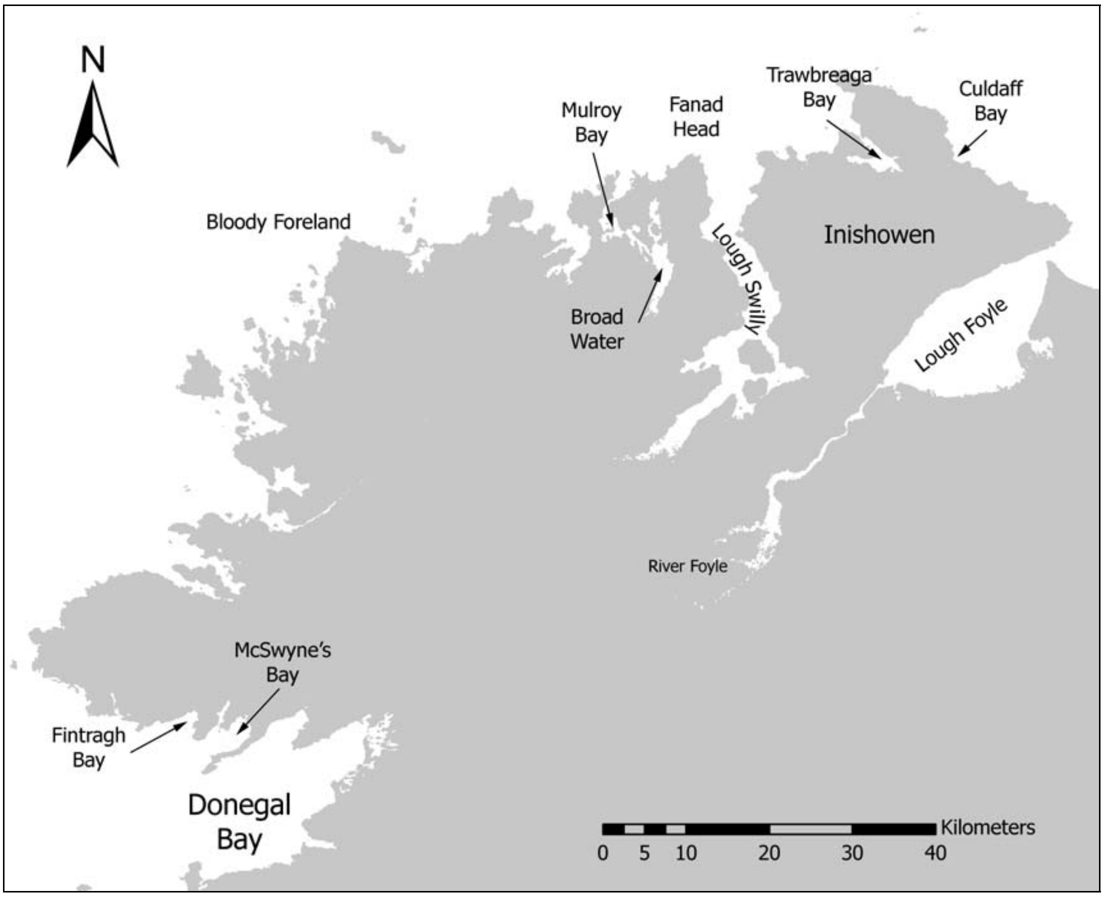


Figure 7.45: Map of Co. Donegal study area. Annotated areas are referred to in the text.

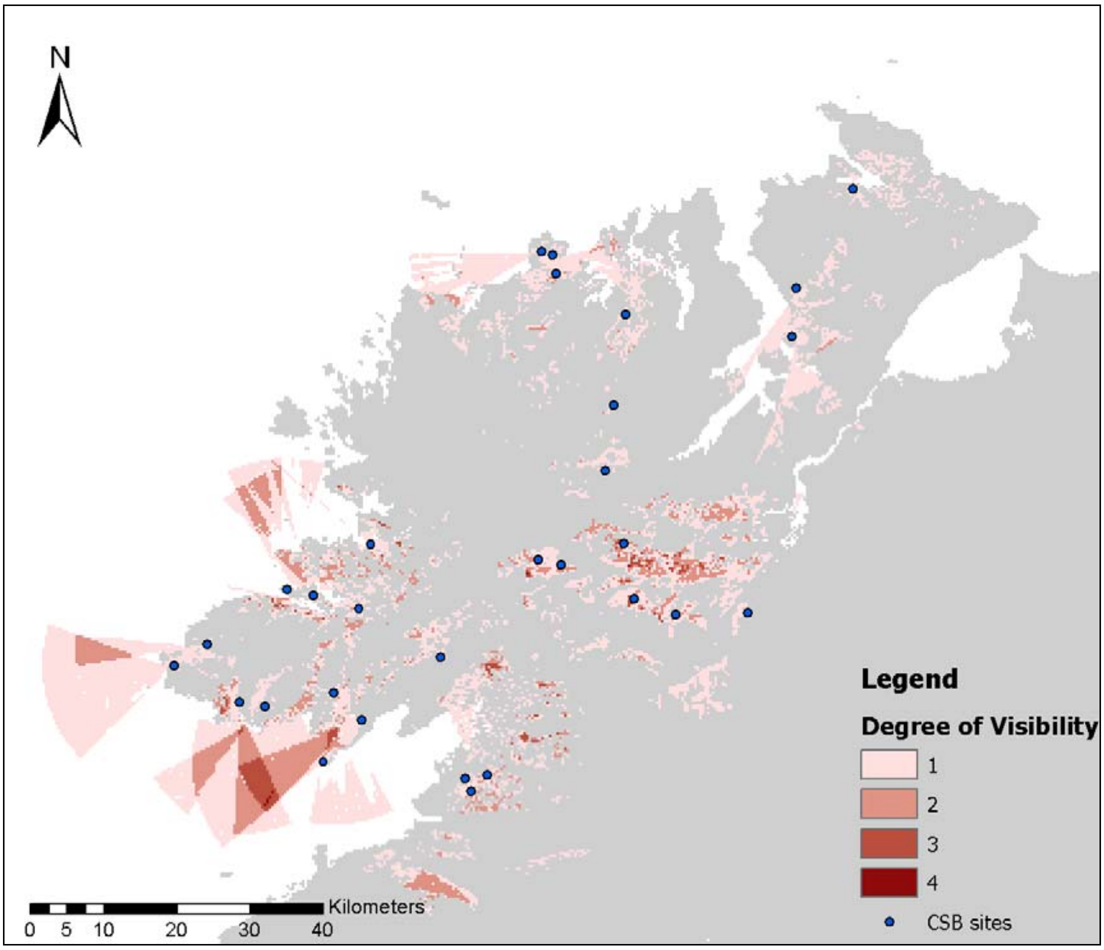


Figure 7.46: Cumulative viewshed from CSB sites in Co. Donegal (m=30), illustrating overlapping viewsheds throughout the study area. Darker areas indicate the higher number of sites that are intervisible with that area.

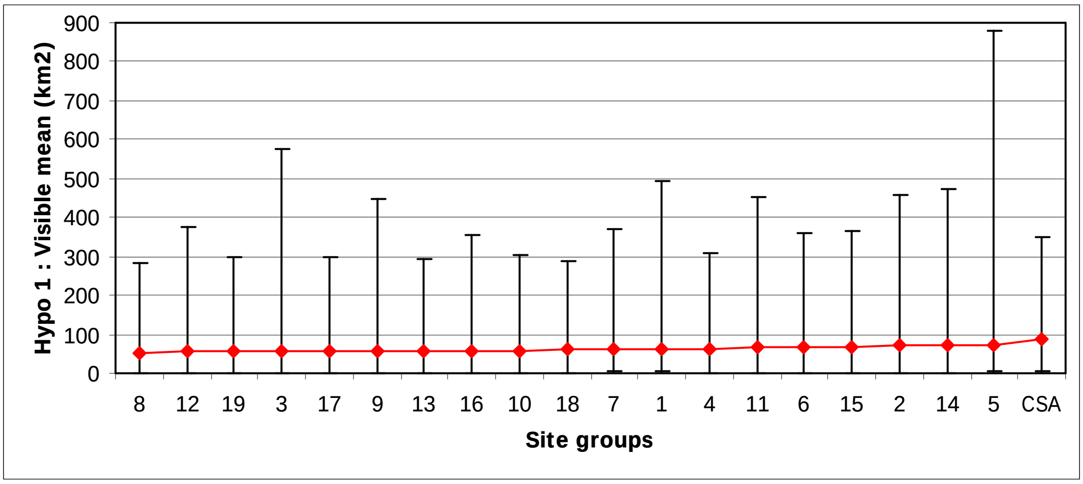


Figure 7.47: Ranking order of sets in Co. Donegal by visible mean, showing CSA sites with the largest value (Y-bars = minimum and maximum value in each set).

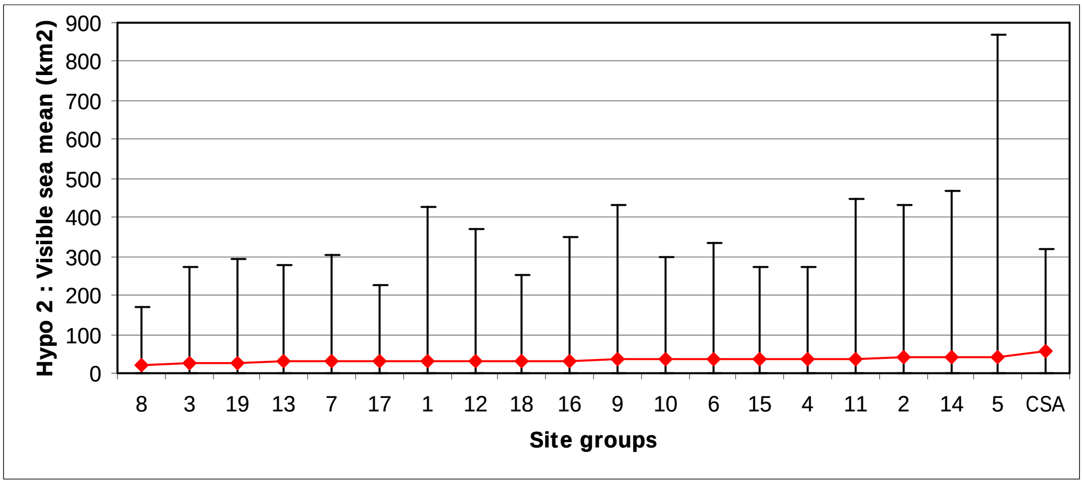


Figure 7.48: Ranking order of sets in Co. Donegal by visible sea mean, showing CSA sites with the largest value (Y-bars = minimum and maximum value in each set).

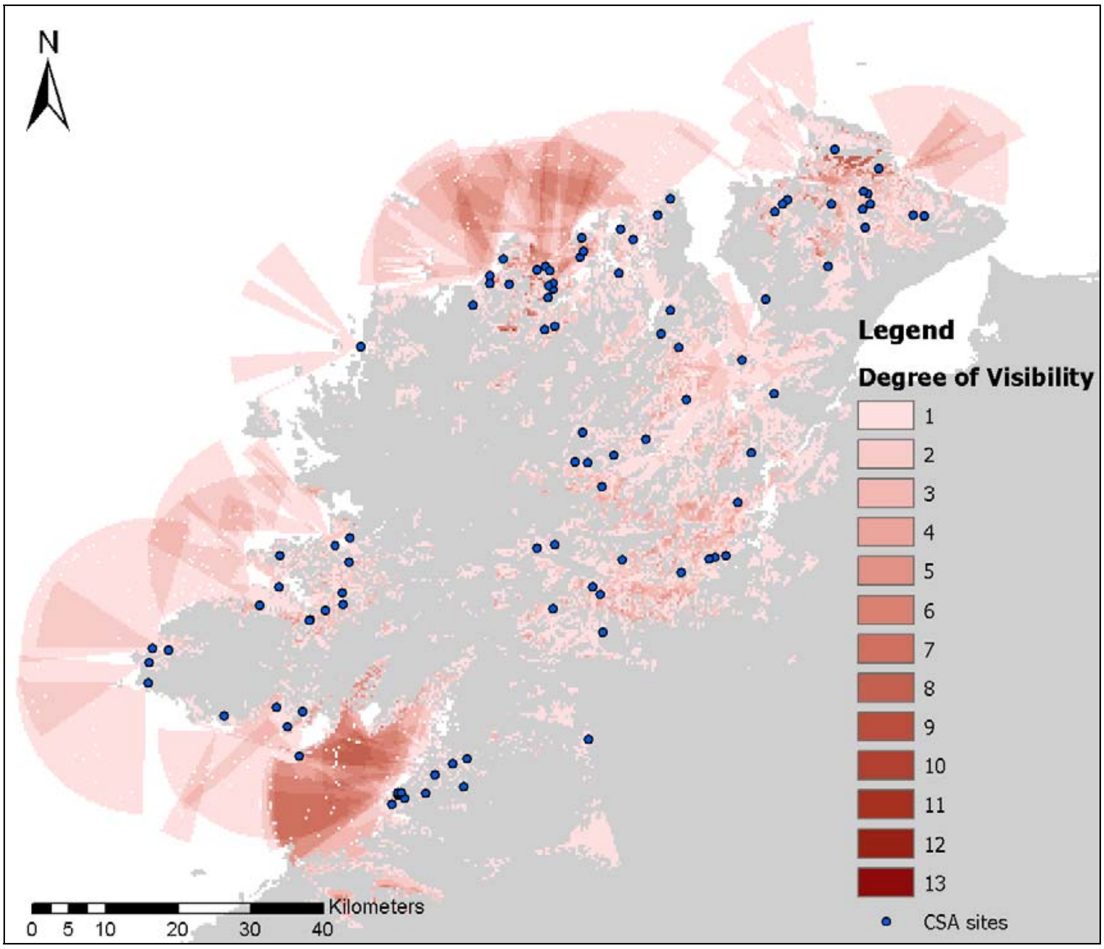


Figure 7.49: Cumulative viewshed from CSA sites in Co. Donegal (n=95), showing areas with the highest frequency of site visibility along the north coast and Donegal Bay. Darker areas indicate the higher number of sites that are intervisible with that area.

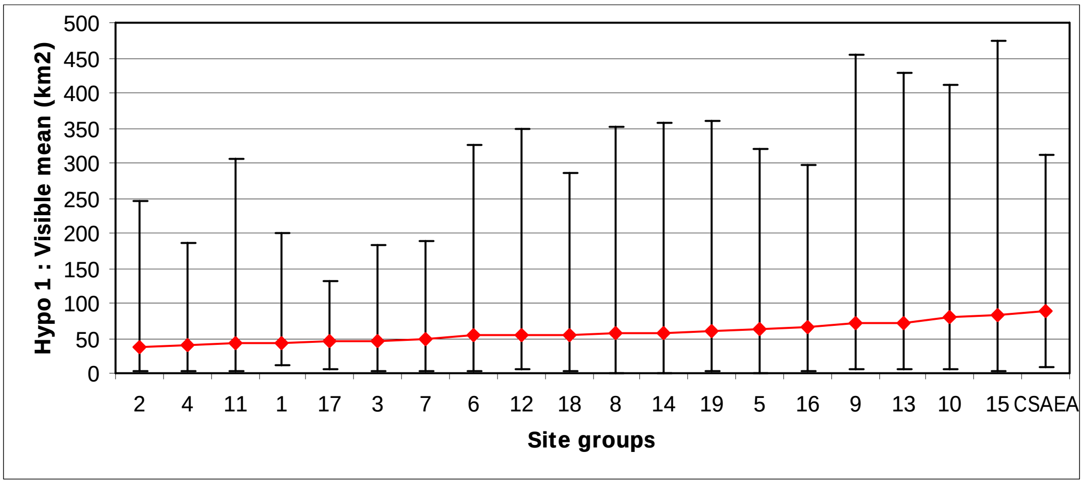


Figure 7.50: Ranking order of sets in Co. Donegal by visible mean, showing CSAEA sites with the largest value (Y-bars = minimum and maximum value in each set).

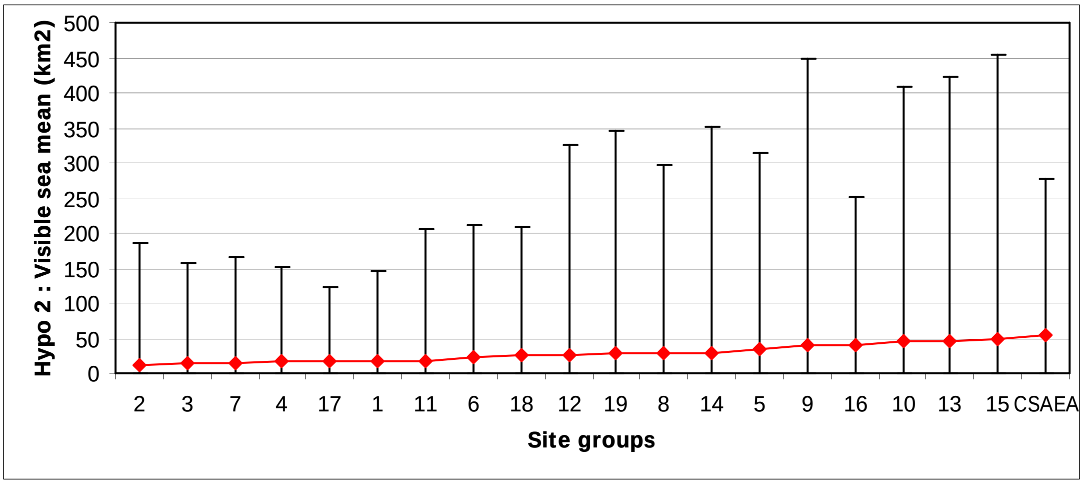


Figure 7.51: Ranking order of sets in Co. Donegal by visible sea mean, showing CSAEA sites with the largest value (Y-bars = minimum and maximum value in each set).

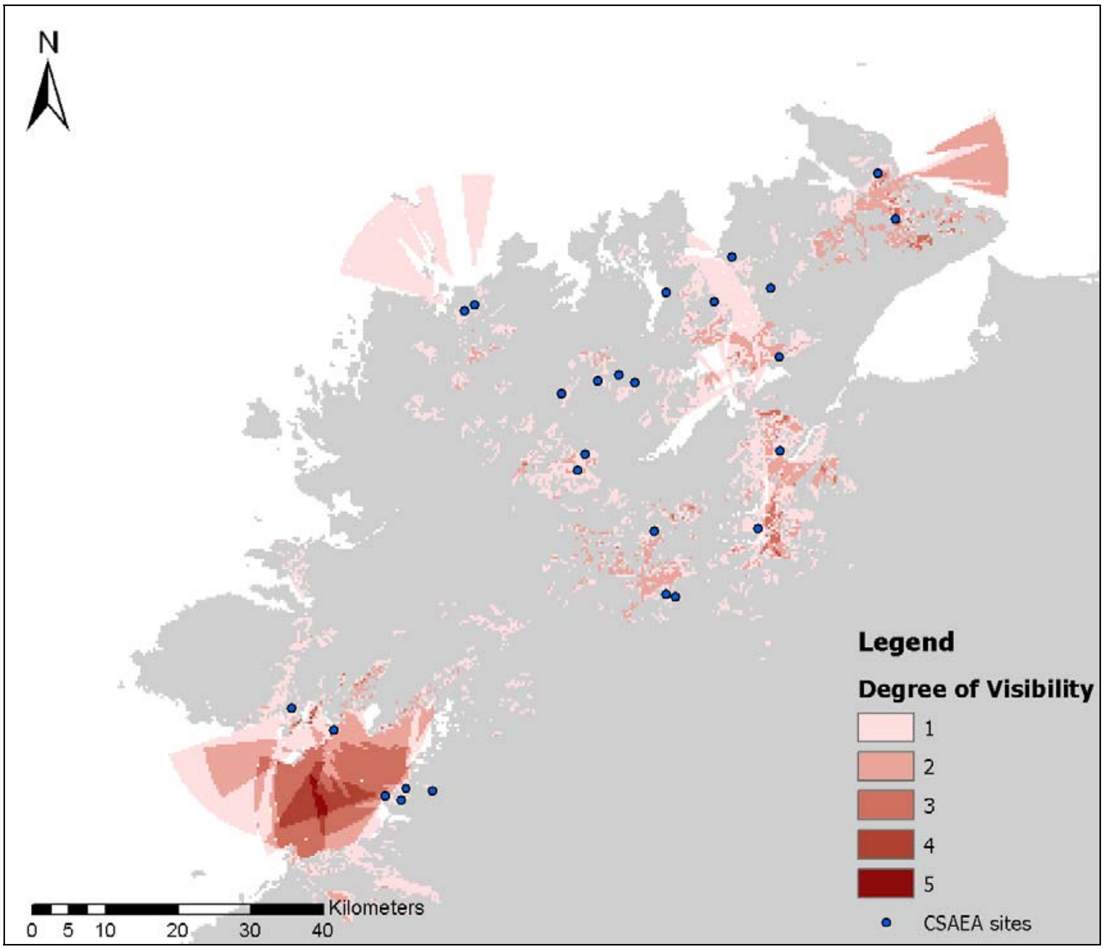


Figure 7.52: Cumulative viewshed from CSAEA sites in Co. Donegal (m=26), showing areas with the highest frequency of site visibility in Donegal Bay. Darker areas indicate the higher number of sites that are intervisible with that area.

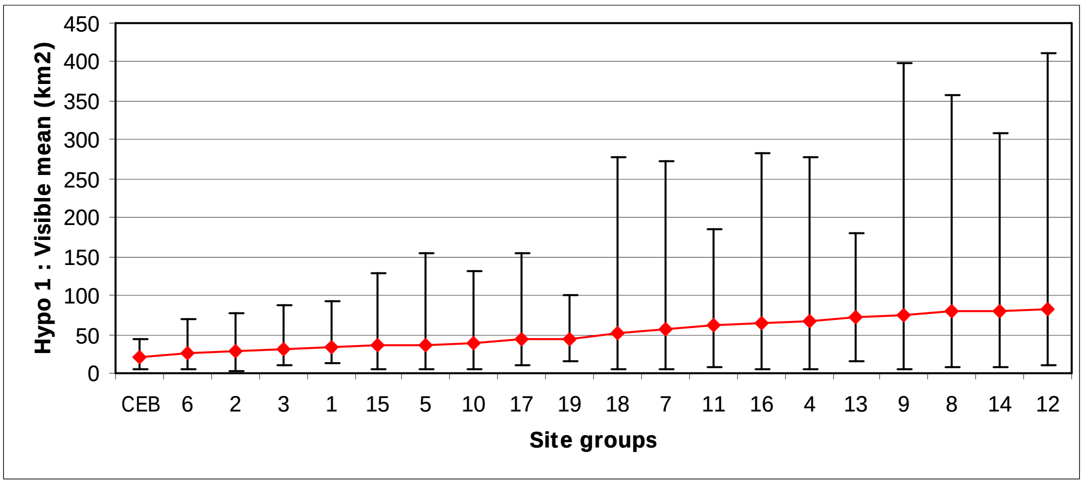


Figure 7.53: Ranking order of sets in Co. Donegal by visible mean, showing CEB sites with the smallest value (Y-bars = minimum and maximum value in each set).

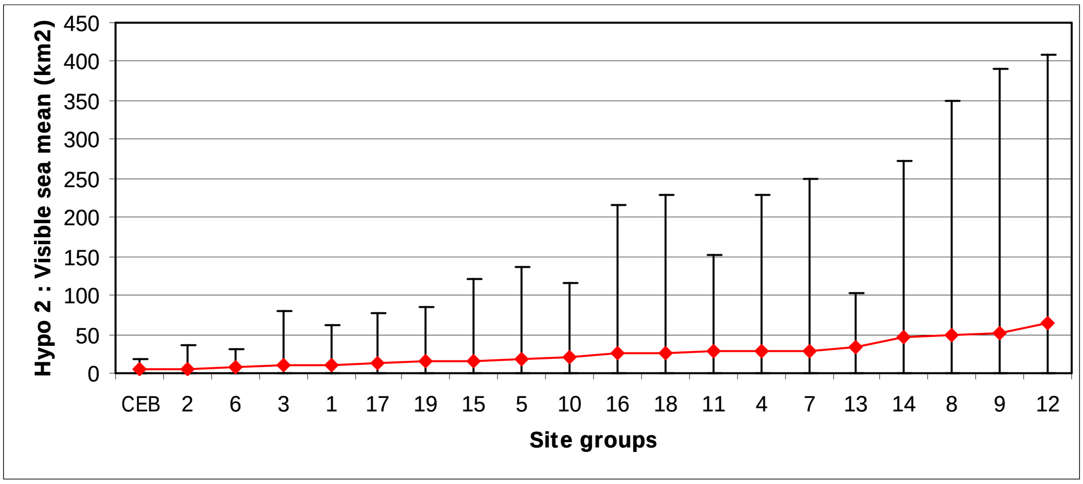


Figure 7.54: Ranking order of sets in Co. Donegal by visible sea mean, showing CEB sites with the smallest value (Y-bars = minimum and maximum value in each set).

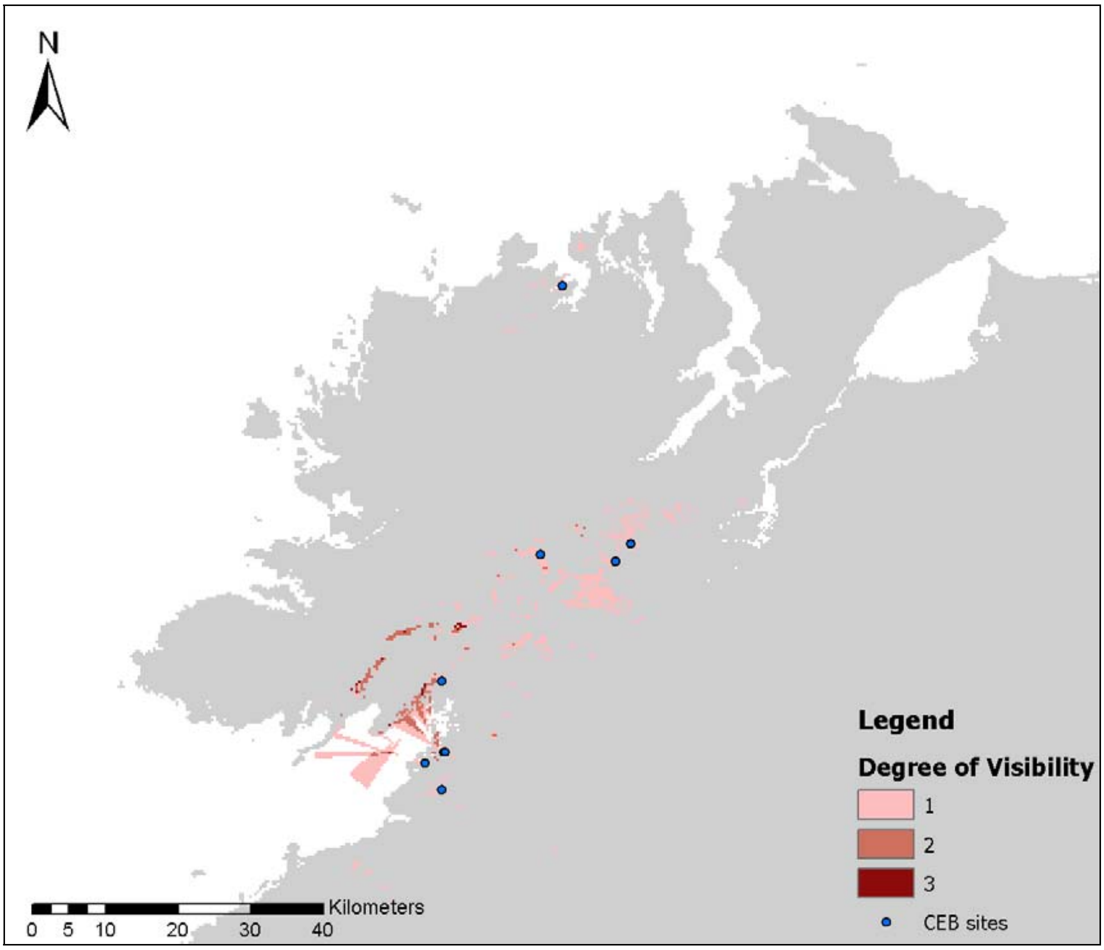


Figure 7.56: Cumulative viewshed from CEB sites in Co. Donegal (m=9). Darker areas indicate the higher number of sites that are intervisible with that area.

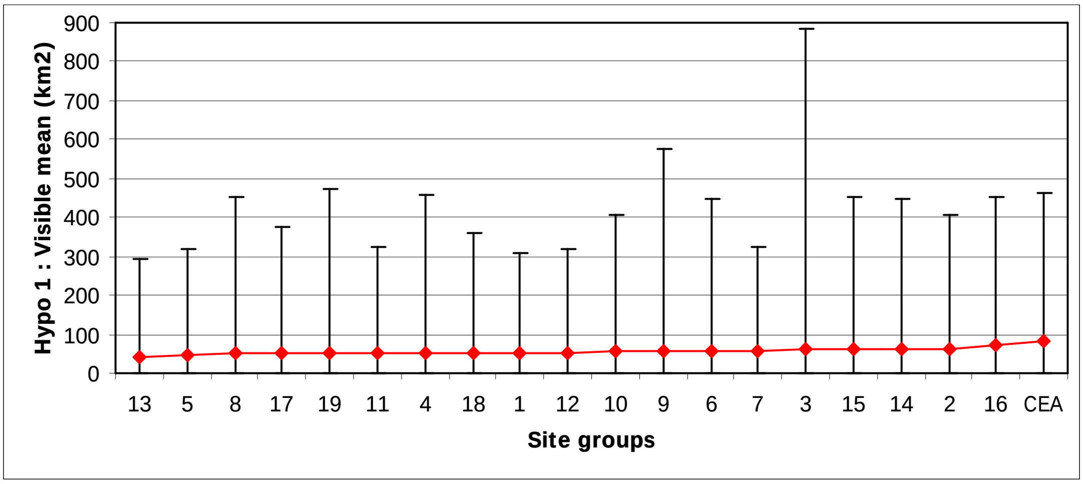


Figure 7.57: Ranking order of sets in Co. Donegal by visible sea mean, showing CEA sites with the largest value (Y-bars = minimum and maximum value in each set).

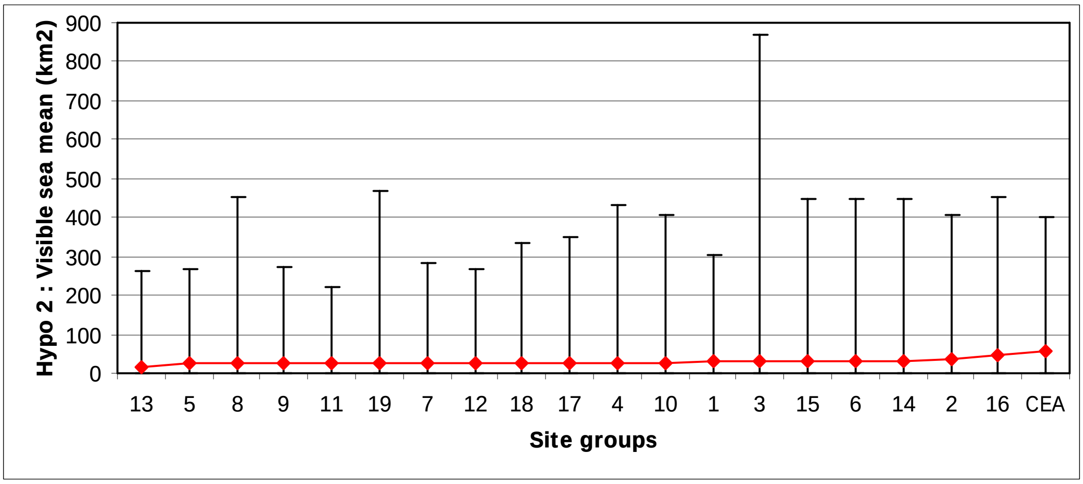


Figure 7.58: Ranking order of sets in Co. Donegal by visible sea mean, showing CEA sites with the largest value (Y-bars = minimum and maximum value in each set).

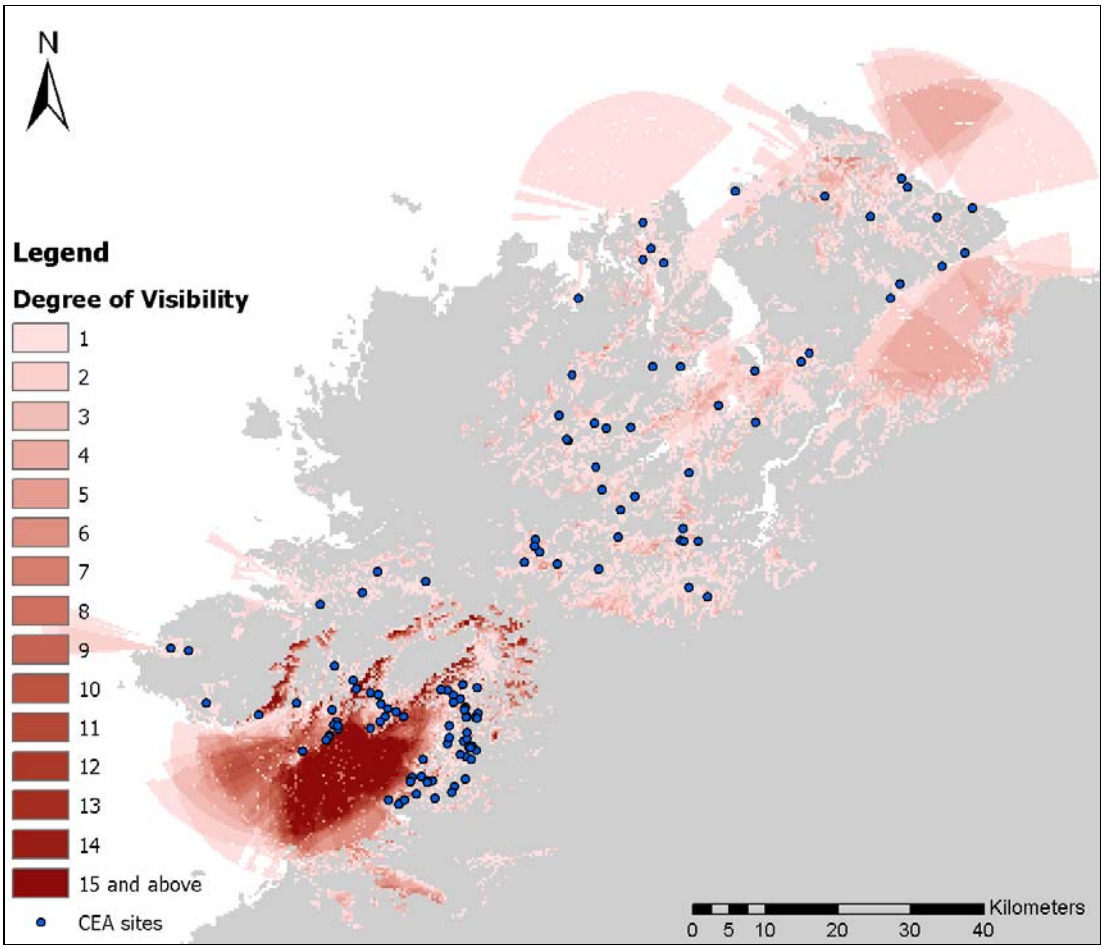


Figure 7.59: Cumulative viewshed from CEA sites in Co. Donegal (m=122), showing areas with the highest frequency of site visibility in Donegal Bay. Darker areas indicate the higher number of sites that are intervisible with that area.

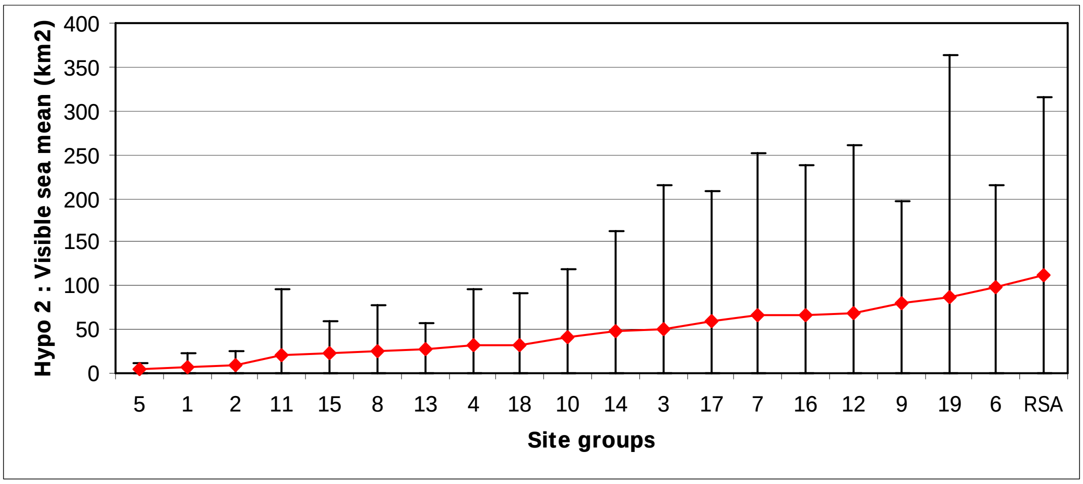


Figure 7.60: Ranking order of sets in Co. Donegal by visible sea mean, showing RSA sites with the largest value (Y-bars = minimum and maximum value in each set).

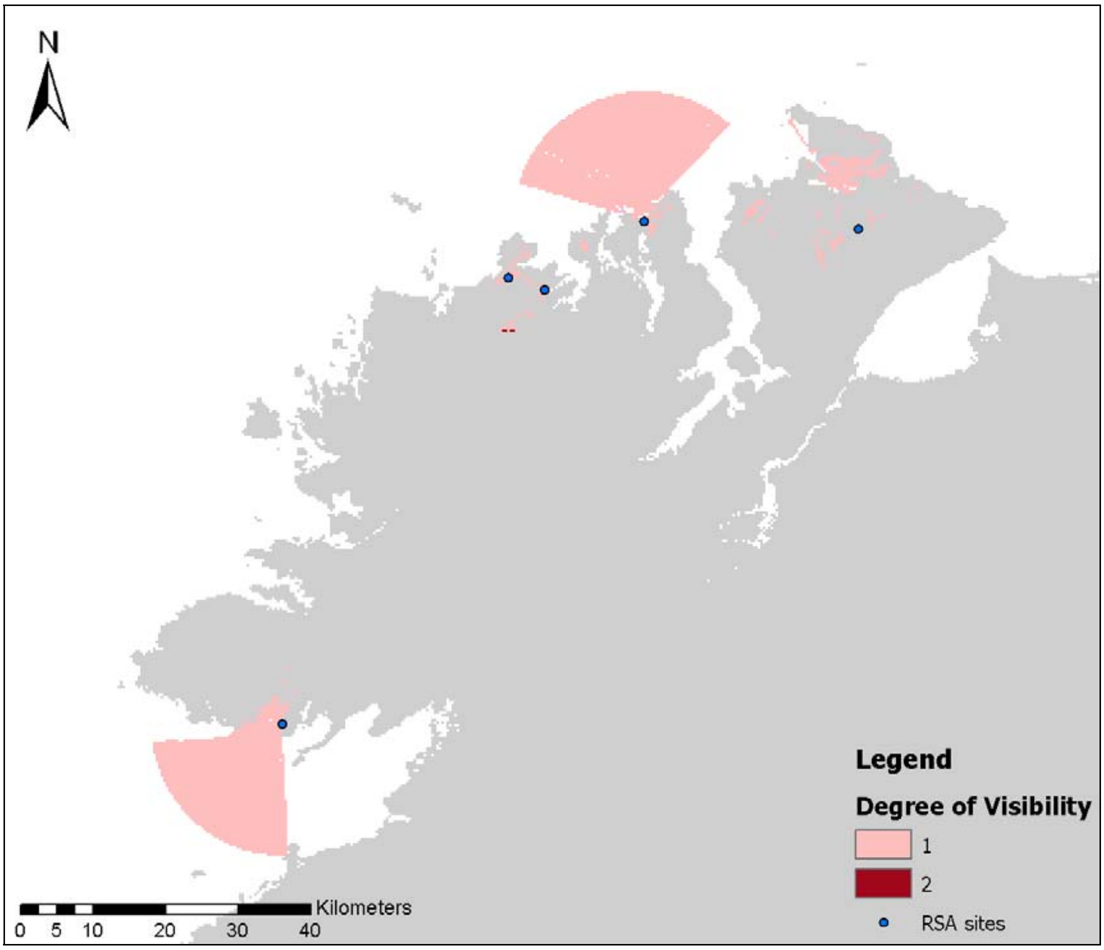


Figure 7.61: Cumulative viewshed from RSA sites in Co. Donegal (n=5). Darker areas indicate the higher number of sites that are intervisible with that area.

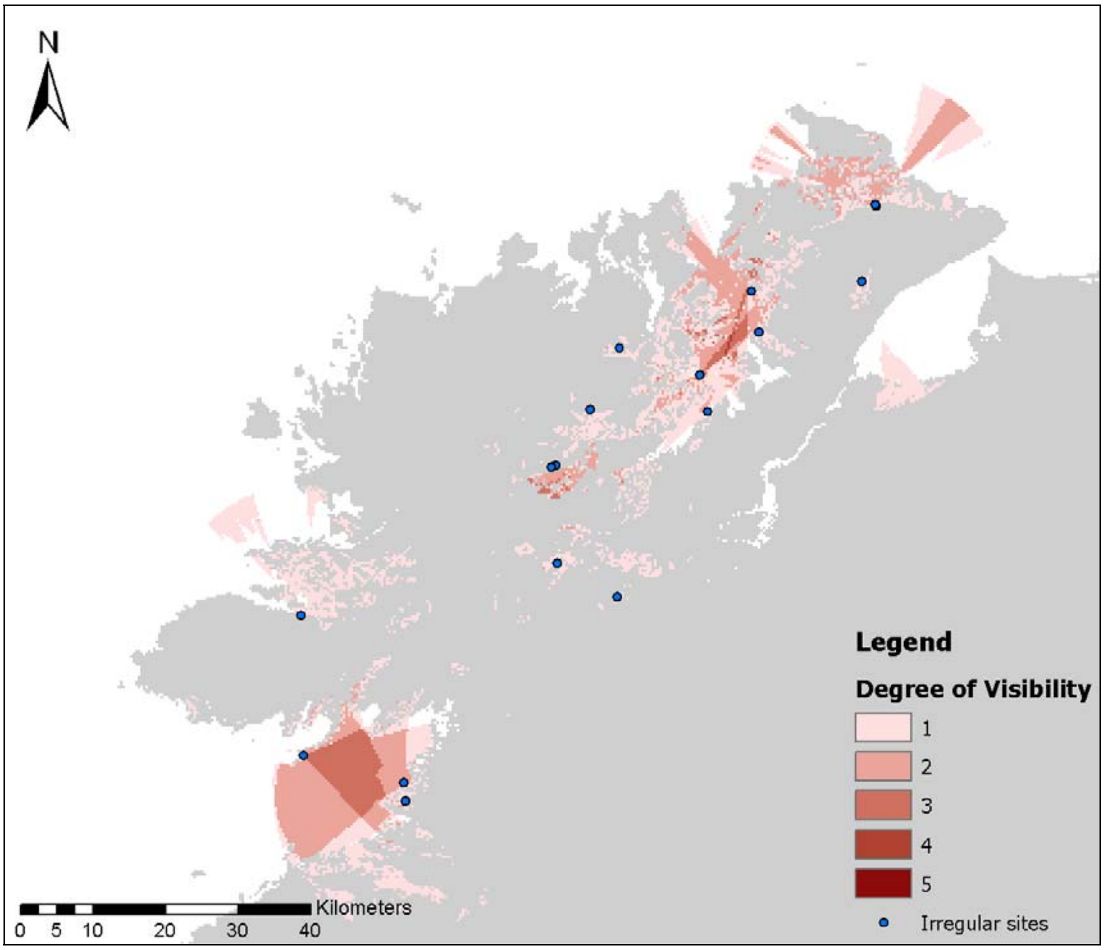


Figure 7.62: Cumulative viewshed from all irregular sites in Co. Donegal (m=17), showing areas with the highest frequency of site visibility in Donegal Bay and along Lough Swilly. Darker areas indicate the higher number of sites that are intervisible with that area.

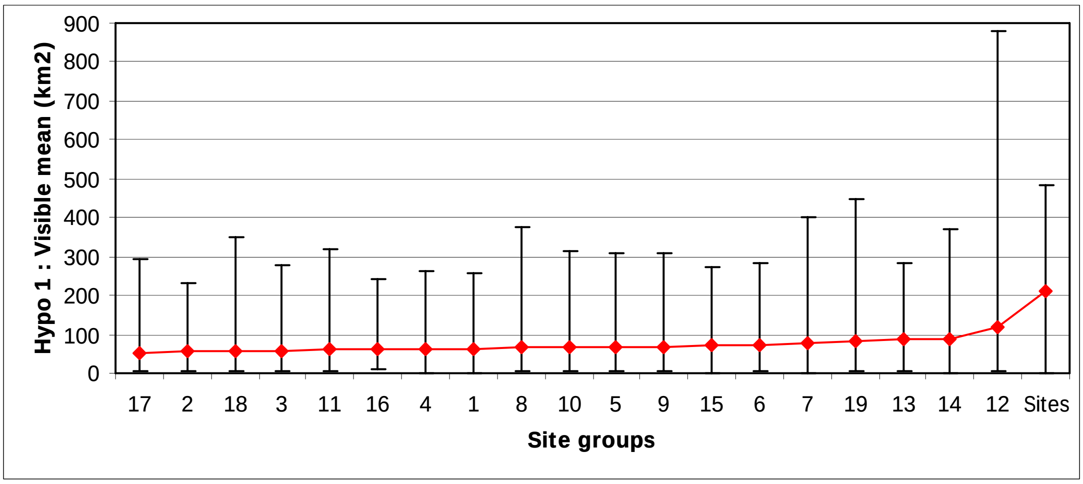


Figure 7.63: Ranking order of sets in Co. Donegal by visible mean, showing all promontory sites with the largest value (Y-bars = minimum and maximum value in each set).

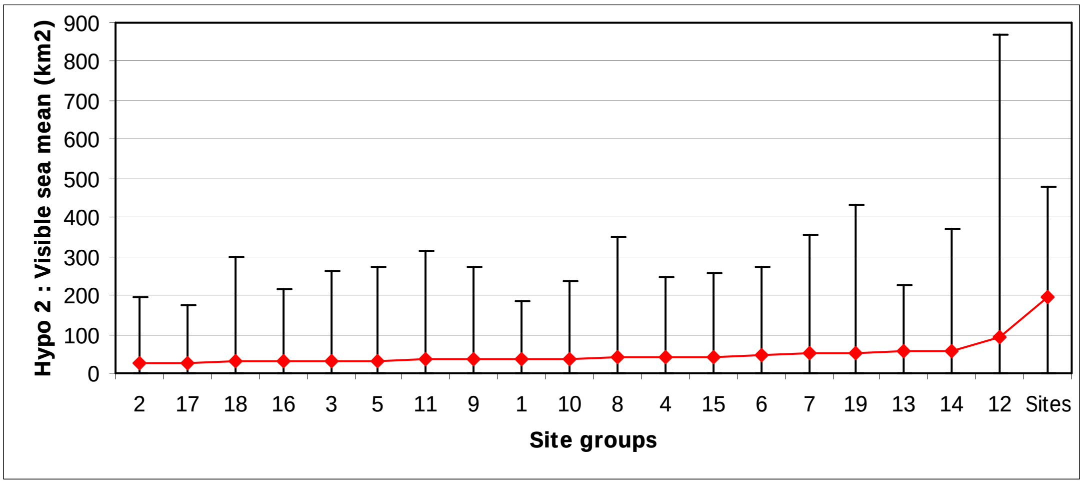


Figure 7.64: Ranking order of sets in Co. Donegal by visible sea mean, showing all promontory sites with the largest value (Y-bars = minimum and maximum value in each set).

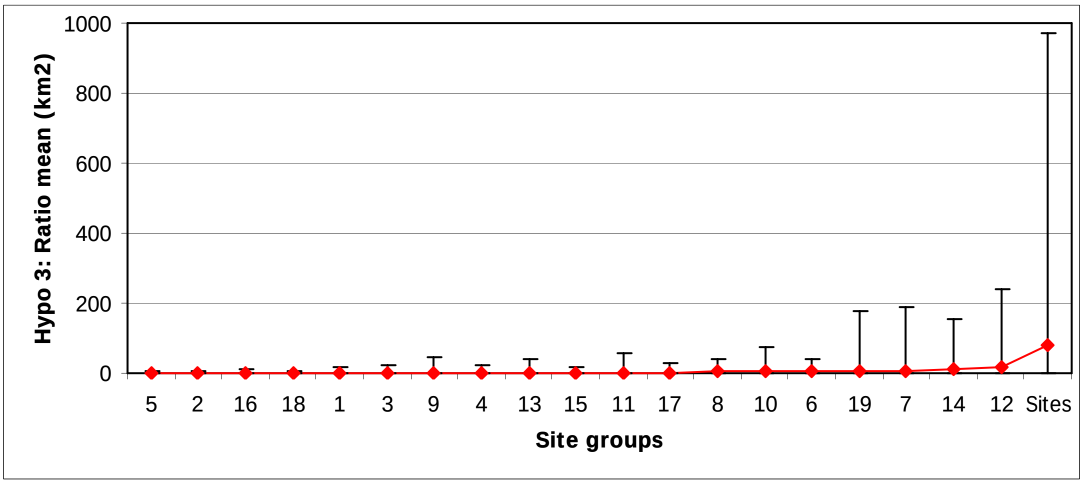


Figure 7.65: Ranking order of sets in Co. Donegal by ratio mean of visible sea to visible land, showing all promontory sites with the largest value (Y-bars = minimum and maximum value in each set).

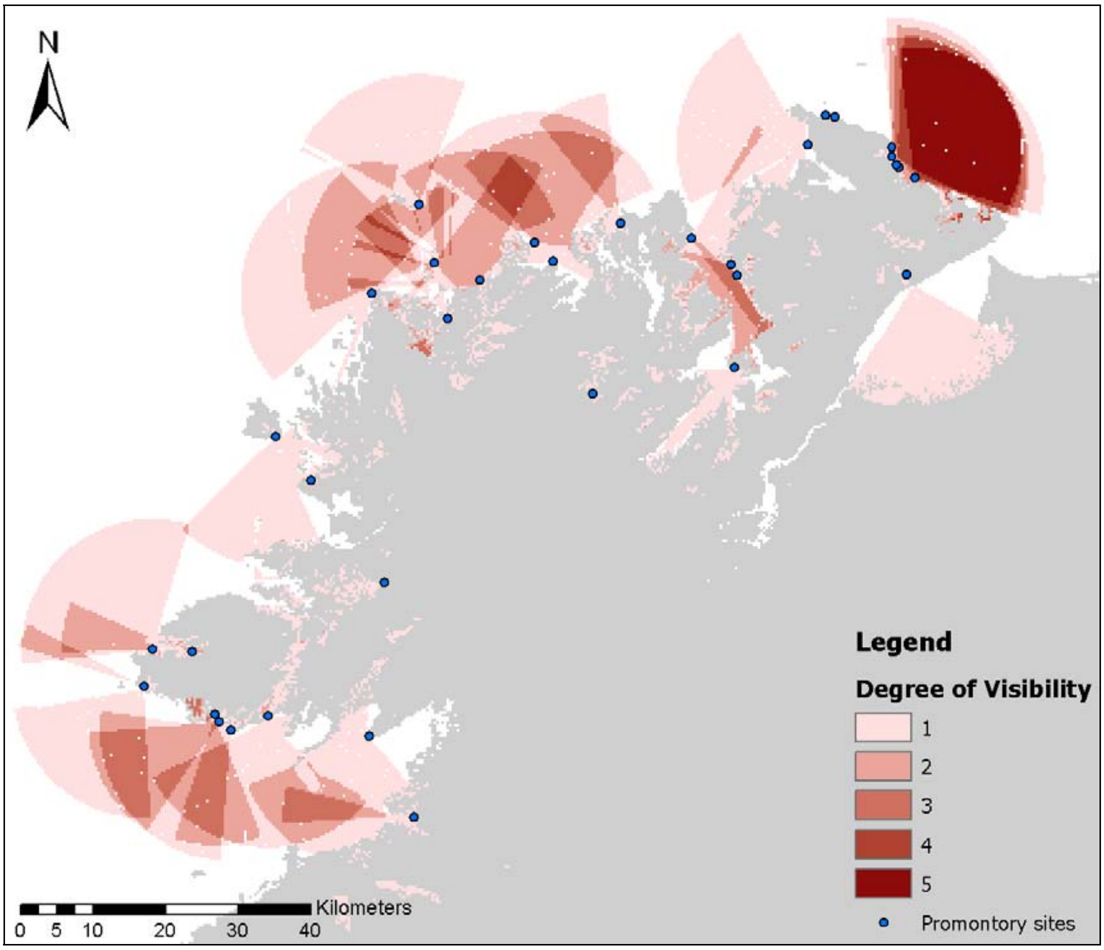


Figure 7.66: Cumulative viewshed from all promontory sites in Co. Donegal (m=33), showing areas with the highest frequency of site visibility in Donegal Bay and along the north and north-east coast. Darker areas indicate the higher number of sites that are intervisible with that area.

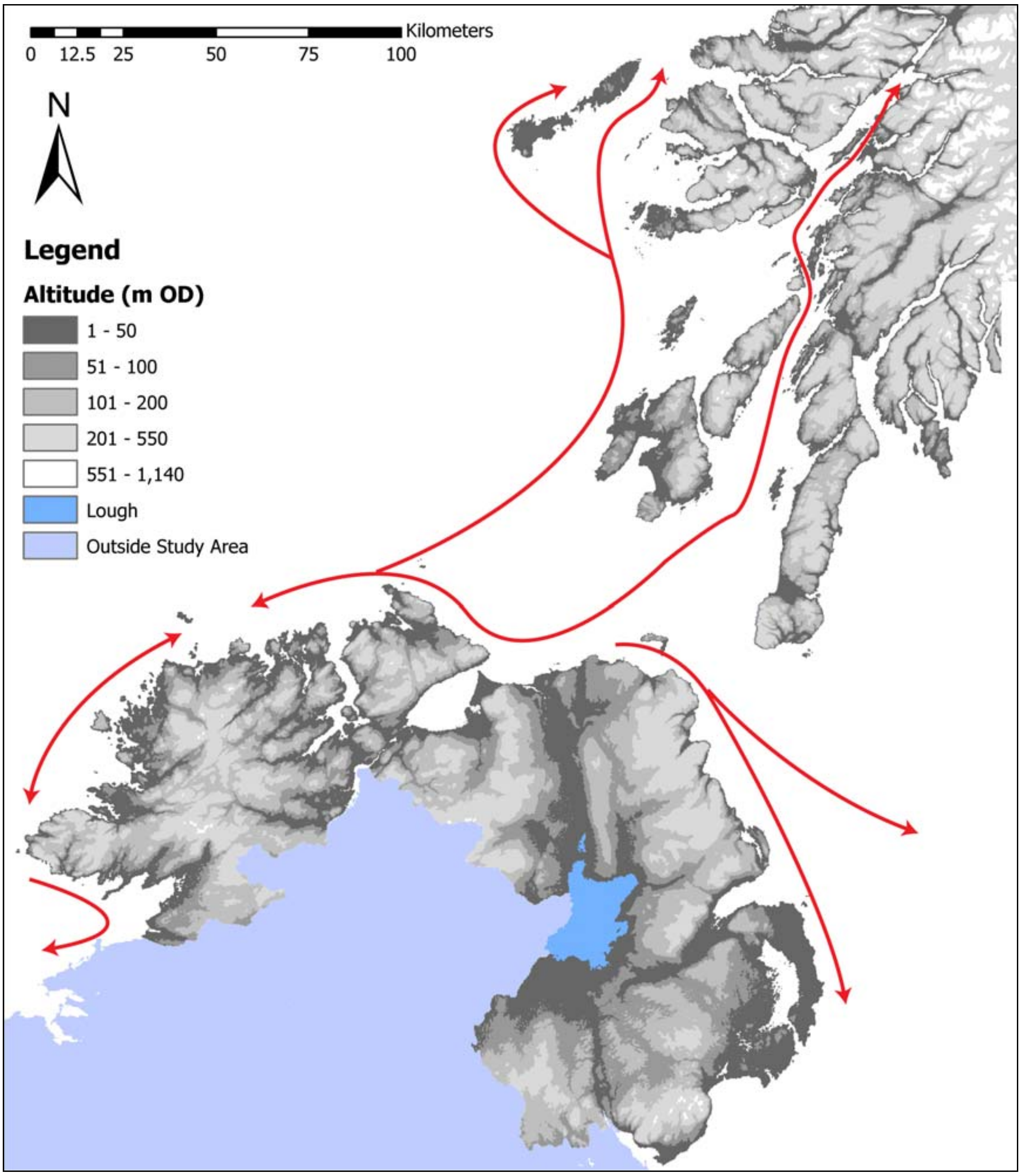


Figure 8.1: Possible sea and land routes suggested by the analyses results.

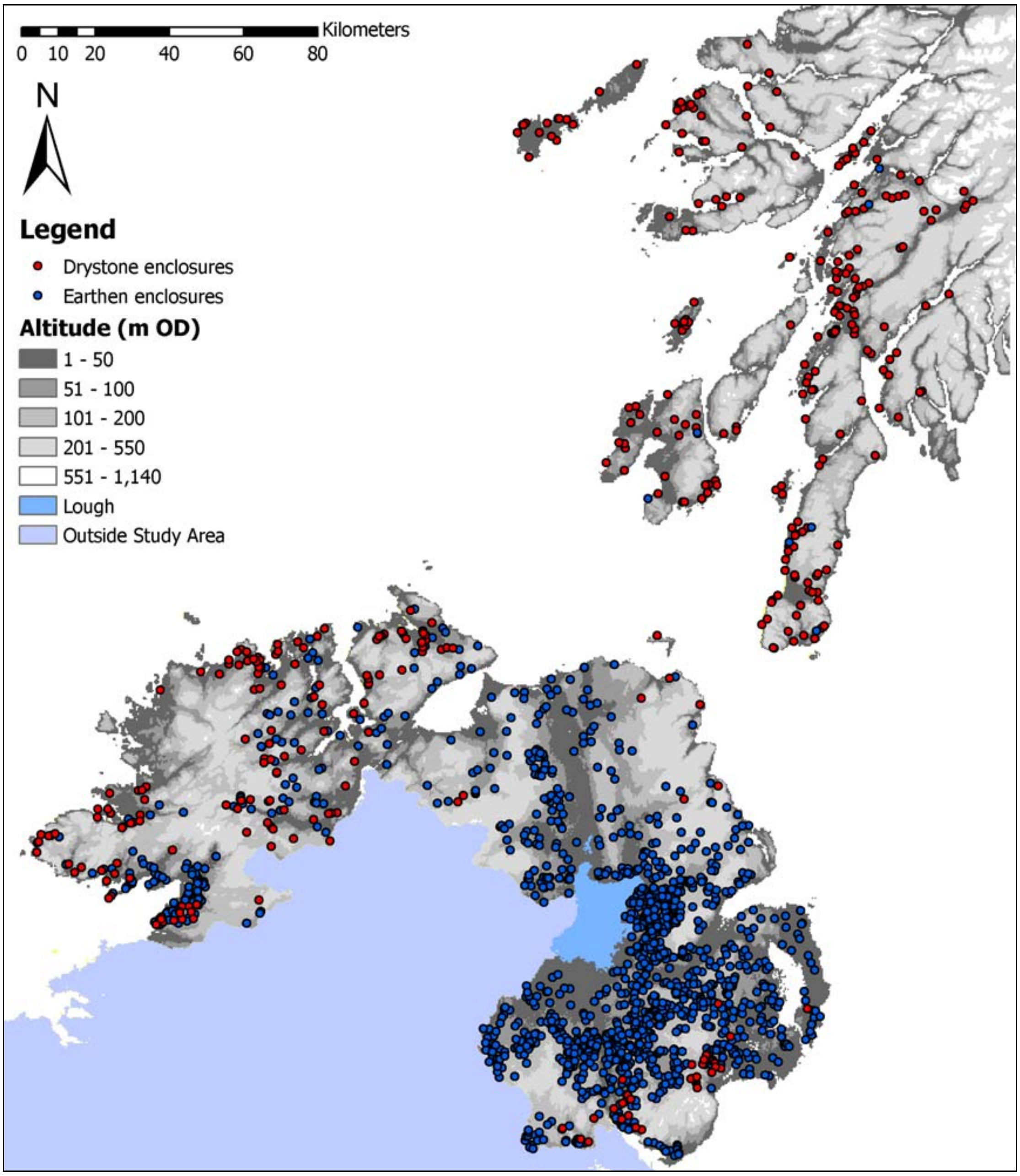


Figure 8.2: Distribution of stone and earthen enclosures throughout study region.

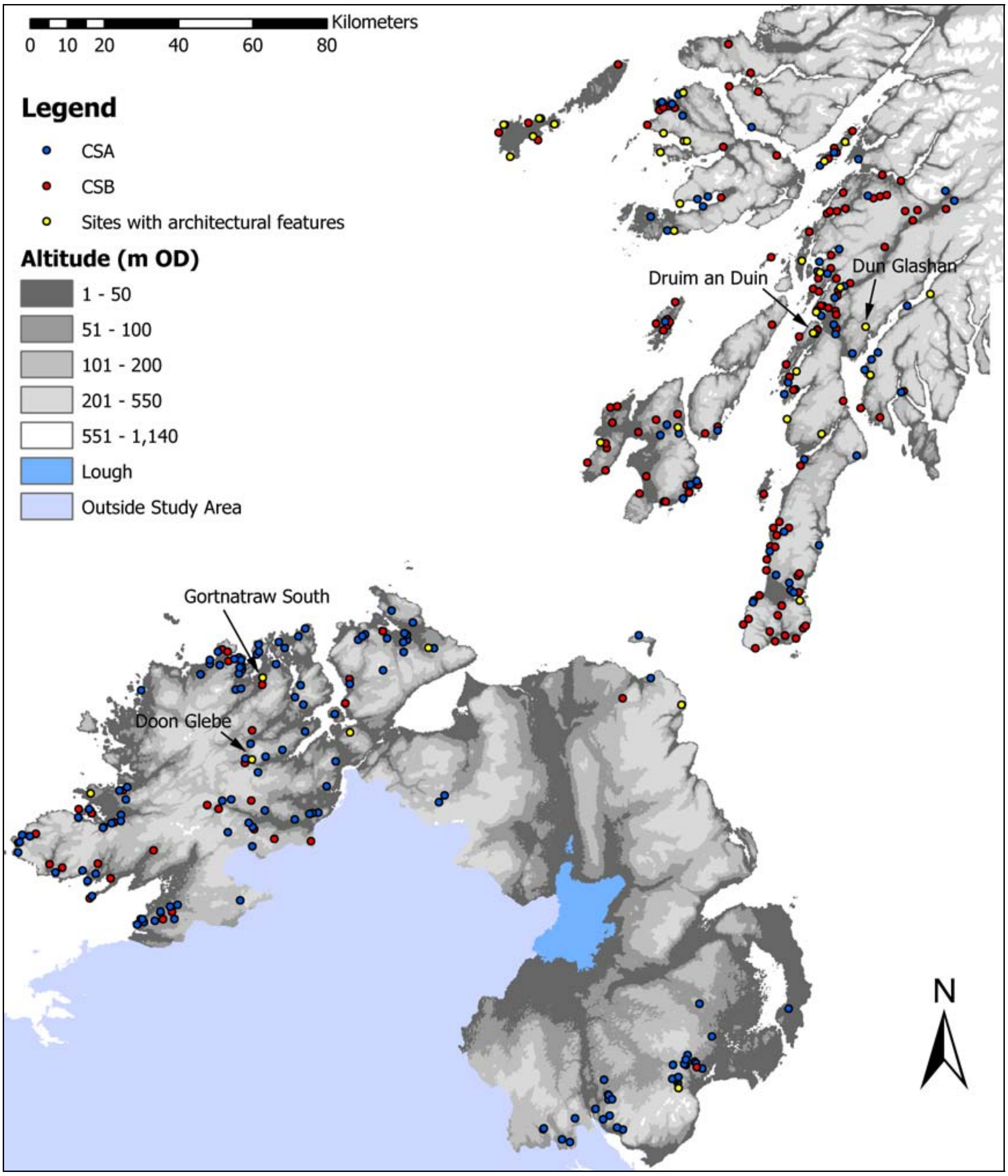


Figure 8.3: Distribution of drystone curvilinear sites by size and drystone curvilinear sites with comparable architectural features throughout the study region.

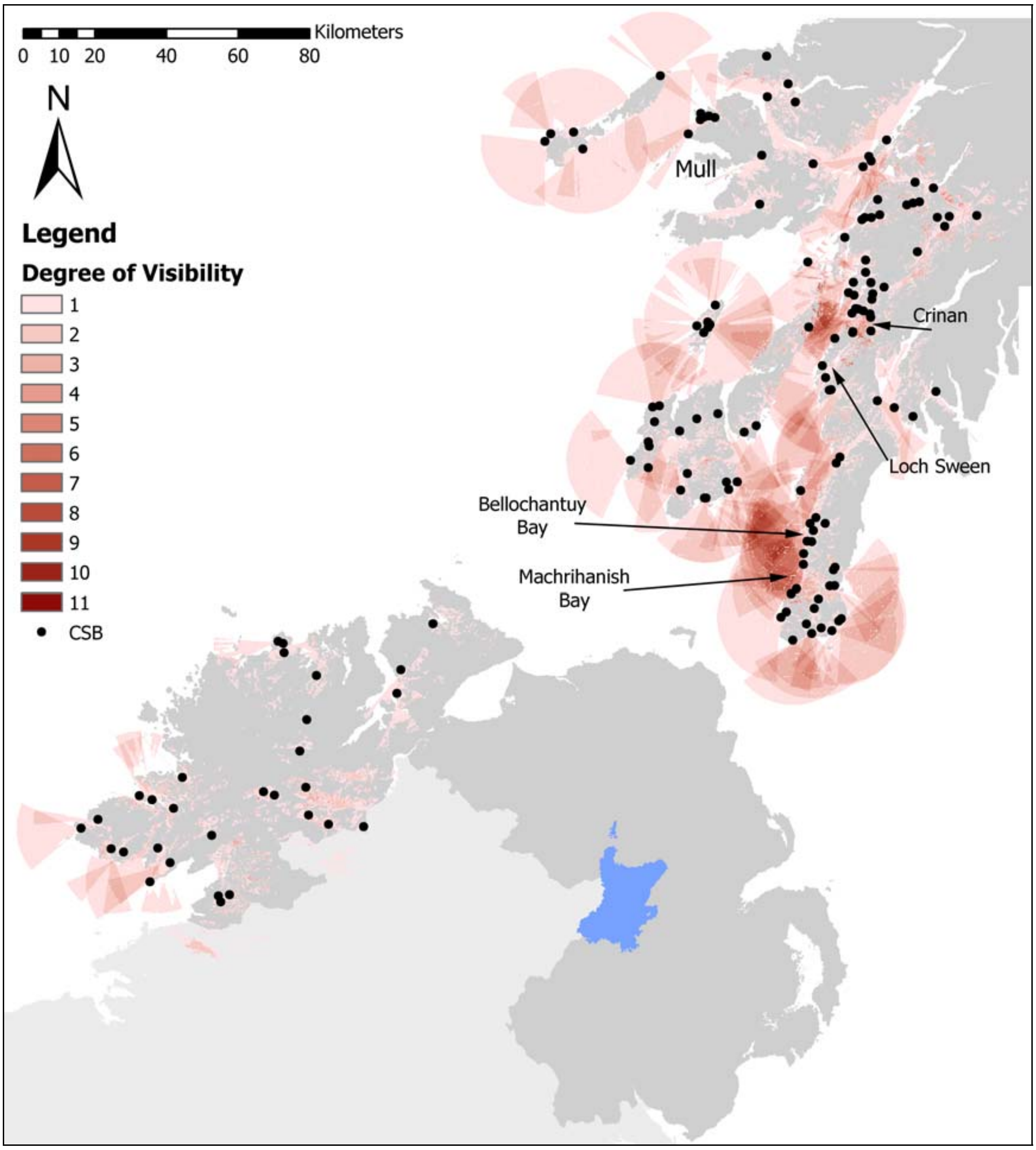


Figure 8.4: Cumulative viewshed from CSB sites in the Argyll and Co. Donegal study areas, showing possible sea route through Argyll and lack of one in Ireland.

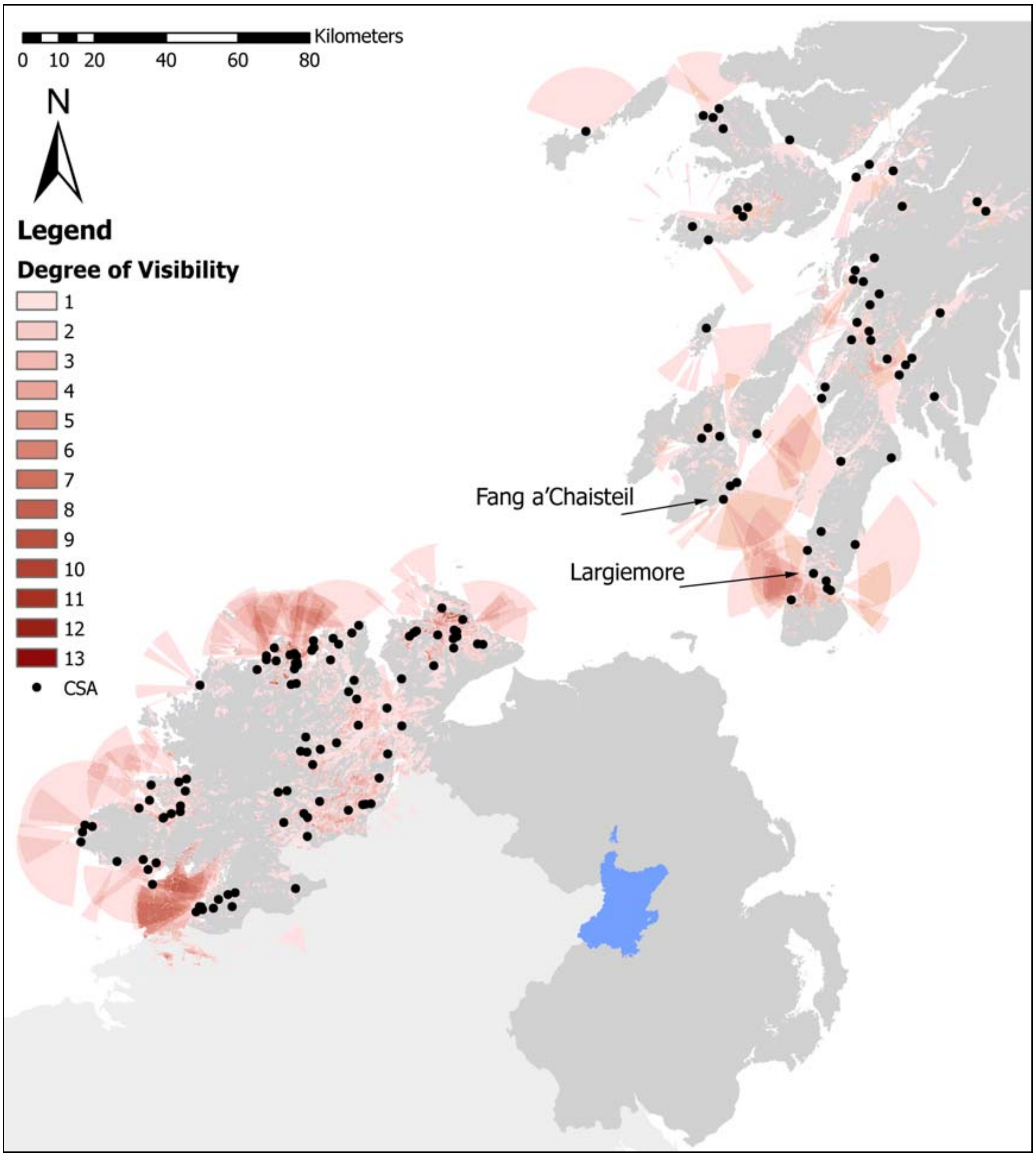


Figure 8.5: Cumulative viewshed from CSA sites in the Argyll and Co. Donegal study areas, showing possible places of contact or strong visual defensive tactics.

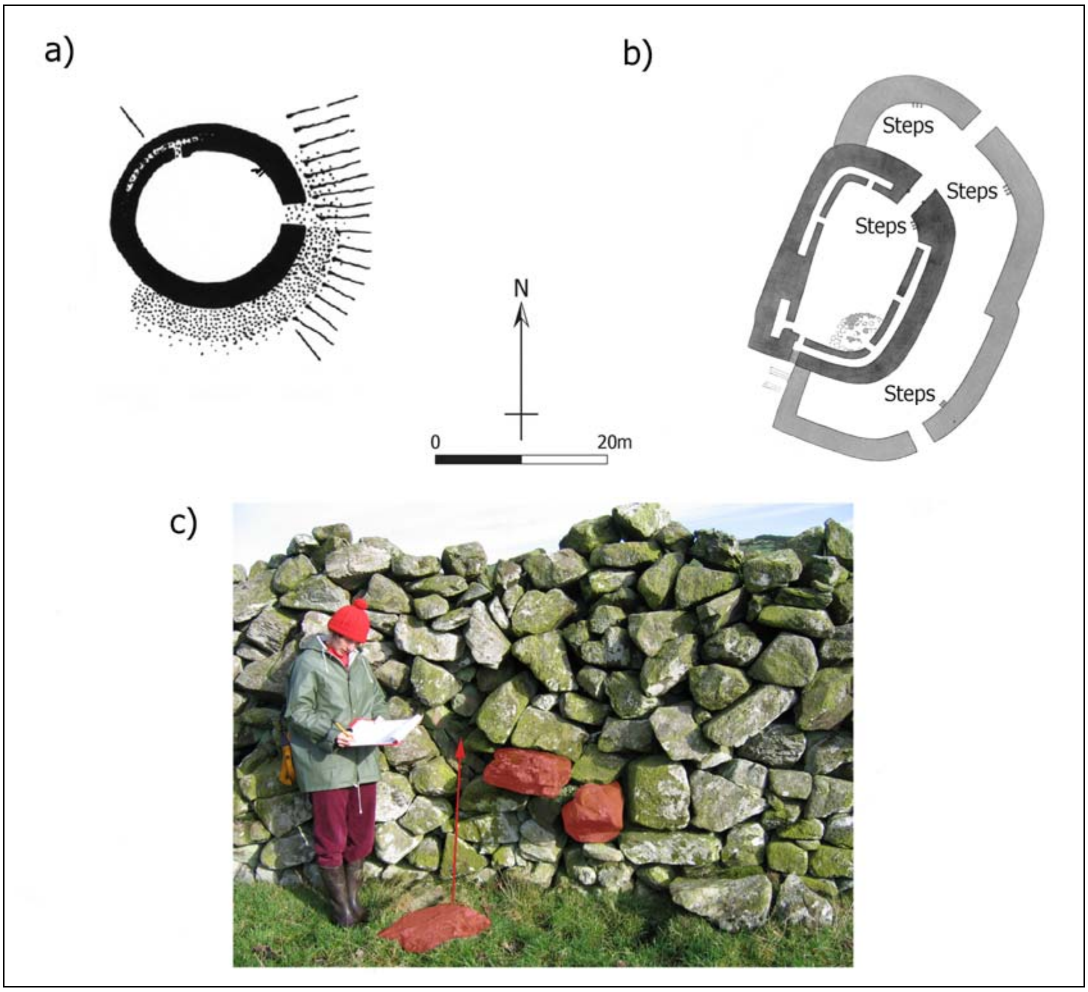


Figure 8.6: Plan of (a).Altagore (Source: Warner 1983) and (b).Castle Haven illustrating similar architectural features (Source: RCAHMS 1914); (c).Fieldwork photograph of stone steps at Altagore.

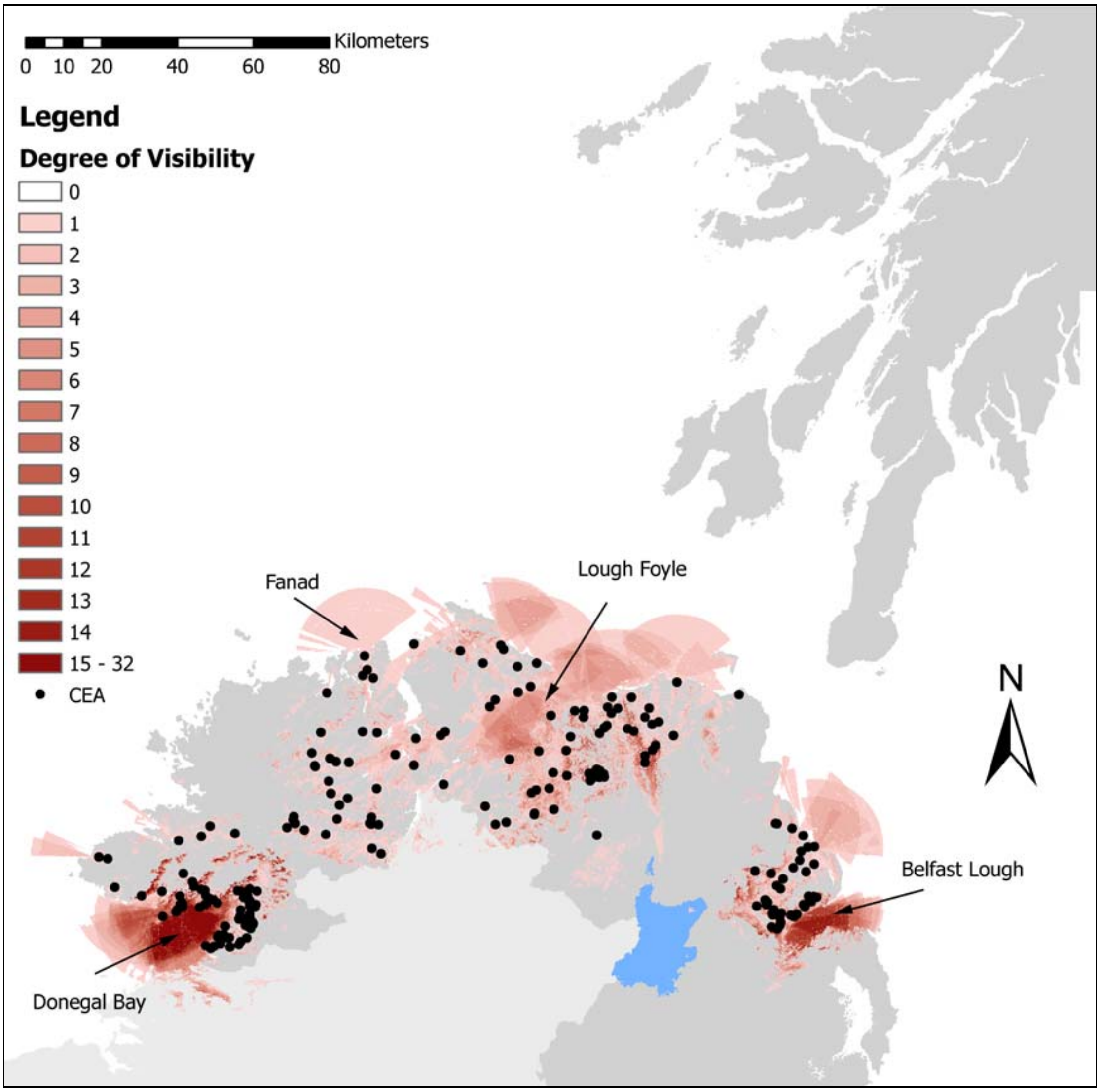


Figure 8.7: Cumulative viewshed from CEA sites in the Co. Donegal and Northern Ireland study areas, showing possible places of contact or strong visual defensive tactics.

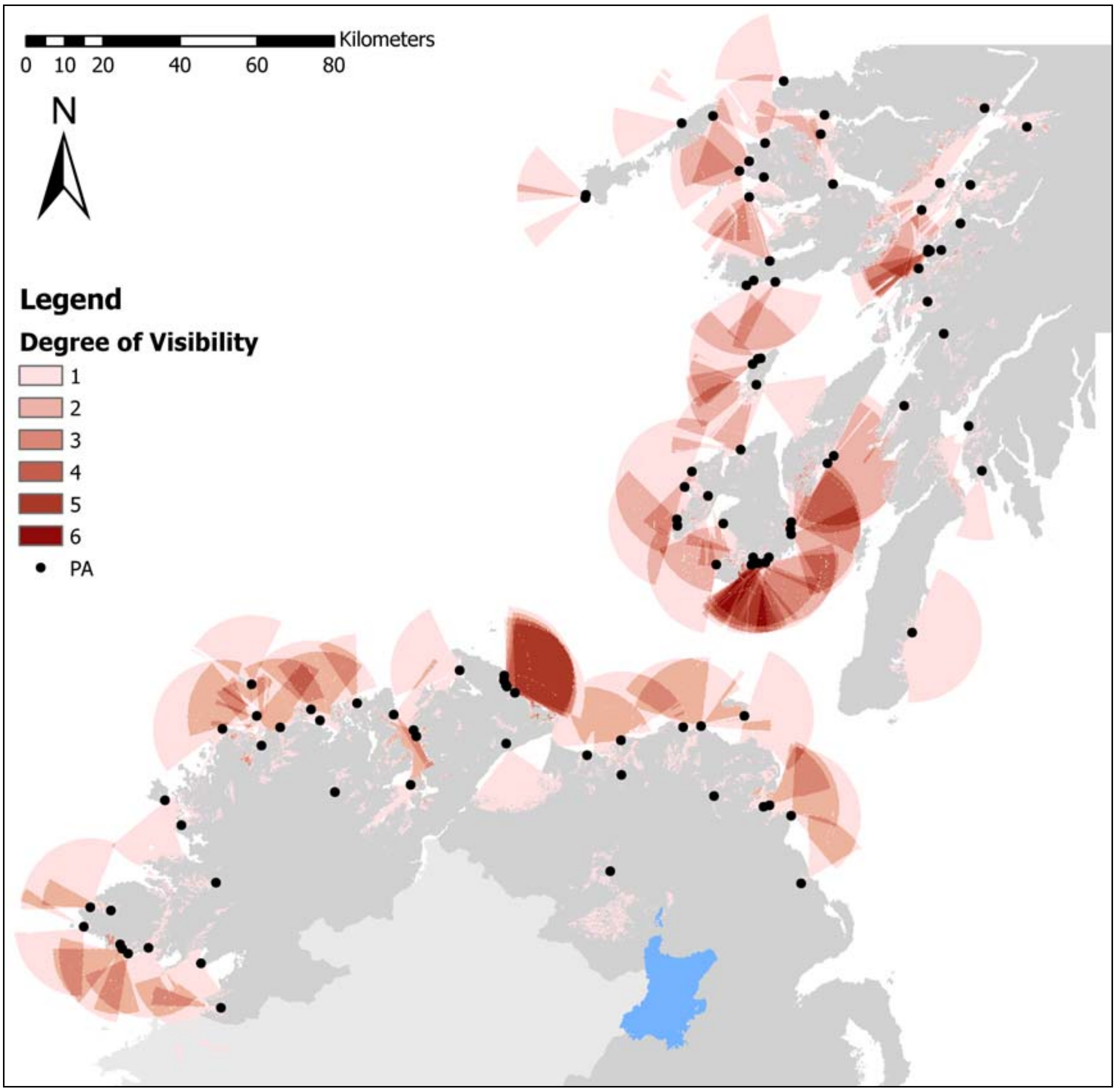


Figure 8.8: Cumulative viewshed from PA sites in the study region, showing site location and visibility forming a 'buffer' around each study area.

Appendix 1

Radiocarbon dates

The following table contains radiocarbon dates for all sites discussed in the text available at the time of writing, with the available species and provenance.

The dates were calibrated using OxCal version 3.10 by C. Bronk Ramsey (2005).

Name	Sample	Lab No.	Determination B.P.	St. Dev. (+/-)	Cat 2 sigma
		Argyll			
Balloch Hill	Charcoal from cremation burial D8, site phase 2	**HAR-1902**	3360	70	1180-1490 BC
Balloch Hill	*Salix,* Rampart 1 +superstructure	**HAR-1093**	2320	80	800-150 BC
Balloch Hill	Charcoal B level 3, possible rampart 1 and superstructure D, site phase 3	**HAR-1903**	2270	80	550-50 BC
Balloch Hill	Charcoal phase 3, rampart 1 superstructure; Dates collapse of rampart superstructure or debris cast out from fort interior	**HAR-1904**	2240	120	750 BC-AD 50
Balloch Hill	Charcoal, J upper level 3, phase 3/4 transition; date suggests occupation period of fort	**HAR-1905**	2240	70	410-90 BC
Balloch Hill	Charcoal from context R3 in site phase 3	**HAR-1906**	2120	110	400 BC-AD 80
Balloch Hill	Charcoal, id as Corylus and Salix spp, from open area and gully assoc with pit, context C51, site phase 3	**HAR-1907**	2120	70	370 BC-AD 20
Balloch Hill	Charcoal from surface on which Rampart 2 collapsed, context D, site phase 3	**HAR-2043**	2130	90	390 BC-AD 30
Balloch Hill	Charcoal from initial clearance? context E level 3, site phase 3	**GU-1031**	2450	65	770-400 BC
Balloch Hill	Charcoal from context A21 entrance barrier, site phase 3	**GU-1033**	2305	110	800-100 BC
Balloch Hill	Charcoal from context K6, structure 5, hearth, site phase 3	**GU-1104**	2320	60	750-200 BC
Balloch Hill	Charcoal from context K362, structure 4 hearth, site phase 3	**GU-1105**	2405	70	770-380 BC
Balloch Hill	Charcoal from context K45 gully, site phase 3	**GU-1106**	2070	85	370 BC-AD 90
Balloch Hill	Charcoal from context J level 3, general occupation, site phase 3	**GU-1028**	2180	70	390-50 BC
Balloch Hill	Charcoal from context CC level 3, general occupation, site phase 3	**GU-1030**	1970	110	400 BC-AD 350

Name	Sample	Lab No.	Determination B.P.	St. Dev. (+/-)	Cat 2 sigma
Balloch Hill	Charcoal from context K level 2, site phase 3/4 transition	**GU-1029**	2040	70	350 BC-AD 130
Balloch Hill	Charcoal from context J1, structure 2 bin, site phase 4	**GU-1032**	2690	70	1020-760 BC
Dunadd	Charcoal from layer in hollow in bedrock at Site 1, Phase IA, Context 70	**GU-2464**	2280	50	410-200 BC
Dunadd	Charcoal from Pit on outside of enclosure, Site 1, Phase IIB, Context 43	**GU-2308**	1630	60	AD 250-560
Dunadd	Charcoal from hearth on outside of enclosure at Site 1, Phase IIB, Context 25	**GU-2463**	1240	80	AD 650-970
Dunadd	Charcoal from floor layer at Site 1, Phase IIIB, Context 35	**GU-2314**	1470	50	AD 430-660
Dunadd	Charcoal from occupation on summit of Site 1, Phase IB, Context 57	**GU-2306**	2000	50	160 BC-AD 130
Dunadd	Charcoal from occupation on summit of Site 1, Phase IB, Context 46	**GU-2307**	1980	50	110 BC-AD 130
Dun Mor Vaul, Tiree	Phase 1a *Epsilon-2*	**GaK-1092**	2350	110	800-150 BC
Dun Mor Vaul, Tiree	Phase 1b *Nu-2*	**GaK-1225**	2230	100	550 BC-AD 50
Dun Mor Vaul, Tiree	Phase 2a *Eta-2*	**GaK-1098**	2395	90	800-200 BC
Dun Mor Vaul, Tiree	Phase 2b *Alpha-2*	**GaK-1097**	1890	90	100 B -AD 350
Dun Mor Vaul, Tiree	Phase 4b *Tau*	**GaK-1521**	2240	80	420-40 BC
Dun Mor Vaul, Tiree	Phase 5 *Gamma-6*	**GaK-1099**	1790	90	AD 20-430
Eilean an Duin	Charcoal from rampart-base section (sample 4) but derived from pre-rampart context	**GU-1814**	2290	65	540-170 BC
Eilean an Duin	Charcoal from rampart-base section (sample 6) but derived from pre-rampart context	**GU-1815**	2160	55	380-50 BC
Kildonan	Charcoal below hearth II2	**GU-1457**	1245	70	AD 650-960
Kildonan	Charcoal below hearth II2	**GU-1458**	1210	60	AD 670-970

Name	Sample	Lab No.	Determination B.P.	St. Dev. (+/-)	Cat 2 sigma
Ireland					
Antiville, Larne, Antrim	Charcoal assoc with souterrain ware	**Dublin-66**	1470	120	AD 250-900
Antiville, Larne, Antrim	Charcoal assoc with souterrain ware; from secondary floor in house structure	**UB-589**	1220	45	AD 670-940
Ballyhenry Rath 2, Antrim	Fine charcoal, small quantity, from feature V near centre of circle defined by trenches A, A'	**UB-944**	2155	435	1300 BC-AD 800
Ballyhenry Rath 2, Antrim	Charcoal from gully H, arc-shaped, 3 metres SW of foundation trench A'	**UB-943**	2065	70	360 BC-AD 80
Ballyhenry Rath 2, Antrim	[sample not specified] from bottom of inner ditch, 87-93cm below datum	**UB-945**	1355	40	AD 600-770
Ballyhenry Rath 2, Antrim	[sample not specified] from bottom of outer ditch, 71-5cm below datum	**UB-947**	1055	30	AD 890-1030
Ballyhenry Rath 2, Antrim	[sample not specified] from midway up fill of inner ditch, 35-9cm below datum	**UB-946**	760	65	AD 1050-1400
Dunbeg, Co. Kerry	Charcoal layer, id as wattle fence, from base of ditch underlying stone rampart	**UB-2216**	2530	35	800-530 BC
Dunbeg, Co. Kerry	Wood charcoal from base of Ditch 1	**UB-2215**	1150	75	AD 690-1020
Dunbeg, Co. Kerry	Charcoal from phase 2 occupation of clochan	**UB-2218**	1050	65	AD 820-1160
Dunbeg, Co. Kerry	Charcoal from phase 1 occupation of clochan	**UB-2217**	960	100	AD 880-1270
Dunsilly Motte, Co. Antrim	Charcoal (very fine) from pre-Rath B occupation	**UB-967**	1905	75	60 BC-AD 330
Dunsilly Motte, Co. Antrim	Charcoal, id as mixed, from external hearth, pre-Rath C	**UB-2001**	1565	105	AD 250-660
Dunsilly Motte, Co. Antrim	Charcoal, very fine, from pre-rath B occupation	**UB-2002**	1380	65	AD 540-780
Dunsilly Motte, Co. Antrim	Charcoal from earth build-up inside house wall of Rath III	**UB-968**	890	40	AD 1030-1220
Dun Aonghasa, Co. Galway	F220: Animal bone from lower level of midden dump	**GrN-20231**	3165	30	1500-139 BC
Dun Aonghasa, Co. Galway	F209	**GrN-20230**	3070	60	1460-1120 BC
Dun Aonghasa, Co. Galway	F42	**AA-10273**	2785	60	1120-810 BC
Dun Aonghasa, Co. Galway	below Hut 1: F221	**GrN-20228**	2990	30	1370-1120 BC

Name	Sample	Lab No.	Determination B.P.	St. Dev. (+/-)	Cat 2 sigma
Dun Aonghasa, Co. Galway	below Hut 1: F216	**GrN-20229**	2955	25	1270-1050 BC
Dun Aonghasa, Co. Galway	Below paved floor of Hut 1: F203	**GrN-20227**	2870	35	1190-910 BC
Dun Aonghasa, Co. Galway	Hut 1: F56	**GrN-20226**	2840	25	1120-910 BC
Dun Aonghasa, Co. Galway	Hut 2 occupation material: F51	**GrN-20234**	2470	35	770-410 BC
Dun Aonghasa, Co. Galway	Stone trough	**UB-3645**	2374	36	730-380 BC
Dun Aonghasa, Co. Galway	F39: spread on bedrock-abutting linear stone features (internal division)	**AA-10274**	2295	60	520-190 BC
Dun Aonghasa, Co. Galway	Upper level of occupation material, abutting & under wall 1	**AA-10276**	2635	60	930-550 BC
Dun Aonghasa, Co. Galway	Upper level of occupation material, abutting & under wall 2	**AA-10270**	2585	60	900-510 BC
Dun Aonghasa, Co. Galway	Below paving of Hut 2: F258	**GrN-20238**	2435	45	760-400 BC
Dun Aonghasa, Co. Galway	F255: occupation material	**GrN-20235**	2765	35	1000-830 BC
Dun Aonghasa, Co. Galway	F71/77; occupation material over F255	**GrN-20233**	2760	35	1000-820 BC
Dun Aonghasa, Co. Galway	Alcove in Wall: F92	**GrN-20236**	1285	40	AD 650-860
Haughey's Fort, Co. Armagh	Pit: Charcoal from F4, deep pit in interior	**UB-3049**	2833	55	1190-840 BC
Haughey's Fort, Co. Armagh	Ditch: Wood, id as small branches, from inner defensive ditch Tr 5	**UB-3050**	2923	50	1300-970 BC
Haughey's Fort, Co. Armagh	Pit: Charcoal from F299, Level 6 of pit	**UB-3384**	2253	26	400-200 BC
Haughey's Fort, Co. Armagh	Pit: Charcoal from F299, Level 1 of pit	**UB-3385**	2221	26	390-200 BC
Haughey's Fort, Co. Armagh	Pit: Charcoal from F267, deep pit associated with coarse ware and gold stud	**UB-3386**	2877	60	1260-900 BC
Haughey's Fort, Co. Armagh	Ditch:Charcoal from outer defensive ditch, Tr 12	**UB-3387**	2889	87	1400-800 BC
Haughey's Fort, Co. Armagh	Ditch: Charcoal from middle defensive ditch, Tr 11	**UB-3388**	2852	55	1220-890 BC
Haughey's Fort, Co. Armagh	Ditch: Wood, id as small branches, from inner defensive ditch, Tr 5; same context as UB-3050.	**GrN-15480**	2855	40	1130-900 BC
Haughey's Fort, Co. Armagh	Charcoal from F2 hearth	**GrN-15481**	2865	25	1130-930 BC
Haughey's Fort, Co. Armagh	Pit: Charcoal from F3, deep pit	**GrN-15482**	2920	25	1250-1010 BC
Haughey's Fort, Co. Armagh	Pit: Charcoal from F4, deep pit	**GrN-15483**	2850	20	1120-920 BC
Haughey's Fort, Co. Armagh	Charcoal from F5 hearth	**GrN-15484**	2850	35	1130-910 BC

Name	Sample	Lab No.	Determination B.P.	St. Dev. (+/-)	Cat 2 sigma
Knoxspark, Co. Sligo	Animal bone, Context 108, Gr SQ 108, ditch cut	**GrA-2452**	1260	40	AD 660-870
Knoxspark, Co. Sligo	Aminal bone, Context 106, Gr SQ 57, ditch fill	**GrA-2454**	1190	40	AD 690-970
Mooghaun, Co. Clare	Occupation layer running under outer rampart	**GrN-20490**	2895	50	1260-930 BC
Navan Fort, Co. Armagh	Charcoal from inner wall slot	**UB-752**	2175	45	380-100 BC
Navan Fort, Co. Armagh	Charcoal from outermost wall slot	**UB-770**	2240	50	400-190 BC
Navan Fort, Co. Armagh	animal bone in upper fill of ringditch	**UB-3407**	1645	25	AD 330-540
Navan Fort, Co. Armagh	animal bone in upper fill of ringditch	**UB-3408**	1515	30	AD 430-620
Navan Fort, Co. Armagh	Phase 3i: Charcoal from primary ditch fill	**UB-188**	2630	50	910-590 BC
Navan Fort, Co. Armagh	Phase 3i: Peaty charcoal from Site B, primary silt of ring ditch (same context as UB-188)	**UB-979**	2615	75	1000-500 BC
Navan Fort, Co. Armagh	Phase 3i: Peaty charcoal from Site B, fill of one pit in a series just within ring ditch predating the round structure	**UB-974**	3140	90	1620-1130 BC
Navan Fort, Co. Armagh	Phase 3ii: Charcoal from slot C1, House	**UB-973**	1785	230	400 BC-AD 700
Navan Fort, Co. Armagh	Phase 3ii: Charcoal from slot A2, House	**UB-976**	1785	45	AD 120-390
Navan Fort, Co. Armagh	Phase 3ii: Charcoal from slot C3, House	**UB-978**	2045	35	170 BC-AD 30
Navan Fort, Co. Armagh	Phase 3ii: Bone, id as skull of Barbary ape, MA231	**OxA-3321**	2150	70	390-30 BC
Navan Fort, Co. Armagh	Phase 3iii?: Charcooal from slot W, Yard	**UB-782**	2185	55	390-90 BC
Navan Fort, Co. Armagh	Phase 3iii?: Burnt plank from slot R, yard	**UB-784**	2110	45	360-0 BC
Navan Fort, Co. Armagh	Phase 3iii?: Charcoal from slot Z, Yard	**UB-790**	2105	70	360 BC-AD 30
Navan Fort, Co. Armagh	Peaty charcoal from base of outer enclosure ditch at Navan from Coring	**UB-3091**	2420	40	760-390 BC
Navan Fort, Co. Armagh	Phase 3: Charcooal from peripheral pit 16 of ditched enclosure	**UB-971**	2085	75	360 BC-AD 70
Navan Fort, Co. Armagh	Phase 4: Branch from destruction layer of 40m structure	**UB-467**	2100	60	360 BC-AD30
Navan Fort, Co. Armagh	Phase 4: Twigs from central post packing of 40m structure	**UB-469**	2150	70	390-30 BC
Navan Fort, Co. Armagh	Phase 4: Branch from packing of central post of 40m structure	**UB-470**	2130	65	370-0 BC
Navan Fort, Co. Armagh	Phase 4: Cnetral post of 40m structure	**UB-772**	2175	45	380-100 BC

Name	Sample	Lab No.	Determination B.P.	St. Dev. (+/-)	Cat 2 sigma
Navan Fort, Co. Armagh	Phase 4: Straw from destruction of 40m structure	**UB-773**	2020	35	160 BC-AD 70
Navan Fort, Co. Armagh	Phase 4: Charcoal from destruction layer of 40m structure	**UB-774**	2160	65	380-50 BC
Navan Fort, Co. Armagh	Phase 4: Charcoal from post pit 75 of 40m structure	**UB-972**	2170	70	390-50 BC
Raheennamadra, Co. Limerick	Charcoal from ?hearth in ?hut	**Uppsala**	1840	110	100 BC-AD 450
Rathgall, Co. Wicklow	Charcoal from pit G	**SI-1481**	7525	115	6600-6050 BC
Rathgall, Co. Wicklow	Charcoal from hearth 10	**SI-1478**	2560	105	900-400 BC
Rathgall, Co. Wicklow	Charcoal from hearth 7	**SI-1477**	2475	80	790-400 BC
Rathgall, Co. Wicklow	Charcoal from hearth 2	**SI-1476**	2470	80	790-400 BC
Rathgall, Co. Wicklow	Charcoal, id as fine, from lower portion of ditch	**SI-1484**	2000	75	200 BC-AD 180
Rathgall, Co. Wicklow	Charcoal, id as fine, from ditch	**SI-1483**	2215	80	410-50 BC
Rathgall, Co. Wicklow	Charcoal from smelting pit	**SI-1480**	1685	70	AD 170-550
Rathgall, Co. Wicklow	Charcoal from pit 25	**SI-1479**	1330	70	AD 590-880
Rathgall, Co. Wicklow	Charcoal from NE side of ditch	**SI-1482**	1055	60	AD 810-1160
Rathgall, Co. Wicklow	Charcoal from upper levels of large basket-lined storage pit outside circular house, Sq 18	**Dublin-132**	2960	110	1450-900 BC
Rathgall, Co. Wicklow	Charcoal from hearth 1, Sq 25	**Dublin-133**	2860	110	1400-800 BC
Rathgall, Co. Wicklow	Charcoal from pit at SW corner, hearth 2, Sq 32	**Dublin-134**	2810	110	1300-750 BC
Rathgall, Co. Wicklow	Charred wood and cereal grain from upper levels of ditch around house, Sq 31	**Dublin-135**	2490	120	900-350 BC
Rathmullan, Co. Down	Charcoal from hearth in phase I house	**UB-2526**	1500	40	AD 430-650
Rathmullan, Co. Down	Charcoal, id as twigs, from layer 11, on floor of phase 3 house	**UB-2527**	1130	40	AD 770-1000
Rathmullan, Co. Down	Wood, id as charred branch, from infill of souterrain	**UB-2525**	1085	20	AD 890-1020
Rathmullan, Co. Down	Anglo-Norman occupation, Charcoal from layer 23	**UB-2524**	1165	55	AD 690-990
Rinnaraw	Shell from midden 10	**GrN-18078**	910	50	AD 1020-1220
Rinnaraw	Shell from midden 24	**GrN-18079**	790	50	AD 1150-1300
Rinnaraw	Charcoal from Hearth 32-4	**GrN-18080**	1330	60	AD 600-870

Name	Sample	Lab No.	Determination B.P.	St. Dev. (+/-)	Cat 2 sigma
Rinnaraw	Charcoal from house wall 85	**GrN-19755**	1085	25	AD 890-1020
Rinnaraw	Charcoal from North midden 87	**GrN-19756**	1160	35	AD 770-980
Rinnaraw	Charcoal from house wall 95	**GrN-19757**	1070	35	AD 890-1030
Rinnaraw	Charcoal from Hearth 98	**GrN-19758**	1055	35	AD 890-1030

Appendix 2

Site Data

Appendix 2 lists all sites utilised in the statistical and viewshed analyses for Argyll, Northern Ireland and Co. Donegal.

Refer to Access database.

Appendix 3

Statistical Analyses Results

Appendix 3 illustrates all statistical analyses and Viewshed Analysis summary results in table format.

Statistical Analyses of Sites in Argyll and Environmental Variables.

Argyll CSB and Altitude (Kolmogorov-Smirnov)

Altitude Bands (m)	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0-10	21	17	17	430807100	6	6	11.79
11-20	11	9	26	356221400	5	10	16.28
21-30	7	6	32	297165000	4	14	18.23
31-40	5	4	36	287003300	4	18	18.66
41-50	12	10	46	258907300	3	21	25.23
51-60	6	5	51	242793200	3	24	27.05
61-70	8	7	58	234051800	3	27	30.64
71-80	5	4	62	228587200	3	30	31.82
81-90	7	6	68	218293000	3	33	34.79
91-100	9	7	75	212727000	3	36	39.48
101-110	5	4	79	210100600	3	38	40.90
111-120	5	4	83	201918300	3	41	42.42
121-130	2	2	85	197013500	3	44	41.53
131-140	3	2	88	196907100	3	46	41.47
141-150	4	3	91	192666400	2	49	42.28
151-160	1	1	92	189155800	2	51	40.67
161-170	1	1	93	187828700	2	53	39.07
171-180	2	2	94	181951900	2	56	38.37
181-190	1	1	95	175585300	2	58	36.93
191-200	2	2	97	172656000	2	60	36.35
201-210	3	2	99	168843300	2	63	36.65
211-220	1	1	100	163020300	2	65	35.37
221-230	0	0	100	156530500	2	67	33.35
231-240	0	0	100	152082500	2	69	31.39
241-250	0	0	100	144308700	2	70	29.53
251-260	0	0	100	139105000	2	72	27.73
261-270	0	0	100	134738200	2	74	25.99
271-280	0	0	100	128673500	2	76	24.33
281-290	0	0	100	122865500	2	77	22.74
291-300	0	0	100	120498700	2	79	21.18
301-310	0	0	100	113183900	1	80	19.72
311-320	0	0	100	107480500	1	82	18.33
321-330	0	0	100	100591400	1	83	17.04
331-340	0	0	100	98266000	1	84	15.77
341-350	0	0	100	92167500	1	85	14.58
351-360	0	0	100	87751900	1	87	13.44
361-370	0	0	100	84834100	1	88	12.35
371-380	0	0	100	75473100	1	89	11.37
381-390	0	0	100	71176500	1	90	10.45
391-400	0	0	100	67290400	1	90	9.58
401-410	0	0	100	64434500	1	91	8.75
411-420	0	0	100	59194200	1	92	7.99
421-430	0	0	100	56029800	1	93	7.26
431-440	0	0	100	52307900	1	93	6.59
441-450	0	0	100	48333300	1	94	5.96
451-460	0	0	100	45148000	1	95	5.38
461-470	0	0	100	43238800	1	95	4.82
471-480	0	0	100	40329300	1	96	4.30
481-490	0	0	100	38792400	1	96	3.80
491-500	0	0	100	36784900	0	97	3.33
501-510	0	0	100	33766400	0	97	2.89
511-520	0	0	100	30941300	0	98	2.49
521-530	0	0	100	29388100	0	98	2.11
531-540	0	0	100	28584600	0	98	1.74
541-550	0	0	100	26817900	0	99	1.40
551-560	0	0	100	25582100	0	99	1.07
561-570	0	0	100	23203100	0	99	0.77
571-580	0	0	100	21111400	0	100	0.49
581-590	0	0	100	20017100	0	100	0.23
591-600	0	0	100	18159900	0	100	0.00
TOTAL	121	100		7743386400	100		

Calc = 42.42%
Crit = 12.36%
Reject Ho

Argyll CSA and Altitude (Kolmogorov-Smirnov)

Altitude Bands (m)	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0-10	6	11	11	430807100	6	6	5.76
11-20	4	8	19	356221400	5	10	8.70
21-30	2	4	23	297165000	4	14	8.64
31-40	3	6	28	287003300	4	18	10.59
41-50	7	13	42	258907300	3	21	20.46
51-60	6	11	53	242793200	3	24	28.64
61-70	3	6	58	234051800	3	27	31.28
71-80	3	6	64	228587200	3	30	33.99
81-90	5	9	74	218293000	3	33	40.60
91-100	3	6	79	212727000	3	36	43.52
101-110	1	2	81	210100600	3	38	42.69
111-120	3	6	87	201918300	3	41	45.74
121-130	1	2	89	197013500	3	44	45.09
131-140	1	2	91	196907100	3	46	44.43
141-150	1	2	92	192666400	2	49	43.83
151-160	0	0	92	189155800	2	51	41.39
161-170	2	4	96	187828700	2	53	42.73
171-180	1	2	98	181951900	2	56	42.27
181-190	0	0	98	175585300	2	58	40.00
191-200	0	0	98	172656000	2	60	37.77
201-210	0	0	98	168843300	2	63	35.59
211-220	1	2	100	163020300	2	65	35.37
221-230	0	0	100	156530500	2	67	33.35
231-240	0	0	100	152082500	2	69	31.39
241-250	0	0	100	144308700	2	70	29.53
251-260	0	0	100	139105000	2	72	27.73
261-270	0	0	100	134738200	2	74	25.99
271-280	0	0	100	128673500	2	76	24.33
281-290	0	0	100	122865500	2	77	22.74
291-300	0	0	100	120498700	2	79	21.18
301-310	0	0	100	113183900	1	80	19.72
311-320	0	0	100	107480500	1	82	18.33
321-330	0	0	100	100591400	1	83	17.04
331-340	0	0	100	98266000	1	84	15.77
341-350	0	0	100	92167500	1	85	14.58
351-360	0	0	100	87751900	1	87	13.44
361-370	0	0	100	84834100	1	88	12.35
371-380	0	0	100	75473100	1	89	11.37
381-390	0	0	100	71176500	1	90	10.45
391-400	0	0	100	67290400	1	90	9.58
401-410	0	0	100	64434500	1	91	8.75
411-420	0	0	100	59194200	1	92	7.99
421-430	0	0	100	56029800	1	93	7.26
431-440	0	0	100	52307900	1	93	6.59
441-450	0	0	100	48333300	1	94	5.96
451-460	0	0	100	45148000	1	95	5.38
461-470	0	0	100	43238800	1	95	4.82
471-480	0	0	100	40329300	1	96	4.30
481-490	0	0	100	38792400	1	96	3.80
491-500	0	0	100	36784900	0	97	3.33
501-510	0	0	100	33766400	0	97	2.89
511-520	0	0	100	30941300	0	98	2.49
521-530	0	0	100	29388100	0	98	2.11
531-540	0	0	100	28584600	0	98	1.74
541-550	0	0	100	26817900	0	99	1.40
551-560	0	0	100	25582100	0	99	1.07
561-570	0	0	100	23203100	0	99	0.77
571-580	0	0	100	21111400	0	100	0.49
581-590	0	0	100	20017100	0	100	0.23
591-600	0	0	100	18159900	0	100	0.00
TOTAL	53	100		7743386400	100		

Calc = 45.74%
Crit = 18.68%
Reject Ho

Argyll CSAEB and Altitude (Kolmogorov-Smirnov)

Altitude Bands (m)	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0-10	2	50	50	430807100	6	6	44.44
11-20	0	0	50	356221400	5	10	39.84
21-30	1	25	75	297165000	4	14	61.00
31-40	0	0	75	287003300	4	18	57.29
41-50	1	25	100	258907300	3	21	78.95
51-60	0	0	100	242793200	3	24	75.81
61-70	0	0	100	234051800	3	27	72.79
71-80	0	0	100	228587200	3	30	69.84
81-90	0	0	100	218293000	3	33	67.02
91-100	0	0	100	212727000	3	36	64.27
101-110	0	0	100	210100600	3	38	61.56
111-120	0	0	100	201918300	3	41	58.95
121-130	0	0	100	197013500	3	44	56.41
131-140	0	0	100	196907100	3	46	53.86
141-150	0	0	100	192666400	2	49	51.38
151-160	0	0	100	189155800	2	51	48.93
161-170	0	0	100	187828700	2	53	46.51
171-180	0	0	100	181951900	2	56	44.16
181-190	0	0	100	175585300	2	58	41.89
191-200	0	0	100	172656000	2	60	39.66
201-210	0	0	100	168843300	2	63	37.48
211-220	0	0	100	163020300	2	65	35.37
221-230	0	0	100	156530500	2	67	33.35
231-240	0	0	100	152082500	2	69	31.39
241-250	0	0	100	144308700	2	70	29.53
251-260	0	0	100	139105000	2	72	27.73
261-270	0	0	100	134738200	2	74	25.99
271-280	0	0	100	128673500	2	76	24.33
281-290	0	0	100	122865500	2	77	22.74
291-300	0	0	100	120498700	2	79	21.18
301-310	0	0	100	113183900	1	80	19.72
311-320	0	0	100	107480500	1	82	18.33
321-330	0	0	100	100591400	1	83	17.04
331-340	0	0	100	98266000	1	84	15.77
341-350	0	0	100	92167500	1	85	14.58
351-360	0	0	100	87751900	1	87	13.44
361-370	0	0	100	84834100	1	88	12.35
371-380	0	0	100	75473100	1	89	11.37
381-390	0	0	100	71176500	1	90	10.45
391-400	0	0	100	67290400	1	90	9.58
401-410	0	0	100	64434500	1	91	8.75
411-420	0	0	100	59194200	1	92	7.99
421-430	0	0	100	56029800	1	93	7.26
431-440	0	0	100	52307900	1	93	6.59
441-450	0	0	100	48333300	1	94	5.96
451-460	0	0	100	45148000	1	95	5.38
461-470	0	0	100	43238800	1	95	4.82
471-480	0	0	100	40329300	1	96	4.30
481-490	0	0	100	38792400	1	96	3.80
491-500	0	0	100	36784900	0	97	3.33
501-510	0	0	100	33766400	0	97	2.89
511-520	0	0	100	30941300	0	98	2.49
521-530	0	0	100	29388100	0	98	2.11
531-540	0	0	100	28584600	0	98	1.74
541-550	0	0	100	26817900	0	99	1.40
551-560	0	0	100	25582100	0	99	1.07
561-570	0	0	100	23203100	0	99	0.77
571-580	0	0	100	21111400	0	100	0.49
581-590	0	0	100	20017100	0	100	0.23
591-600	0	0	100	18159900	0	100	0.00
TOTAL	4	100		7743386400	100		

Calc = 78.95%
Crit = 68.00%
Reject Ho

Argyll CSAEA and Altitude (Kolmogorov-Smirnov)

Altitude Bands (m)	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0-10	4	80	80	430807100	6	6	74.44
11-20	0	0	80	356221400	5	10	69.84
21-30	0	0	80	297165000	4	14	66.00
31-40	0	0	80	287003300	4	18	62.29
41-50	0	0	80	258907300	3	21	58.95
51-60	0	0	80	242793200	3	24	55.81
61-70	0	0	80	234051800	3	27	52.79
71-80	0	0	80	228587200	3	30	49.84
81-90	1	20	100	218293000	3	33	67.02
91-100	0	0	100	212727000	3	36	64.27
101-110	0	0	100	210100600	3	38	61.56
111-120	0	0	100	201918300	3	41	58.95
121-130	0	0	100	197013500	3	44	56.41
131-140	0	0	100	196907100	3	46	53.86
141-150	0	0	100	192666400	2	49	51.38
151-160	0	0	100	189155800	2	51	48.93
161-170	0	0	100	187828700	2	53	46.51
171-180	0	0	100	181951900	2	56	44.16
181-190	0	0	100	175585300	2	58	41.89
191-200	0	0	100	172656000	2	60	39.66
201-210	0	0	100	168843300	2	63	37.48
211-220	0	0	100	163020300	2	65	35.37
221-230	0	0	100	156530500	2	67	33.35
231-240	0	0	100	152082500	2	69	31.39
241-250	0	0	100	144308700	2	70	29.53
251-260	0	0	100	139105000	2	72	27.73
261-270	0	0	100	134738200	2	74	25.99
271-280	0	0	100	128673500	2	76	24.33
281-290	0	0	100	122865500	2	77	22.74
291-300	0	0	100	120498700	2	79	21.18
301-310	0	0	100	113183900	1	80	19.72
311-320	0	0	100	107480500	1	82	18.33
321-330	0	0	100	100591400	1	83	17.04
331-340	0	0	100	98266000	1	84	15.77
341-350	0	0	100	92167500	1	85	14.58
351-360	0	0	100	87751900	1	87	13.44
361-370	0	0	100	84834100	1	88	12.35
371-380	0	0	100	75473100	1	89	11.37
381-390	0	0	100	71176500	1	90	10.45
391-400	0	0	100	67290400	1	90	9.58
401-410	0	0	100	64434500	1	91	8.75
411-420	0	0	100	59194200	1	92	7.99
421-430	0	0	100	56029800	1	93	7.26
431-440	0	0	100	52307900	1	93	6.59
441-450	0	0	100	48333300	1	94	5.96
451-460	0	0	100	45148000	1	95	5.38
461-470	0	0	100	43238800	1	95	4.82
471-480	0	0	100	40329300	1	96	4.30
481-490	0	0	100	38792400	1	96	3.80
491-500	0	0	100	36784900	0	97	3.33
501-510	0	0	100	33766400	0	97	2.89
511-520	0	0	100	30941300	0	98	2.49
521-530	0	0	100	29388100	0	98	2.11
531-540	0	0	100	28584600	0	98	1.74
541-550	0	0	100	26817900	0	99	1.40
551-560	0	0	100	25582100	0	99	1.07
561-570	0	0	100	23203100	0	99	0.77
571-580	0	0	100	21111400	0	100	0.49
581-590	0	0	100	20017100	0	100	0.23
591-600	0	0	100	18159900	0	100	0.00
TOTAL	5	100		7743386400	100		

Calc = 74.44%

Crit =60.82 %

Reject Ho

Argyll All earth constructed sites and Altitude (Kolmogorov-Smirnov)

Altitude Bands (m)	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0-10	4	67	67	430807100	6	6	61.10
11-20	0	0	67	356221400	5	10	56.50
21-30	0	0	67	297165000	4	14	52.67
31-40	0	0	67	287003300	4	18	48.96
41-50	0	0	67	258907300	3	21	45.62
51-60	0	0	67	242793200	3	24	42.48
61-70	0	0	67	234051800	3	27	39.46
71-80	1	17	83	228587200	3	30	53.17
81-90	0	0	83	218293000	3	33	50.35
91-100	0	0	83	212727000	3	36	47.61
101-110	0	0	83	210100600	3	38	44.89
111-120	0	0	83	201918300	3	41	42.28
121-130	0	0	83	197013500	3	44	39.74
131-140	0	0	83	196907100	3	46	37.20
141-150	0	0	83	192666400	2	49	34.71
151-160	1	17	100	189155800	2	51	48.93
161-170	0	0	100	187828700	2	53	46.51
171-180	0	0	100	181951900	2	56	44.16
181-190	0	0	100	175585300	2	58	41.89
191-200	0	0	100	172656000	2	60	39.66
201-210	0	0	100	168843300	2	63	37.48
211-220	0	0	100	163020300	2	65	35.37
221-230	0	0	100	156530500	2	67	33.35
231-240	0	0	100	152082500	2	69	31.39
241-250	0	0	100	144308700	2	70	29.53
251-260	0	0	100	139105000	2	72	27.73
261-270	0	0	100	134738200	2	74	25.99
271-280	0	0	100	128673500	2	76	24.33
281-290	0	0	100	122865500	2	77	22.74
291-300	0	0	100	120498700	2	79	21.18
301-310	0	0	100	113183900	1	80	19.72
311-320	0	0	100	107480500	1	82	18.33
321-330	0	0	100	100591400	1	83	17.04
331-340	0	0	100	98266000	1	84	15.77
341-350	0	0	100	92167500	1	85	14.58
351-360	0	0	100	87751900	1	87	13.44
361-370	0	0	100	84834100	1	88	12.35
371-380	0	0	100	75473100	1	89	11.37
381-390	0	0	100	71176500	1	90	10.45
391-400	0	0	100	67290400	1	90	9.58
401-410	0	0	100	64434500	1	91	8.75
411-420	0	0	100	59194200	1	92	7.99
421-430	0	0	100	56029800	1	93	7.26
431-440	0	0	100	52307900	1	93	6.59
441-450	0	0	100	48333300	1	94	5.96
451-460	0	0	100	45148000	1	95	5.38
461-470	0	0	100	43238800	1	95	4.82
471-480	0	0	100	40329300	1	96	4.30
481-490	0	0	100	38792400	1	96	3.80
491-500	0	0	100	36784900	0	97	3.33
501-510	0	0	100	33766400	0	97	2.89
511-520	0	0	100	30941300	0	98	2.49
521-530	0	0	100	29388100	0	98	2.11
531-540	0	0	100	28584600	0	98	1.74
541-550	0	0	100	26817900	0	99	1.40
551-560	0	0	100	25582100	0	99	1.07
561-570	0	0	100	23203100	0	99	0.77
571-580	0	0	100	21111400	0	100	0.49
581-590	0	0	100	20017100	0	100	0.23
591-600	0	0	100	18159900	0	100	0.00
TOTAL	6	100		7743386400	100		

Calc = 61.10%
Crit = 55.52%
Reject Ho

Argyll RSB and Altitude (Kolmogorov-Smirnov)

Altitude Bands (m)	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0-10	6	38	38	430807100	6	6	31.94
11-20	2	13	50	356221400	5	10	39.84
21-30	0	0	50	297165000	4	14	36.00
31-40	0	0	50	287003300	4	18	32.29
41-50	3	19	69	258907300	3	21	47.70
51-60	2	13	81	242793200	3	24	57.06
61-70	0	0	81	234051800	3	27	54.04
71-80	1	6	88	228587200	3	30	57.34
81-90	0	0	88	218293000	3	33	54.52
91-100	1	6	94	212727000	3	36	58.02
101-110	0	0	94	210100600	3	38	55.31
111-120	1	6	100	201918300	3	41	58.95
121-130	0	0	100	197013500	3	44	56.41
131-140	0	0	100	196907100	3	46	53.86
141-150	0	0	100	192666400	2	49	51.38
151-160	0	0	100	189155800	2	51	48.93
161-170	0	0	100	187828700	2	53	46.51
171-180	0	0	100	181951900	2	56	44.16
181-190	0	0	100	175585300	2	58	41.89
191-200	0	0	100	172656000	2	60	39.66
201-210	0	0	100	168843300	2	63	37.48
211-220	0	0	100	163020300	2	65	35.37
221-230	0	0	100	156530500	2	67	33.35
231-240	0	0	100	152082500	2	69	31.39
241-250	0	0	100	144308700	2	70	29.53
251-260	0	0	100	139105000	2	72	27.73
261-270	0	0	100	134738200	2	74	25.99
271-280	0	0	100	128673500	2	76	24.33
281-290	0	0	100	122865500	2	77	22.74
291-300	0	0	100	120498700	2	79	21.18
301-310	0	0	100	113183900	1	80	19.72
311-320	0	0	100	107480500	1	82	18.33
321-330	0	0	100	100591400	1	83	17.04
331-340	0	0	100	98266000	1	84	15.77
341-350	0	0	100	92167500	1	85	14.58
351-360	0	0	100	87751900	1	87	13.44
361-370	0	0	100	84834100	1	88	12.35
371-380	0	0	100	75473100	1	89	11.37
381-390	0	0	100	71176500	1	90	10.45
391-400	0	0	100	67290400	1	90	9.58
401-410	0	0	100	64434500	1	91	8.75
411-420	0	0	100	59194200	1	92	7.99
421-430	0	0	100	56029800	1	93	7.26
431-440	0	0	100	52307900	1	93	6.59
441-450	0	0	100	48333300	1	94	5.96
451-460	0	0	100	45148000	1	95	5.38
461-470	0	0	100	43238800	1	95	4.82
471-480	0	0	100	40329300	1	96	4.30
481-490	0	0	100	38792400	1	96	3.80
491-500	0	0	100	36784900	0	97	3.33
501-510	0	0	100	33766400	0	97	2.89
511-520	0	0	100	30941300	0	98	2.49
521-530	0	0	100	29388100	0	98	2.11
531-540	0	0	100	28584600	0	98	1.74
541-550	0	0	100	26817900	0	99	1.40
551-560	0	0	100	25582100	0	99	1.07
561-570	0	0	100	23203100	0	99	0.77
571-580	0	0	100	21111400	0	100	0.49
581-590	0	0	100	20017100	0	100	0.23
591-600	0	0	100	18159900	0	100	0.00
TOTAL	16	100		7743386400	100		

Calc = 58.95%

Crit = 34.00%

Reject Ho

Argyll RSA and Altitude (Kolmogorov-Smirnov)

Altitude Bands (m)	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0-10	8	28	28	430807100	6	6	22.02
11-20	2	7	34	356221400	5	10	24.32
21-30	2	7	41	297165000	4	14	27.38
31-40	3	10	52	287003300	4	18	34.02
41-50	2	7	59	258907300	3	21	37.57
51-60	0	0	59	242793200	3	24	34.43
61-70	1	3	62	234051800	3	27	34.86
71-80	2	7	69	228587200	3	30	38.80
81-90	2	7	76	218293000	3	33	42.88
91-100	0	0	76	212727000	3	36	40.13
101-110	0	0	76	210100600	3	38	37.42
111-120	0	0	76	201918300	3	41	34.81
121-130	1	3	79	197013500	3	44	35.72
131-140	1	3	83	196907100	3	46	36.62
141-150	1	3	86	192666400	2	49	37.58
151-160	1	3	90	189155800	2	51	38.59
161-170	1	3	93	187828700	2	53	39.61
171-180	1	3	97	181951900	2	56	40.71
181-190	0	0	97	175585300	2	58	38.44
191-200	0	0	97	172656000	2	60	36.21
201-210	0	0	97	168843300	2	63	34.03
211-220	0	0	97	163020300	2	65	31.93
221-230	0	0	97	156530500	2	67	29.90
231-240	0	0	97	152082500	2	69	27.94
241-250	1	3	100	144308700	2	70	29.53
251-260	0	0	100	139105000	2	72	27.73
261-270	0	0	100	134738200	2	74	25.99
271-280	0	0	100	128673500	2	76	24.33
281-290	0	0	100	122865500	2	77	22.74
291-300	0	0	100	120498700	2	79	21.18
301-310	0	0	100	113183900	1	80	19.72
311-320	0	0	100	107480500	1	82	18.33
321-330	0	0	100	100591400	1	83	17.04
331-340	0	0	100	98266000	1	84	15.77
341-350	0	0	100	92167500	1	85	14.58
351-360	0	0	100	87751900	1	87	13.44
361-370	0	0	100	84834100	1	88	12.35
371-380	0	0	100	75473100	1	89	11.37
381-390	0	0	100	71176500	1	90	10.45
391-400	0	0	100	67290400	1	90	9.58
401-410	0	0	100	64434500	1	91	8.75
411-420	0	0	100	59194200	1	92	7.99
421-430	0	0	100	56029800	1	93	7.26
431-440	0	0	100	52307900	1	93	6.59
441-450	0	0	100	48333300	1	94	5.96
451-460	0	0	100	45148000	1	95	5.38
461-470	0	0	100	43238800	1	95	4.82
471-480	0	0	100	40329300	1	96	4.30
481-490	0	0	100	38792400	1	96	3.80
491-500	0	0	100	36784900	0	97	3.33
501-510	0	0	100	33766400	0	97	2.89
511-520	0	0	100	30941300	0	98	2.49
521-530	0	0	100	29388100	0	98	2.11
531-540	0	0	100	28584600	0	98	1.74
541-550	0	0	100	26817900	0	99	1.40
551-560	0	0	100	25582100	0	99	1.07
561-570	0	0	100	23203100	0	99	0.77
571-580	0	0	100	21111400	0	100	0.49
581-590	0	0	100	20017100	0	100	0.23
591-600	0	0	100	18159900	0	100	0.00
TOTAL	29	100		7743386400	100		

Calc = 42.88%

Crit = 25.25%

Reject Ho

Argyll ICSB and Altitude (Kolmogorov-Smirnov)

Altitude Bands (m)	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0-10	5	22	22	430807100	6	6	16.18
11-20	1	4	26	356221400	5	10	15.92
21-30	0	0	26	297165000	4	14	12.09
31-40	2	9	35	287003300	4	18	17.07
41-50	1	4	39	258907300	3	21	18.08
51-60	4	17	57	242793200	3	24	32.33
61-70	3	13	70	234051800	3	27	42.36
71-80	2	9	78	228587200	3	30	48.10
81-90	0	0	78	218293000	3	33	45.28
91-100	0	0	78	212727000	3	36	42.53
101-110	3	13	91	210100600	3	38	52.86
111-120	1	4	96	201918300	3	41	54.60
121-130	0	0	96	197013500	3	44	52.06
131-140	0	0	96	196907100	3	46	49.52
141-150	0	0	96	192666400	2	49	47.03
151-160	0	0	96	189155800	2	51	44.59
161-170	1	4	100	187828700	2	53	46.51
171-180	0	0	100	181951900	2	56	44.16
181-190	0	0	100	175585300	2	58	41.89
191-200	0	0	100	172656000	2	60	39.66
201-210	0	0	100	168843300	2	63	37.48
211-220	0	0	100	163020300	2	65	35.37
221-230	0	0	100	156530500	2	67	33.35
231-240	0	0	100	152082500	2	69	31.39
241-250	0	0	100	144308700	2	70	29.53
251-260	0	0	100	139105000	2	72	27.73
261-270	0	0	100	134738200	2	74	25.99
271-280	0	0	100	128673500	2	76	24.33
281-290	0	0	100	122865500	2	77	22.74
291-300	0	0	100	120498700	2	79	21.18
301-310	0	0	100	113183900	1	80	19.72
311-320	0	0	100	107480500	1	82	18.33
321-330	0	0	100	100591400	1	83	17.04
331-340	0	0	100	98266000	1	84	15.77
341-350	0	0	100	92167500	1	85	14.58
351-360	0	0	100	87751900	1	87	13.44
361-370	0	0	100	84834100	1	88	12.35
371-380	0	0	100	75473100	1	89	11.37
381-390	0	0	100	71176500	1	90	10.45
391-400	0	0	100	67290400	1	90	9.58
401-410	0	0	100	64434500	1	91	8.75
411-420	0	0	100	59194200	1	92	7.99
421-430	0	0	100	56029800	1	93	7.26
431-440	0	0	100	52307900	1	93	6.59
441-450	0	0	100	48333300	1	94	5.96
451-460	0	0	100	45148000	1	95	5.38
461-470	0	0	100	43238800	1	95	4.82
471-480	0	0	100	40329300	1	96	4.30
481-490	0	0	100	38792400	1	96	3.80
491-500	0	0	100	36784900	0	97	3.33
501-510	0	0	100	33766400	0	97	2.89
511-520	0	0	100	30941300	0	98	2.49
521-530	0	0	100	29388100	0	98	2.11
531-540	0	0	100	28584600	0	98	1.74
541-550	0	0	100	26817900	0	99	1.40
551-560	0	0	100	25582100	0	99	1.07
561-570	0	0	100	23203100	0	99	0.77
571-580	0	0	100	21111400	0	100	0.49
581-590	0	0	100	20017100	0	100	0.23
591-600	0	0	100	18159900	0	100	0.00
TOTAL	23	100		7743386400	100		

Calc = 54.60%
Crit = 28.35%
Reject Ho

Argyll ICSA and Altitude (Kolmogorov-Smirnov)

Altitude Bands (m)	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0-10	5	12	12	430807100	6	6	6.06
11-20	3	7	19	356221400	5	10	8.44
21-30	2	5	23	297165000	4	14	9.25
31-40	5	12	35	287003300	4	18	17.18
41-50	2	5	40	258907300	3	21	18.48
51-60	5	12	51	242793200	3	24	26.98
61-70	3	7	58	234051800	3	27	30.93
71-80	2	5	63	228587200	3	30	32.63
81-90	5	12	74	218293000	3	33	41.44
91-100	2	5	79	212727000	3	36	43.34
101-110	1	2	81	210100600	3	38	42.95
111-120	1	2	84	201918300	3	41	42.67
121-130	1	2	86	197013500	3	44	42.45
131-140	1	2	88	196907100	3	46	42.24
141-150	2	5	93	192666400	2	49	44.40
151-160	0	0	93	189155800	2	51	41.96
161-170	0	0	93	187828700	2	53	39.53
171-180	1	2	95	181951900	2	56	39.51
181-190	0	0	95	175585300	2	58	37.24
191-200	1	2	98	172656000	2	60	37.33
201-210	0	0	98	168843300	2	63	35.15
211-220	0	0	98	163020300	2	65	33.05
221-230	1	2	100	156530500	2	67	33.35
231-240	0	0	100	152082500	2	69	31.39
241-250	0	0	100	144308700	2	70	29.53
251-260	0	0	100	139105000	2	72	27.73
261-270	0	0	100	134738200	2	74	25.99
271-280	0	0	100	128673500	2	76	24.33
281-290	0	0	100	122865500	2	77	22.74
291-300	0	0	100	120498700	2	79	21.18
301-310	0	0	100	113183900	1	80	19.72
311-320	0	0	100	107480500	1	82	18.33
321-330	0	0	100	100591400	1	83	17.04
331-340	0	0	100	98266000	1	84	15.77
341-350	0	0	100	92167500	1	85	14.58
351-360	0	0	100	87751900	1	87	13.44
361-370	0	0	100	84834100	1	88	12.35
371-380	0	0	100	75473100	1	89	11.37
381-390	0	0	100	71176500	1	90	10.45
391-400	0	0	100	67290400	1	90	9.58
401-410	0	0	100	64434500	1	91	8.75
411-420	0	0	100	59194200	1	92	7.99
421-430	0	0	100	56029800	1	93	7.26
431-440	0	0	100	52307900	1	93	6.59
441-450	0	0	100	48333300	1	94	5.96
451-460	0	0	100	45148000	1	95	5.38
461-470	0	0	100	43238800	1	95	4.82
471-480	0	0	100	40329300	1	96	4.30
481-490	0	0	100	38792400	1	96	3.80
491-500	0	0	100	36784900	0	97	3.33
501-510	0	0	100	33766400	0	97	2.89
511-520	0	0	100	30941300	0	98	2.49
521-530	0	0	100	29388100	0	98	2.11
531-540	0	0	100	28584600	0	98	1.74
541-550	0	0	100	26817900	0	99	1.40
551-560	0	0	100	25582100	0	99	1.07
561-570	0	0	100	23203100	0	99	0.77
571-580	0	0	100	21111400	0	100	0.49
581-590	0	0	100	20017100	0	100	0.23
591-600	0	0	100	18159900	0	100	0.00
TOTAL	43	100		7743386400	100		

Calc =44.40%

Crit = 20.74%

Reject Ho

Argyll IRSB and Altitude (Kolmogorov-Smirnov)

Altitude Bands (m)	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0-10	4	100	100	430807100	6	6	94.44
11-20	0	0	100	356221400	5	10	89.84
21-30	0	0	100	297165000	4	14	86.00
31-40	0	0	100	287003300	4	18	82.29
41-50	0	0	100	258907300	3	21	78.95
51-60	0	0	100	242793200	3	24	75.81
61-70	0	0	100	234051800	3	27	72.79
71-80	0	0	100	228587200	3	30	69.84
81-90	0	0	100	218293000	3	33	67.02
91-100	0	0	100	212727000	3	36	64.27
101-110	0	0	100	210100600	3	38	61.56
111-120	0	0	100	201918300	3	41	58.95
121-130	0	0	100	197013500	3	44	56.41
131-140	0	0	100	196907100	3	46	53.86
141-150	0	0	100	192666400	2	49	51.38
151-160	0	0	100	189155800	2	51	48.93
161-170	0	0	100	187828700	2	53	46.51
171-180	0	0	100	181951900	2	56	44.16
181-190	0	0	100	175585300	2	58	41.89
191-200	0	0	100	172656000	2	60	39.66
201-210	0	0	100	168843300	2	63	37.48
211-220	0	0	100	163020300	2	65	35.37
221-230	0	0	100	156530500	2	67	33.35
231-240	0	0	100	152082500	2	69	31.39
241-250	0	0	100	144308700	2	70	29.53
251-260	0	0	100	139105000	2	72	27.73
261-270	0	0	100	134738200	2	74	25.99
271-280	0	0	100	128673500	2	76	24.33
281-290	0	0	100	122865500	2	77	22.74
291-300	0	0	100	120498700	2	79	21.18
301-310	0	0	100	113183900	1	80	19.72
311-320	0	0	100	107480500	1	82	18.33
321-330	0	0	100	100591400	1	83	17.04
331-340	0	0	100	98266000	1	84	15.77
341-350	0	0	100	92167500	1	85	14.58
351-360	0	0	100	87751900	1	87	13.44
361-370	0	0	100	84834100	1	88	12.35
371-380	0	0	100	75473100	1	89	11.37
381-390	0	0	100	71176500	1	90	10.45
391-400	0	0	100	67290400	1	90	9.58
401-410	0	0	100	64434500	1	91	8.75
411-420	0	0	100	59194200	1	92	7.99
421-430	0	0	100	56029800	1	93	7.26
431-440	0	0	100	52307900	1	93	6.59
441-450	0	0	100	48333300	1	94	5.96
451-460	0	0	100	45148000	1	95	5.38
461-470	0	0	100	43238800	1	95	4.82
471-480	0	0	100	40329300	1	96	4.30
481-490	0	0	100	38792400	1	96	3.80
491-500	0	0	100	36784900	0	97	3.33
501-510	0	0	100	33766400	0	97	2.89
511-520	0	0	100	30941300	0	98	2.49
521-530	0	0	100	29388100	0	98	2.11
531-540	0	0	100	28584600	0	98	1.74
541-550	0	0	100	26817900	0	99	1.40
551-560	0	0	100	25582100	0	99	1.07
561-570	0	0	100	23203100	0	99	0.77
571-580	0	0	100	21111400	0	100	0.49
581-590	0	0	100	20017100	0	100	0.23
591-600	0	0	100	18159900	0	100	0.00
TOTAL	4	100		7743386400	100		

Calc = 94.44%
Crit = 68.00%
Reject Ho

Argyll IRSA and Altitude (Kolmogorov-Smirnov)

Altitude Bands (m)	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0-10	7	22	22	430807100	6	6	16.31
11-20	5	16	38	356221400	5	10	27.34
21-30	3	9	47	297165000	4	14	32.87
31-40	4	13	59	287003300	4	18	41.67
41-50	1	3	63	258907300	3	21	41.45
51-60	1	3	66	242793200	3	24	41.44
61-70	3	9	75	234051800	3	27	47.79
71-80	1	3	78	228587200	3	30	47.96
81-90	0	0	78	218293000	3	33	45.14
91-100	0	0	78	212727000	3	36	42.40
101-110	0	0	78	210100600	3	38	39.68
111-120	1	3	81	201918300	3	41	40.20
121-130	1	3	84	197013500	3	44	40.78
131-140	0	0	84	196907100	3	46	38.24
141-150	1	3	88	192666400	2	49	38.88
151-160	1	3	91	189155800	2	51	39.56
161-170	1	3	94	187828700	2	53	40.26
171-180	0	0	94	181951900	2	56	37.91
181-190	0	0	94	175585300	2	58	35.64
191-200	0	0	94	172656000	2	60	33.41
201-210	0	0	94	168843300	2	63	31.23
211-220	2	6	100	163020300	2	65	35.37
221-230	0	0	100	156530500	2	67	33.35
231-240	0	0	100	152082500	2	69	31.39
241-250	0	0	100	144308700	2	70	29.53
251-260	0	0	100	139105000	2	72	27.73
261-270	0	0	100	134738200	2	74	25.99
271-280	0	0	100	128673500	2	76	24.33
281-290	0	0	100	122865500	2	77	22.74
291-300	0	0	100	120498700	2	79	21.18
301-310	0	0	100	113183900	1	80	19.72
311-320	0	0	100	107480500	1	82	18.33
321-330	0	0	100	100591400	1	83	17.04
331-340	0	0	100	98266000	1	84	15.77
341-350	0	0	100	92167500	1	85	14.58
351-360	0	0	100	87751900	1	87	13.44
361-370	0	0	100	84834100	1	88	12.35
371-380	0	0	100	75473100	1	89	11.37
381-390	0	0	100	71176500	1	90	10.45
391-400	0	0	100	67290400	1	90	9.58
401-410	0	0	100	64434500	1	91	8.75
411-420	0	0	100	59194200	1	92	7.99
421-430	0	0	100	56029800	1	93	7.26
431-440	0	0	100	52307900	1	93	6.59
441-450	0	0	100	48333300	1	94	5.96
451-460	0	0	100	45148000	1	95	5.38
461-470	0	0	100	43238800	1	95	4.82
471-480	0	0	100	40329300	1	96	4.30
481-490	0	0	100	38792400	1	96	3.80
491-500	0	0	100	36784900	0	97	3.33
501-510	0	0	100	33766400	0	97	2.89
511-520	0	0	100	30941300	0	98	2.49
521-530	0	0	100	29388100	0	98	2.11
531-540	0	0	100	28584600	0	98	1.74
541-550	0	0	100	26817900	0	99	1.40
551-560	0	0	100	25582100	0	99	1.07
561-570	0	0	100	23203100	0	99	0.77
571-580	0	0	100	21111400	0	100	0.49
581-590	0	0	100	20017100	0	100	0.23
591-600	0	0	100	18159900	0	100	0.00
TOTAL	32	100		7743386400	100		

Calc = 40.96%
Crit = 24.04%
Reject Ho

Argyll IISB and Altitude (Kolmogorov-Smirnov)

Altitude Bands (m)	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0-10	2	67	67	430807100	6	6	61.10
11-20	1	33	100	356221400	5	10	89.84
21-30	0	0	100	297165000	4	14	86.00
31-40	0	0	100	287003300	4	18	82.29
41-50	0	0	100	258907300	3	21	78.95
51-60	0	0	100	242793200	3	24	75.81
61-70	0	0	100	234051800	3	27	72.79
71-80	0	0	100	228587200	3	30	69.84
81-90	0	0	100	218293000	3	33	67.02
91-100	0	0	100	212727000	3	36	64.27
101-110	0	0	100	210100600	3	38	61.56
111-120	0	0	100	201918300	3	41	58.95
121-130	0	0	100	197013500	3	44	56.41
131-140	0	0	100	196907100	3	46	53.86
141-150	0	0	100	192666400	2	49	51.38
151-160	0	0	100	189155800	2	51	48.93
161-170	0	0	100	187828700	2	53	46.51
171-180	0	0	100	181951900	2	56	44.16
181-190	0	0	100	175585300	2	58	41.89
191-200	0	0	100	172656000	2	60	39.66
201-210	0	0	100	168843300	2	63	37.48
211-220	0	0	100	163020300	2	65	35.37
221-230	0	0	100	156530500	2	67	33.35
231-240	0	0	100	152082500	2	69	31.39
241-250	0	0	100	144308700	2	70	29.53
251-260	0	0	100	139105000	2	72	27.73
261-270	0	0	100	134738200	2	74	25.99
271-280	0	0	100	128673500	2	76	24.33
281-290	0	0	100	122865500	2	77	22.74
291-300	0	0	100	120498700	2	79	21.18
301-310	0	0	100	113183900	1	80	19.72
311-320	0	0	100	107480500	1	82	18.33
321-330	0	0	100	100591400	1	83	17.04
331-340	0	0	100	98266000	1	84	15.77
341-350	0	0	100	92167500	1	85	14.58
351-360	0	0	100	87751900	1	87	13.44
361-370	0	0	100	84834100	1	88	12.35
371-380	0	0	100	75473100	1	89	11.37
381-390	0	0	100	71176500	1	90	10.45
391-400	0	0	100	67290400	1	90	9.58
401-410	0	0	100	64434500	1	91	8.75
411-420	0	0	100	59194200	1	92	7.99
421-430	0	0	100	56029800	1	93	7.26
431-440	0	0	100	52307900	1	93	6.59
441-450	0	0	100	48333300	1	94	5.96
451-460	0	0	100	45148000	1	95	5.38
461-470	0	0	100	43238800	1	95	4.82
471-480	0	0	100	40329300	1	96	4.30
481-490	0	0	100	38792400	1	96	3.80
491-500	0	0	100	36784900	0	97	3.33
501-510	0	0	100	33766400	0	97	2.89
511-520	0	0	100	30941300	0	98	2.49
521-530	0	0	100	29388100	0	98	2.11
531-540	0	0	100	28584600	0	98	1.74
541-550	0	0	100	26817900	0	99	1.40
551-560	0	0	100	25582100	0	99	1.07
561-570	0	0	100	23203100	0	99	0.77
571-580	0	0	100	21111400	0	100	0.49
581-590	0	0	100	20017100	0	100	0.23
591-600	0	0	100	18159900	0	100	0.00
TOTAL	3	100		7743386400	100		

Calc = 89.84%
Crit = 78.52%
Reject Ho

Argyll IISA and Altitude (Kolmogorov-Smirnov)

Altitude Bands (m)	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0-10	5	28	28	430807100	6	6	22.21
11-20	0	0	28	356221400	5	10	17.61
21-30	2	11	39	297165000	4	14	24.89
31-40	1	6	44	287003300	4	18	26.74
41-50	0	0	44	258907300	3	21	23.39
51-60	0	0	44	242793200	3	24	20.26
61-70	3	17	61	234051800	3	27	33.90
71-80	0	0	61	228587200	3	30	30.95
81-90	0	0	61	218293000	3	33	28.13
91-100	0	0	61	212727000	3	36	25.38
101-110	0	0	61	210100600	3	38	22.67
111-120	0	0	61	201918300	3	41	20.06
121-130	2	11	72	197013500	3	44	28.63
131-140	1	6	78	196907100	3	46	31.64
141-150	0	0	78	192666400	2	49	29.15
151-160	2	11	89	189155800	2	51	37.82
161-170	1	6	94	187828700	2	53	40.95
171-180	1	6	100	181951900	2	56	44.16
181-190	0	0	100	175585300	2	58	41.89
191-200	0	0	100	172656000	2	60	39.66
201-210	0	0	100	168843300	2	63	37.48
211-220	0	0	100	163020300	2	65	35.37
221-230	0	0	100	156530500	2	67	33.35
231-240	0	0	100	152082500	2	69	31.39
241-250	0	0	100	144308700	2	70	29.53
251-260	0	0	100	139105000	2	72	27.73
261-270	0	0	100	134738200	2	74	25.99
271-280	0	0	100	128673500	2	76	24.33
281-290	0	0	100	122865500	2	77	22.74
291-300	0	0	100	120498700	2	79	21.18
301-310	0	0	100	113183900	1	80	19.72
311-320	0	0	100	107480500	1	82	18.33
321-330	0	0	100	100591400	1	83	17.04
331-340	0	0	100	98266000	1	84	15.77
341-350	0	0	100	92167500	1	85	14.58
351-360	0	0	100	87751900	1	87	13.44
361-370	0	0	100	84834100	1	88	12.35
371-380	0	0	100	75473100	1	89	11.37
381-390	0	0	100	71176500	1	90	10.45
391-400	0	0	100	67290400	1	90	9.58
401-410	0	0	100	64434500	1	91	8.75
411-420	0	0	100	59194200	1	92	7.99
421-430	0	0	100	56029800	1	93	7.26
431-440	0	0	100	52307900	1	93	6.59
441-450	0	0	100	48333300	1	94	5.96
451-460	0	0	100	45148000	1	95	5.38
461-470	0	0	100	43238800	1	95	4.82
471-480	0	0	100	40329300	1	96	4.30
481-490	0	0	100	38792400	1	96	3.80
491-500	0	0	100	36784900	0	97	3.33
501-510	0	0	100	33766400	0	97	2.89
511-520	0	0	100	30941300	0	98	2.49
521-530	0	0	100	29388100	0	98	2.11
531-540	0	0	100	28584600	0	98	1.74
541-550	0	0	100	26817900	0	99	1.40
551-560	0	0	100	25582100	0	99	1.07
561-570	0	0	100	23203100	0	99	0.77
571-580	0	0	100	21111400	0	100	0.49
581-590	0	0	100	20017100	0	100	0.23
591-600	0	0	100	18159900	0	100	0.00
TOTAL	18	100		7743386400	100		

Calc = 44.16%
Crit = 32.06%
Reject Ho

Argyll PB and Altitude (Kolmogorov-Smirnov)

Altitude Bands (m)	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0-10	2	40	40	430807100	6	6	34.44
11-20	2	40	80	356221400	5	10	69.84
21-30	0	0	80	297165000	4	14	66.00
31-40	0	0	80	287003300	4	18	62.29
41-50	1	20	100	258907300	3	21	78.95
51-60	0	0	100	242793200	3	24	75.81
61-70	0	0	100	234051800	3	27	72.79
71-80	0	0	100	228587200	3	30	69.84
81-90	0	0	100	218293000	3	33	67.02
91-100	0	0	100	212727000	3	36	64.27
101-110	0	0	100	210100600	3	38	61.56
111-120	0	0	100	201918300	3	41	58.95
121-130	0	0	100	197013500	3	44	56.41
131-140	0	0	100	196907100	3	46	53.86
141-150	0	0	100	192666400	2	49	51.38
151-160	0	0	100	189155800	2	51	48.93
161-170	0	0	100	187828700	2	53	46.51
171-180	0	0	100	181951900	2	56	44.16
181-190	0	0	100	175585300	2	58	41.89
191-200	0	0	100	172656000	2	60	39.66
201-210	0	0	100	168843300	2	63	37.48
211-220	0	0	100	163020300	2	65	35.37
221-230	0	0	100	156530500	2	67	33.35
231-240	0	0	100	152082500	2	69	31.39
241-250	0	0	100	144308700	2	70	29.53
251-260	0	0	100	139105000	2	72	27.73
261-270	0	0	100	134738200	2	74	25.99
271-280	0	0	100	128673500	2	76	24.33
281-290	0	0	100	122865500	2	77	22.74
291-300	0	0	100	120498700	2	79	21.18
301-310	0	0	100	113183900	1	80	19.72
311-320	0	0	100	107480500	1	82	18.33
321-330	0	0	100	100591400	1	83	17.04
331-340	0	0	100	98266000	1	84	15.77
341-350	0	0	100	92167500	1	85	14.58
351-360	0	0	100	87751900	1	87	13.44
361-370	0	0	100	84834100	1	88	12.35
371-380	0	0	100	75473100	1	89	11.37
381-390	0	0	100	71176500	1	90	10.45
391-400	0	0	100	67290400	1	90	9.58
401-410	0	0	100	64434500	1	91	8.75
411-420	0	0	100	59194200	1	92	7.99
421-430	0	0	100	56029800	1	93	7.26
431-440	0	0	100	52307900	1	93	6.59
441-450	0	0	100	48333300	1	94	5.96
451-460	0	0	100	45148000	1	95	5.38
461-470	0	0	100	43238800	1	95	4.82
471-480	0	0	100	40329300	1	96	4.30
481-490	0	0	100	38792400	1	96	3.80
491-500	0	0	100	36784900	0	97	3.33
501-510	0	0	100	33766400	0	97	2.89
511-520	0	0	100	30941300	0	98	2.49
521-530	0	0	100	29388100	0	98	2.11
531-540	0	0	100	28584600	0	98	1.74
541-550	0	0	100	26817900	0	99	1.40
551-560	0	0	100	25582100	0	99	1.07
561-570	0	0	100	23203100	0	99	0.77
571-580	0	0	100	21111400	0	100	0.49
581-590	0	0	100	20017100	0	100	0.23
591-600	0	0	100	18159900	0	100	0.00
TOTAL	5	100		7743386400	100		

Calc = 78.95%
Crit = 60.82%
Reject Ho

Argyll PA and Altitude (Kolmogorov-Smirnov)

Altitude Bands (m)	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0-10	18	32	32	430807100	6	6	26.02
11-20	9	16	47	356221400	5	10	37.20
21-30	9	16	63	297165000	4	14	49.16
31-40	6	11	74	287003300	4	18	55.98
41-50	3	5	79	258907300	3	21	57.90
51-60	1	2	81	242793200	3	24	56.51
61-70	2	4	84	234051800	3	27	57.00
71-80	0	0	84	228587200	3	30	54.05
81-90	0	0	84	218293000	3	33	51.23
91-100	3	5	89	212727000	3	36	53.75
101-110	1	2	91	210100600	3	38	52.79
111-120	1	2	93	201918300	3	41	51.93
121-130	0	0	93	197013500	3	44	49.39
131-140	1	2	95	196907100	3	46	48.60
141-150	1	2	96	192666400	2	49	47.87
151-160	0	0	96	189155800	2	51	45.42
161-170	0	0	96	187828700	2	53	43.00
171-180	1	2	98	181951900	2	56	42.40
181-190	0	0	98	175585300	2	58	40.14
191-200	1	2	100	172656000	2	60	39.66
201-210	0	0	100	168843300	2	63	37.48
211-220	0	0	100	163020300	2	65	35.37
221-230	0	0	100	156530500	2	67	33.35
231-240	0	0	100	152082500	2	69	31.39
241-250	0	0	100	144308700	2	70	29.53
251-260	0	0	100	139105000	2	72	27.73
261-270	0	0	100	134738200	2	74	25.99
271-280	0	0	100	128673500	2	76	24.33
281-290	0	0	100	122865500	2	77	22.74
291-300	0	0	100	120498700	2	79	21.18
301-310	0	0	100	113183900	1	80	19.72
311-320	0	0	100	107480500	1	82	18.33
321-330	0	0	100	100591400	1	83	17.04
331-340	0	0	100	98266000	1	84	15.77
341-350	0	0	100	92167500	1	85	14.58
351-360	0	0	100	87751900	1	87	13.44
361-370	0	0	100	84834100	1	88	12.35
371-380	0	0	100	75473100	1	89	11.37
381-390	0	0	100	71176500	1	90	10.45
391-400	0	0	100	67290400	1	90	9.58
401-410	0	0	100	64434500	1	91	8.75
411-420	0	0	100	59194200	1	92	7.99
421-430	0	0	100	56029800	1	93	7.26
431-440	0	0	100	52307900	1	93	6.59
441-450	0	0	100	48333300	1	94	5.96
451-460	0	0	100	45148000	1	95	5.38
461-470	0	0	100	43238800	1	95	4.82
471-480	0	0	100	40329300	1	96	4.30
481-490	0	0	100	38792400	1	96	3.80
491-500	0	0	100	36784900	0	97	3.33
501-510	0	0	100	33766400	0	97	2.89
511-520	0	0	100	30941300	0	98	2.49
521-530	0	0	100	29388100	0	98	2.11
531-540	0	0	100	28584600	0	98	1.74
541-550	0	0	100	26817900	0	99	1.40
551-560	0	0	100	25582100	0	99	1.07
561-570	0	0	100	23203100	0	99	0.77
571-580	0	0	100	21111400	0	100	0.49
581-590	0	0	100	20017100	0	100	0.23
591-600	0	0	100	18159900	0	100	0.00
TOTAL	57	100		7743386400	100		

Calc = 52.90%

Crit = 18.01%

Reject Ho

Argyll AFCB and Altitude (Kolmogorov-Smirnov)

Altitude Bands (m)	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0-10	3	14	14	430807100	6	6	8.07
11-20	2	9	23	356221400	5	10	12.56
21-30	3	14	36	297165000	4	14	22.36
31-40	2	9	45	287003300	4	18	27.75
41-50	4	18	64	258907300	3	21	42.58
51-60	0	0	64	242793200	3	24	39.45
61-70	2	9	73	234051800	3	27	45.52
71-80	1	5	77	228587200	3	30	47.11
81-90	1	5	82	218293000	3	33	48.84
91-100	0	0	82	212727000	3	36	46.09
101-110	0	0	82	210100600	3	38	43.38
111-120	1	5	86	201918300	3	41	45.31
121-130	1	5	91	197013500	3	44	47.32
131-140	0	0	91	196907100	3	46	44.77
141-150	0	0	91	192666400	2	49	42.28
151-160	1	5	95	189155800	2	51	44.39
161-170	0	0	95	187828700	2	53	41.96
171-180	1	5	100	181951900	2	56	44.16
181-190	0	0	100	175585300	2	58	41.89
191-200	0	0	100	172656000	2	60	39.66
201-210	0	0	100	168843300	2	63	37.48
211-220	0	0	100	163020300	2	65	35.37
221-230	0	0	100	156530500	2	67	33.35
231-240	0	0	100	152082500	2	69	31.39
241-250	0	0	100	144308700	2	70	29.53
251-260	0	0	100	139105000	2	72	27.73
261-270	0	0	100	134738200	2	74	25.99
271-280	0	0	100	128673500	2	76	24.33
281-290	0	0	100	122865500	2	77	22.74
291-300	0	0	100	120498700	2	79	21.18
301-310	0	0	100	113183900	1	80	19.72
311-320	0	0	100	107480500	1	82	18.33
321-330	0	0	100	100591400	1	83	17.04
331-340	0	0	100	98266000	1	84	15.77
341-350	0	0	100	92167500	1	85	14.58
351-360	0	0	100	87751900	1	87	13.44
361-370	0	0	100	84834100	1	88	12.35
371-380	0	0	100	75473100	1	89	11.37
381-390	0	0	100	71176500	1	90	10.45
391-400	0	0	100	67290400	1	90	9.58
401-410	0	0	100	64434500	1	91	8.75
411-420	0	0	100	59194200	1	92	7.99
421-430	0	0	100	56029800	1	93	7.26
431-440	0	0	100	52307900	1	93	6.59
441-450	0	0	100	48333300	1	94	5.96
451-460	0	0	100	45148000	1	95	5.38
461-470	0	0	100	43238800	1	95	4.82
471-480	0	0	100	40329300	1	96	4.30
481-490	0	0	100	38792400	1	96	3.80
491-500	0	0	100	36784900	0	97	3.33
501-510	0	0	100	33766400	0	97	2.89
511-520	0	0	100	30941300	0	98	2.49
521-530	0	0	100	29388100	0	98	2.11
531-540	0	0	100	28584600	0	98	1.74
541-550	0	0	100	26817900	0	99	1.40
551-560	0	0	100	25582100	0	99	1.07
561-570	0	0	100	23203100	0	99	0.77
571-580	0	0	100	21111400	0	100	0.49
581-590	0	0	100	20017100	0	100	0.23
591-600	0	0	100	18159900	0	100	0.00
TOTAL	22	100		7743386400	100		

Calc = 48.84%
Crit = 29.00%
Reject Ho

Argyll AFCA and Altitude (Kolmogorov-Smirnov)

Altitude Bands (m)	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0-10	1	17	17	430807100	6	6	11.10
11-20	0	0	17	356221400	5	10	6.50
21-30	1	17	33	297165000	4	14	19.33
31-40	0	0	33	287003300	4	18	15.63
41-50	0	0	33	258907300	3	21	12.28
51-60	0	0	33	242793200	3	24	9.15
61-70	0	0	33	234051800	3	27	6.12
71-80	1	17	50	228587200	3	30	19.84
81-90	0	0	50	218293000	3	33	17.02
91-100	0	0	50	212727000	3	36	14.27
101-110	0	0	50	210100600	3	38	11.56
111-120	0	0	50	201918300	3	41	8.95
121-130	1	17	67	197013500	3	44	23.07
131-140	0	0	67	196907100	3	46	20.53
141-150	1	17	83	192666400	2	49	34.71
151-160	0	0	83	189155800	2	51	32.27
161-170	0	0	83	187828700	2	53	29.84
171-180	0	0	83	181951900	2	56	27.49
181-190	0	0	83	175585300	2	58	25.22
191-200	0	0	83	172656000	2	60	22.99
201-210	0	0	83	168843300	2	63	20.81
211-220	0	0	83	163020300	2	65	18.71
221-230	0	0	83	156530500	2	67	16.69
231-240	1	17	100	152082500	2	69	31.39
241-250	0	0	100	144308700	2	70	29.53
251-260	0	0	100	139105000	2	72	27.73
261-270	0	0	100	134738200	2	74	25.99
271-280	0	0	100	128673500	2	76	24.33
281-290	0	0	100	122865500	2	77	22.74
291-300	0	0	100	120498700	2	79	21.18
301-310	0	0	100	113183900	1	80	19.72
311-320	0	0	100	107480500	1	82	18.33
321-330	0	0	100	100591400	1	83	17.04
331-340	0	0	100	98266000	1	84	15.77
341-350	0	0	100	92167500	1	85	14.58
351-360	0	0	100	87751900	1	87	13.44
361-370	0	0	100	84834100	1	88	12.35
371-380	0	0	100	75473100	1	89	11.37
381-390	0	0	100	71176500	1	90	10.45
391-400	0	0	100	67290400	1	90	9.58
401-410	0	0	100	64434500	1	91	8.75
411-420	0	0	100	59194200	1	92	7.99
421-430	0	0	100	56029800	1	93	7.26
431-440	0	0	100	52307900	1	93	6.59
441-450	0	0	100	48333300	1	94	5.96
451-460	0	0	100	45148000	1	95	5.38
461-470	0	0	100	43238800	1	95	4.82
471-480	0	0	100	40329300	1	96	4.30
481-490	0	0	100	38792400	1	96	3.80
491-500	0	0	100	36784900	0	97	3.33
501-510	0	0	100	33766400	0	97	2.89
511-520	0	0	100	30941300	0	98	2.49
521-530	0	0	100	29388100	0	98	2.11
531-540	0	0	100	28584600	0	98	1.74
541-550	0	0	100	26817900	0	99	1.40
551-560	0	0	100	25582100	0	99	1.07
561-570	0	0	100	23203100	0	99	0.77
571-580	0	0	100	21111400	0	100	0.49
581-590	0	0	100	20017100	0	100	0.23
591-600	0	0	100	18159900	0	100	0.00
TOTAL	6	100		7743386400	100		

Calc = 34.71%
Crit = 55.52%
Cannot Reject Ho

Argyll AFIR and Altitude (Kolmogorov-Smirnov)

Altitude Bands (m)	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0-10	4	50	50	430807100	6	6	44.44
11-20	0	0	50	356221400	5	10	39.84
21-30	0	0	50	297165000	4	14	36.00
31-40	1	13	63	287003300	4	18	44.79
41-50	0	0	63	258907300	3	21	41.45
51-60	0	0	63	242793200	3	24	38.31
61-70	0	0	63	234051800	3	27	35.29
71-80	1	13	75	228587200	3	30	44.84
81-90	0	0	75	218293000	3	33	42.02
91-100	0	0	75	212727000	3	36	39.27
101-110	0	0	75	210100600	3	38	36.56
111-120	0	0	75	201918300	3	41	33.95
121-130	0	0	75	197013500	3	44	31.41
131-140	0	0	75	196907100	3	46	28.86
141-150	0	0	75	192666400	2	49	26.38
151-160	0	0	75	189155800	2	51	23.93
161-170	0	0	75	187828700	2	53	21.51
171-180	1	13	88	181951900	2	56	31.66
181-190	0	0	88	175585300	2	58	29.39
191-200	0	0	88	172656000	2	60	27.16
201-210	0	0	88	168843300	2	63	24.98
211-220	0	0	88	163020300	2	65	22.87
221-230	0	0	88	156530500	2	67	20.85
231-240	0	0	88	152082500	2	69	18.89
241-250	0	0	88	144308700	2	70	17.03
251-260	0	0	88	139105000	2	72	15.23
261-270	1	13	100	134738200	2	74	25.99
271-280	0	0	100	128673500	2	76	24.33
281-290	0	0	100	122865500	2	77	22.74
291-300	0	0	100	120498700	2	79	21.18
301-310	0	0	100	113183900	1	80	19.72
311-320	0	0	100	107480500	1	82	18.33
321-330	0	0	100	100591400	1	83	17.04
331-340	0	0	100	98266000	1	84	15.77
341-350	0	0	100	92167500	1	85	14.58
351-360	0	0	100	87751900	1	87	13.44
361-370	0	0	100	84834100	1	88	12.35
371-380	0	0	100	75473100	1	89	11.37
381-390	0	0	100	71176500	1	90	10.45
391-400	0	0	100	67290400	1	90	9.58
401-410	0	0	100	64434500	1	91	8.75
411-420	0	0	100	59194200	1	92	7.99
421-430	0	0	100	56029800	1	93	7.26
431-440	0	0	100	52307900	1	93	6.59
441-450	0	0	100	48333300	1	94	5.96
451-460	0	0	100	45148000	1	95	5.38
461-470	0	0	100	43238800	1	95	4.82
471-480	0	0	100	40329300	1	96	4.30
481-490	0	0	100	38792400	1	96	3.80
491-500	0	0	100	36784900	0	97	3.33
501-510	0	0	100	33766400	0	97	2.89
511-520	0	0	100	30941300	0	98	2.49
521-530	0	0	100	29388100	0	98	2.11
531-540	0	0	100	28584600	0	98	1.74
541-550	0	0	100	26817900	0	99	1.40
551-560	0	0	100	25582100	0	99	1.07
561-570	0	0	100	23203100	0	99	0.77
571-580	0	0	100	21111400	0	100	0.49
581-590	0	0	100	20017100	0	100	0.23
591-600	0	0	100	18159900	0	100	0.00
TOTAL	8	100		7743386400	100		

Calc = 44.84%

Crit = 48.08%

Cannot Reject Ho

Argyll CSB and Slope (Kolmogorov-Smirnov)

Slope Categories	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0	3	2	2	677113600	9	9	-6.27
1	7	6	8	231056300	3	12	-3.46
2	14	12	20	444735300	6	17	2.36
3	12	10	30	394852600	5	23	7.18
4	10	8	38	304863200	4	27	11.51
5	6	5	43	537401200	7	33	9.53
6	16	13	56	380733100	5	38	17.83
7	6	5	61	328949900	4	43	18.54
8	2	2	63	459740900	6	49	14.26
9	8	7	69	294668800	4	52	17.07
10	3	2	72	304812600	4	56	15.61
11	5	4	76	310035100	4	60	15.74
12	11	9	85	338532100	4	65	20.46
13	8	7	92	197916400	3	67	24.51
14	5	4	96	260414900	3	71	25.28
15	2	2	98	207756100	3	73	24.25
16	1	1	98	219371300	3	76	22.24
17	2	2	100	163570100	2	78	21.78
18	0	0	100	175629700	2	80	19.52
19	0	0	100	134482800	2	82	17.78
20	0	0	100	146188600	2	84	15.89
21	0	0	100	129777600	2	86	14.22
22	0	0	100	104584400	1	87	12.87
23	0	0	100	114764800	1	89	11.38
24	0	0	100	98609400	1	90	10.11
25	0	0	100	84419600	1	91	9.02
26	0	0	100	80492400	1	92	7.98
27	0	0	100	73529300	1	93	7.03
28	0	0	100	69674100	1	94	6.13
29	0	0	100	56552500	1	95	5.40
30	0	0	100	53226200	1	95	4.71
31	0	0	100	49635800	1	96	4.07
32	0	0	100	45445700	1	97	3.48
33	0	0	100	40208600	1	97	2.97
34	0	0	100	33421700	0	97	2.53
35	0	0	100	30553800	0	98	2.14
36	0	0	100	27572700	0	98	1.78
37	0	0	100	22432000	0	99	1.49
38	0	0	100	19326700	0	99	1.24
39	0	0	100	18071700	0	99	1.01
40	0	0	100	13990200	0	99	0.83
41	0	0	100	11759800	0	99	0.68
42	0	0	100	10911700	0	99	0.54
43	0	0	100	9135500	0	100	0.42
44	0	0	100	7240600	0	100	0.33
45	0	0	100	6345100	0	100	0.24
46	0	0	100	5223400	0	100	0.18
47	0	0	100	4413300	0	100	0.12
48	0	0	100	3645300	0	100	0.07
49	0	0	100	3096100	0	100	0.03
50	0	0	100	2501800	0	100	0.00
TOTAL	121	100		7743386400	100		

Calc = 25.28%
Crit = 12.36%
Reject Ho

Argyll CSA and Slope (Kolmogorov-Smirnov)

Slope Categories	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0	4	8	8	677113600	9	9	-1.20
1	5	9	17	231056300	3	12	5.25
2	5	9	26	444735300	6	17	8.94
3	7	13	40	394852600	5	23	17.05
4	4	8	47	304863200	4	27	20.66
5	6	11	58	537401200	7	33	25.04
6	6	11	70	380733100	5	38	31.45
7	1	2	72	328949900	4	43	29.08
8	4	8	79	459740900	6	49	30.69
9	3	6	85	294668800	4	52	32.55
10	5	9	94	304812600	4	56	38.05
11	3	6	100	310035100	4	60	39.70
12	0	0	100	338532100	4	65	35.33
13	0	0	100	197916400	3	67	32.78
14	0	0	100	260414900	3	71	29.41
15	0	0	100	207756100	3	73	26.73
16	0	0	100	219371300	3	76	23.90
17	0	0	100	163570100	2	78	21.78
18	0	0	100	175629700	2	80	19.52
19	0	0	100	134482800	2	82	17.78
20	0	0	100	146188600	2	84	15.89
21	0	0	100	129777600	2	86	14.22
22	0	0	100	104584400	1	87	12.87
23	0	0	100	114764800	1	89	11.38
24	0	0	100	98609400	1	90	10.11
25	0	0	100	84419600	1	91	9.02
26	0	0	100	80492400	1	92	7.98
27	0	0	100	73529300	1	93	7.03
28	0	0	100	69674100	1	94	6.13
29	0	0	100	56552500	1	95	5.40
30	0	0	100	53226200	1	95	4.71
31	0	0	100	49635800	1	96	4.07
32	0	0	100	45445700	1	97	3.48
33	0	0	100	40208600	1	97	2.97
34	0	0	100	33421700	0	97	2.53
35	0	0	100	30553800	0	98	2.14
36	0	0	100	27572700	0	98	1.78
37	0	0	100	22432000	0	99	1.49
38	0	0	100	19326700	0	99	1.24
39	0	0	100	18071700	0	99	1.01
40	0	0	100	13990200	0	99	0.83
41	0	0	100	11759800	0	99	0.68
42	0	0	100	10911700	0	99	0.54
43	0	0	100	9135500	0	100	0.42
44	0	0	100	7240600	0	100	0.33
45	0	0	100	6345100	0	100	0.24
46	0	0	100	5223400	0	100	0.18
47	0	0	100	4413300	0	100	0.12
48	0	0	100	3645300	0	100	0.07
49	0	0	100	3096100	0	100	0.03
50	0	0	100	2501800	0	100	0.00
TOTAL	53	100		7743386400	100		

Calc = 39.70%
Crit = 18.68%
Reject Ho

Argyll CSAEB and Slope (Kolmogorov-Smirnov)

Slope Categories	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0	3	75	75	677113600	9	9	66.26
1	0	0	75	231056300	3	12	63.27
2	0	0	75	444735300	6	17	57.53
3	0	0	75	394852600	5	23	52.43
4	0	0	75	304863200	4	27	48.49
5	1	25	100	537401200	7	33	66.55
6	0	0	100	380733100	5	38	61.63
7	0	0	100	328949900	4	43	57.39
8	0	0	100	459740900	6	49	51.45
9	0	0	100	294668800	4	52	47.64
10	0	0	100	304812600	4	56	43.71
11	0	0	100	310035100	4	60	39.70
12	0	0	100	338532100	4	65	35.33
13	0	0	100	197916400	3	67	32.78
14	0	0	100	260414900	3	71	29.41
15	0	0	100	207756100	3	73	26.73
16	0	0	100	219371300	3	76	23.90
17	0	0	100	163570100	2	78	21.78
18	0	0	100	175629700	2	80	19.52
19	0	0	100	134482800	2	82	17.78
20	0	0	100	146188600	2	84	15.89
21	0	0	100	129777600	2	86	14.22
22	0	0	100	104584400	1	87	12.87
23	0	0	100	114764800	1	89	11.38
24	0	0	100	98609400	1	90	10.11
25	0	0	100	84419600	1	91	9.02
26	0	0	100	80492400	1	92	7.98
27	0	0	100	73529300	1	93	7.03
28	0	0	100	69674100	1	94	6.13
29	0	0	100	56552500	1	95	5.40
30	0	0	100	53226200	1	95	4.71
31	0	0	100	49635800	1	96	4.07
32	0	0	100	45445700	1	97	3.48
33	0	0	100	40208600	1	97	2.97
34	0	0	100	33421700	0	97	2.53
35	0	0	100	30553800	0	98	2.14
36	0	0	100	27572700	0	98	1.78
37	0	0	100	22432000	0	99	1.49
38	0	0	100	19326700	0	99	1.24
39	0	0	100	18071700	0	99	1.01
40	0	0	100	13990200	0	99	0.83
41	0	0	100	11759800	0	99	0.68
42	0	0	100	10911700	0	99	0.54
43	0	0	100	9135500	0	100	0.42
44	0	0	100	7240600	0	100	0.33
45	0	0	100	6345100	0	100	0.24
46	0	0	100	5223400	0	100	0.18
47	0	0	100	4413300	0	100	0.12
48	0	0	100	3645300	0	100	0.07
49	0	0	100	3096100	0	100	0.03
50	0	0	100	2501800	0	100	0.00
TOTAL	4	100		7743386400	100		

Calc = 66.55%

Crit = 68.00%

Cannot Reject Ho

Argyll CSAEA and Slope (Kolmogorov-Smirnov)

Slope Categories	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0	4	80	80	677113600	9	9	71.26
1	0	0	80	231056300	3	12	68.27
2	0	0	80	444735300	6	17	62.53
3	0	0	80	394852600	5	23	57.43
4	0	0	80	304863200	4	27	53.49
5	0	0	80	537401200	7	33	46.55
6	0	0	80	380733100	5	38	41.63
7	0	0	80	328949900	4	43	37.39
8	0	0	80	459740900	6	49	31.45
9	0	0	80	294668800	4	52	27.64
10	0	0	80	304812600	4	56	23.71
11	0	0	80	310035100	4	60	19.70
12	0	0	80	338532100	4	65	15.33
13	0	0	80	197916400	3	67	12.78
14	0	0	80	260414900	3	71	9.41
15	0	0	80	207756100	3	73	6.73
16	0	0	80	219371300	3	76	3.90
17	0	0	80	163570100	2	78	1.78
18	0	0	80	175629700	2	80	-0.48
19	0	0	80	134482800	2	82	-2.22
20	1	20	100	146188600	2	84	15.89
21	0	0	100	129777600	2	86	14.22
22	0	0	100	104584400	1	87	12.87
23	0	0	100	114764800	1	89	11.38
24	0	0	100	98609400	1	90	10.11
25	0	0	100	84419600	1	91	9.02
26	0	0	100	80492400	1	92	7.98
27	0	0	100	73529300	1	93	7.03
28	0	0	100	69674100	1	94	6.13
29	0	0	100	56552500	1	95	5.40
30	0	0	100	53226200	1	95	4.71
31	0	0	100	49635800	1	96	4.07
32	0	0	100	45445700	1	97	3.48
33	0	0	100	40208600	1	97	2.97
34	0	0	100	33421700	0	97	2.53
35	0	0	100	30553800	0	98	2.14
36	0	0	100	27572700	0	98	1.78
37	0	0	100	22432000	0	99	1.49
38	0	0	100	19326700	0	99	1.24
39	0	0	100	18071700	0	99	1.01
40	0	0	100	13990200	0	99	0.83
41	0	0	100	11759800	0	99	0.68
42	0	0	100	10911700	0	99	0.54
43	0	0	100	9135500	0	100	0.42
44	0	0	100	7240600	0	100	0.33
45	0	0	100	6345100	0	100	0.24
46	0	0	100	5223400	0	100	0.18
47	0	0	100	4413300	0	100	0.12
48	0	0	100	3645300	0	100	0.07
49	0	0	100	3096100	0	100	0.03
50	0	0	100	2501800	0	100	0.00
TOTAL	5	100		7743386400	100		

Calc = 71.26%
Crit = 60.82%
Reject Ho

Argyll All earth constructed sites and Slope (Kolmogorov-Smirnov)

Slope Categories	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0	5	83	83	677113600	9	9	74.59
1	0	0	83	231056300	3	12	71.61
2	0	0	83	444735300	6	17	65.86
3	0	0	83	394852600	5	23	60.76
4	1	17	100	304863200	4	27	73.49
5	0	0	100	537401200	7	33	66.55
6	0	0	100	380733100	5	38	61.63
7	0	0	100	328949900	4	43	57.39
8	0	0	100	459740900	6	49	51.45
9	0	0	100	294668800	4	52	47.64
10	0	0	100	304812600	4	56	43.71
11	0	0	100	310035100	4	60	39.70
12	0	0	100	338532100	4	65	35.33
13	0	0	100	197916400	3	67	32.78
14	0	0	100	260414900	3	71	29.41
15	0	0	100	207756100	3	73	26.73
16	0	0	100	219371300	3	76	23.90
17	0	0	100	163570100	2	78	21.78
18	0	0	100	175629700	2	80	19.52
19	0	0	100	134482800	2	82	17.78
20	0	0	100	146188600	2	84	15.89
21	0	0	100	129777600	2	86	14.22
22	0	0	100	104584400	1	87	12.87
23	0	0	100	114764800	1	89	11.38
24	0	0	100	98609400	1	90	10.11
25	0	0	100	84419600	1	91	9.02
26	0	0	100	80492400	1	92	7.98
27	0	0	100	73529300	1	93	7.03
28	0	0	100	69674100	1	94	6.13
29	0	0	100	56552500	1	95	5.40
30	0	0	100	53226200	1	95	4.71
31	0	0	100	49635800	1	96	4.07
32	0	0	100	45445700	1	97	3.48
33	0	0	100	40208600	1	97	2.97
34	0	0	100	33421700	0	97	2.53
35	0	0	100	30553800	0	98	2.14
36	0	0	100	27572700	0	98	1.78
37	0	0	100	22432000	0	99	1.49
38	0	0	100	19326700	0	99	1.24
39	0	0	100	18071700	0	99	1.01
40	0	0	100	13990200	0	99	0.83
41	0	0	100	11759800	0	99	0.68
42	0	0	100	10911700	0	99	0.54
43	0	0	100	9135500	0	100	0.42
44	0	0	100	7240600	0	100	0.33
45	0	0	100	6345100	0	100	0.24
46	0	0	100	5223400	0	100	0.18
47	0	0	100	4413300	0	100	0.12
48	0	0	100	3645300	0	100	0.07
49	0	0	100	3096100	0	100	0.03
50	0	0	100	2501800	0	100	0.00
TOTAL	6	100		7743386400	100		

Calc = 74.49%

Crit = 55.52%

Reject Ho

Argyll RSB and Slope (Kolmogorov-Smirnov)

Slope Categories	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0	1	6	6	677113600	9	9	-2.49
1	4	25	31	231056300	3	12	19.52
2	3	19	50	444735300	6	17	32.53
3	1	6	56	394852600	5	23	33.68
4	1	6	63	304863200	4	27	35.99
5	0	0	63	537401200	7	33	29.05
6	0	0	63	380733100	5	38	24.13
7	1	6	69	328949900	4	43	26.14
8	1	6	75	459740900	6	49	26.45
9	1	6	81	294668800	4	52	28.89
10	0	0	81	304812600	4	56	24.96
11	0	0	81	310035100	4	60	20.95
12	0	0	81	338532100	4	65	16.58
13	0	0	81	197916400	3	67	14.03
14	1	6	88	260414900	3	71	16.91
15	0	0	88	207756100	3	73	14.23
16	2	13	100	219371300	3	76	23.90
17	0	0	100	163570100	2	78	21.78
18	0	0	100	175629700	2	80	19.52
19	0	0	100	134482800	2	82	17.78
20	0	0	100	146188600	2	84	15.89
21	0	0	100	129777600	2	86	14.22
22	0	0	100	104584400	1	87	12.87
23	0	0	100	114764800	1	89	11.38
24	0	0	100	98609400	1	90	10.11
25	0	0	100	84419600	1	91	9.02
26	0	0	100	80492400	1	92	7.98
27	0	0	100	73529300	1	93	7.03
28	0	0	100	69674100	1	94	6.13
29	0	0	100	56552500	1	95	5.40
30	0	0	100	53226200	1	95	4.71
31	0	0	100	49635800	1	96	4.07
32	0	0	100	45445700	1	97	3.48
33	0	0	100	40208600	1	97	2.97
34	0	0	100	33421700	0	97	2.53
35	0	0	100	30553800	0	98	2.14
36	0	0	100	27572700	0	98	1.78
37	0	0	100	22432000	0	99	1.49
38	0	0	100	19326700	0	99	1.24
39	0	0	100	18071700	0	99	1.01
40	0	0	100	13990200	0	99	0.83
41	0	0	100	11759800	0	99	0.68
42	0	0	100	10911700	0	99	0.54
43	0	0	100	9135500	0	100	0.42
44	0	0	100	7240600	0	100	0.33
45	0	0	100	6345100	0	100	0.24
46	0	0	100	5223400	0	100	0.18
47	0	0	100	4413300	0	100	0.12
48	0	0	100	3645300	0	100	0.07
49	0	0	100	3096100	0	100	0.03
50	0	0	100	2501800	0	100	0.00
TOTAL	16	100		7743386400	100		

Calc = 35.99%
Crit = 34.00%
Reject Ho

Argyll RSA and Slope (Kolmogorov-Smirnov)

Slope Categories	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0	2	7	7	677113600	9	9	-1.85
1	3	10	17	231056300	3	12	5.51
2	4	14	31	444735300	6	17	13.56
3	3	10	41	394852600	5	23	18.81
4	0	0	41	304863200	4	27	14.87
5	3	10	52	537401200	7	33	18.28
6	2	7	59	380733100	5	38	20.26
7	1	3	62	328949900	4	43	19.46
8	2	7	69	459740900	6	49	20.42
9	2	7	76	294668800	4	52	23.51
10	0	0	76	304812600	4	56	19.57
11	1	3	79	310035100	4	60	19.01
12	3	10	90	338532100	4	65	24.99
13	0	0	90	197916400	3	67	22.43
14	1	3	93	260414900	3	71	22.52
15	0	0	93	207756100	3	73	19.83
16	2	7	100	219371300	3	76	23.90
17	0	0	100	163570100	2	78	21.78
18	0	0	100	175629700	2	80	19.52
19	0	0	100	134482800	2	82	17.78
20	0	0	100	146188600	2	84	15.89
21	0	0	100	129777600	2	86	14.22
22	0	0	100	104584400	1	87	12.87
23	0	0	100	114764800	1	89	11.38
24	0	0	100	98609400	1	90	10.11
25	0	0	100	84419600	1	91	9.02
26	0	0	100	80492400	1	92	7.98
27	0	0	100	73529300	1	93	7.03
28	0	0	100	69674100	1	94	6.13
29	0	0	100	56552500	1	95	5.40
30	0	0	100	53226200	1	95	4.71
31	0	0	100	49635800	1	96	4.07
32	0	0	100	45445700	1	97	3.48
33	0	0	100	40208600	1	97	2.97
34	0	0	100	33421700	0	97	2.53
35	0	0	100	30553800	0	98	2.14
36	0	0	100	27572700	0	98	1.78
37	0	0	100	22432000	0	99	1.49
38	0	0	100	19326700	0	99	1.24
39	0	0	100	18071700	0	99	1.01
40	0	0	100	13990200	0	99	0.83
41	0	0	100	11759800	0	99	0.68
42	0	0	100	10911700	0	99	0.54
43	0	0	100	9135500	0	100	0.42
44	0	0	100	7240600	0	100	0.33
45	0	0	100	6345100	0	100	0.24
46	0	0	100	5223400	0	100	0.18
47	0	0	100	4413300	0	100	0.12
48	0	0	100	3645300	0	100	0.07
49	0	0	100	3096100	0	100	0.03
50	0	0	100	2501800	0	100	0.00
TOTAL	29	100		7743386400	100		

Calc = 24.99%
Crit = 25.25%
Cannot Reject Ho

Argyll ICSB and Slope (Kolmogorov-Smirnov)

Slope Categories	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0	2	9	9	677113600	9	9	-0.05
1	0	0	9	231056300	3	12	-3.03
2	1	4	13	444735300	6	17	-4.43
3	4	17	30	394852600	5	23	7.86
4	1	4	35	304863200	4	27	8.27
5	5	22	57	537401200	7	33	23.07
6	0	0	57	380733100	5	38	18.16
7	2	9	65	328949900	4	43	22.60
8	1	4	70	459740900	6	49	21.01
9	4	17	87	294668800	4	52	34.60
10	0	0	87	304812600	4	56	30.66
11	1	4	91	310035100	4	60	31.01
12	2	9	100	338532100	4	65	35.33
13	0	0	100	197916400	3	67	32.78
14	0	0	100	260414900	3	71	29.41
15	0	0	100	207756100	3	73	26.73
16	0	0	100	219371300	3	76	23.90
17	0	0	100	163570100	2	78	21.78
18	0	0	100	175629700	2	80	19.52
19	0	0	100	134482800	2	82	17.78
20	0	0	100	146188600	2	84	15.89
21	0	0	100	129777600	2	86	14.22
22	0	0	100	104584400	1	87	12.87
23	0	0	100	114764800	1	89	11.38
24	0	0	100	98609400	1	90	10.11
25	0	0	100	84419600	1	91	9.02
26	0	0	100	80492400	1	92	7.98
27	0	0	100	73529300	1	93	7.03
28	0	0	100	69674100	1	94	6.13
29	0	0	100	56552500	1	95	5.40
30	0	0	100	53226200	1	95	4.71
31	0	0	100	49635800	1	96	4.07
32	0	0	100	45445700	1	97	3.48
33	0	0	100	40208600	1	97	2.97
34	0	0	100	33421700	0	97	2.53
35	0	0	100	30553800	0	98	2.14
36	0	0	100	27572700	0	98	1.78
37	0	0	100	22432000	0	99	1.49
38	0	0	100	19326700	0	99	1.24
39	0	0	100	18071700	0	99	1.01
40	0	0	100	13990200	0	99	0.83
41	0	0	100	11759800	0	99	0.68
42	0	0	100	10911700	0	99	0.54
43	0	0	100	9135500	0	100	0.42
44	0	0	100	7240600	0	100	0.33
45	0	0	100	6345100	0	100	0.24
46	0	0	100	5223400	0	100	0.18
47	0	0	100	4413300	0	100	0.12
48	0	0	100	3645300	0	100	0.07
49	0	0	100	3096100	0	100	0.03
50	0	0	100	2501800	0	100	0.00
TOTAL	23	100		7743386400	100		

Calc = 35.33%
Crit = 28.35%
Reject Ho

Argyll ICSA and Slope (Kolmogorov-Smirnov)

Slope Categories	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0	1	2	2	677113600	9	9	-6.42
1	1	2	5	231056300	3	12	-7.08
2	6	14	19	444735300	6	17	1.13
3	7	16	35	394852600	5	23	12.31
4	3	7	42	304863200	4	27	15.35
5	3	7	49	537401200	7	33	15.39
6	1	2	51	380733100	5	38	12.80
7	5	12	63	328949900	4	43	20.18
8	2	5	67	459740900	6	49	18.89
9	3	7	74	294668800	4	52	22.06
10	1	2	77	304812600	4	56	20.45
11	2	5	81	310035100	4	60	21.10
12	6	14	95	338532100	4	65	30.68
13	1	2	98	197916400	3	67	30.45
14	0	0	98	260414900	3	71	27.09
15	0	0	98	207756100	3	73	24.40
16	1	2	100	219371300	3	76	23.90
17	0	0	100	163570100	2	78	21.78
18	0	0	100	175629700	2	80	19.52
19	0	0	100	134482800	2	82	17.78
20	0	0	100	146188600	2	84	15.89
21	0	0	100	129777600	2	86	14.22
22	0	0	100	104584400	1	87	12.87
23	0	0	100	114764800	1	89	11.38
24	0	0	100	98609400	1	90	10.11
25	0	0	100	84419600	1	91	9.02
26	0	0	100	80492400	1	92	7.98
27	0	0	100	73529300	1	93	7.03
28	0	0	100	69674100	1	94	6.13
29	0	0	100	56552500	1	95	5.40
30	0	0	100	53226200	1	95	4.71
31	0	0	100	49635800	1	96	4.07
32	0	0	100	45445700	1	97	3.48
33	0	0	100	40208600	1	97	2.97
34	0	0	100	33421700	0	97	2.53
35	0	0	100	30553800	0	98	2.14
36	0	0	100	27572700	0	98	1.78
37	0	0	100	22432000	0	99	1.49
38	0	0	100	19326700	0	99	1.24
39	0	0	100	18071700	0	99	1.01
40	0	0	100	13990200	0	99	0.83
41	0	0	100	11759800	0	99	0.68
42	0	0	100	10911700	0	99	0.54
43	0	0	100	9135500	0	100	0.42
44	0	0	100	7240600	0	100	0.33
45	0	0	100	6345100	0	100	0.24
46	0	0	100	5223400	0	100	0.18
47	0	0	100	4413300	0	100	0.12
48	0	0	100	3645300	0	100	0.07
49	0	0	100	3096100	0	100	0.03
50	0	0	100	2501800	0	100	0.00
TOTAL	43	100		7743386400	100		

Calc = 30.68%
Crit = 20.74%
Reject Ho

Argyll IRSB and Slope (Kolmogorov-Smirnov)

Slope Categories	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0	0	0	0	677113600	9	9	-8.74
1	0	0	0	231056300	3	12	-11.73
2	0	0	0	444735300	6	17	-17.47
3	0	0	0	394852600	5	23	-22.57
4	0	0	0	304863200	4	27	-26.51
5	1	25	25	537401200	7	33	-8.45
6	0	0	25	380733100	5	38	-13.37
7	1	25	50	328949900	4	43	7.39
8	0	0	50	459740900	6	49	1.45
9	0	0	50	294668800	4	52	-2.36
10	2	50	100	304812600	4	56	43.71
11	0	0	100	310035100	4	60	39.70
12	0	0	100	338532100	4	65	35.33
13	0	0	100	197916400	3	67	32.78
14	0	0	100	260414900	3	71	29.41
15	0	0	100	207756100	3	73	26.73
16	0	0	100	219371300	3	76	23.90
17	0	0	100	163570100	2	78	21.78
18	0	0	100	175629700	2	80	19.52
19	0	0	100	134482800	2	82	17.78
20	0	0	100	146188600	2	84	15.89
21	0	0	100	129777600	2	86	14.22
22	0	0	100	104584400	1	87	12.87
23	0	0	100	114764800	1	89	11.38
24	0	0	100	98609400	1	90	10.11
25	0	0	100	84419600	1	91	9.02
26	0	0	100	80492400	1	92	7.98
27	0	0	100	73529300	1	93	7.03
28	0	0	100	69674100	1	94	6.13
29	0	0	100	56552500	1	95	5.40
30	0	0	100	53226200	1	95	4.71
31	0	0	100	49635800	1	96	4.07
32	0	0	100	45445700	1	97	3.48
33	0	0	100	40208600	1	97	2.97
34	0	0	100	33421700	0	97	2.53
35	0	0	100	30553800	0	98	2.14
36	0	0	100	27572700	0	98	1.78
37	0	0	100	22432000	0	99	1.49
38	0	0	100	19326700	0	99	1.24
39	0	0	100	18071700	0	99	1.01
40	0	0	100	13990200	0	99	0.83
41	0	0	100	11759800	0	99	0.68
42	0	0	100	10911700	0	99	0.54
43	0	0	100	9135500	0	100	0.42
44	0	0	100	7240600	0	100	0.33
45	0	0	100	6345100	0	100	0.24
46	0	0	100	5223400	0	100	0.18
47	0	0	100	4413300	0	100	0.12
48	0	0	100	3645300	0	100	0.07
49	0	0	100	3096100	0	100	0.03
50	0	0	100	2501800	0	100	0.00
TOTAL	4	100		7743386400	100		

Calc = 43.71%

Crit = 68.00%

Cannot reject Ho

Argyll IRSA and Slope (Kolmogorov-Smirnov)

Slope Categories	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0	2	6	6	677113600	9	9	-2.49
1	3	9	16	231056300	3	12	3.90
2	5	16	31	444735300	6	17	13.78
3	3	9	41	394852600	5	23	18.05
4	4	13	53	304863200	4	27	26.62
5	2	6	59	537401200	7	33	25.93
6	0	0	59	380733100	5	38	21.01
7	2	6	66	328949900	4	43	23.01
8	2	6	72	459740900	6	49	23.32
9	2	6	78	294668800	4	52	25.77
10	4	13	91	304812600	4	56	34.33
11	1	3	94	310035100	4	60	33.45
12	0	0	94	338532100	4	65	29.08
13	0	0	94	197916400	3	67	26.53
14	0	0	94	260414900	3	71	23.16
15	0	0	94	207756100	3	73	20.48
16	2	6	100	219371300	3	76	23.90
17	0	0	100	163570100	2	78	21.78
18	0	0	100	175629700	2	80	19.52
19	0	0	100	134482800	2	82	17.78
20	0	0	100	146188600	2	84	15.89
21	0	0	100	129777600	2	86	14.22
22	0	0	100	104584400	1	87	12.87
23	0	0	100	114764800	1	89	11.38
24	0	0	100	98609400	1	90	10.11
25	0	0	100	84419600	1	91	9.02
26	0	0	100	80492400	1	92	7.98
27	0	0	100	73529300	1	93	7.03
28	0	0	100	69674100	1	94	6.13
29	0	0	100	56552500	1	95	5.40
30	0	0	100	53226200	1	95	4.71
31	0	0	100	49635800	1	96	4.07
32	0	0	100	45445700	1	97	3.48
33	0	0	100	40208600	1	97	2.97
34	0	0	100	33421700	0	97	2.53
35	0	0	100	30553800	0	98	2.14
36	0	0	100	27572700	0	98	1.78
37	0	0	100	22432000	0	99	1.49
38	0	0	100	19326700	0	99	1.24
39	0	0	100	18071700	0	99	1.01
40	0	0	100	13990200	0	99	0.83
41	0	0	100	11759800	0	99	0.68
42	0	0	100	10911700	0	99	0.54
43	0	0	100	9135500	0	100	0.42
44	0	0	100	7240600	0	100	0.33
45	0	0	100	6345100	0	100	0.24
46	0	0	100	5223400	0	100	0.18
47	0	0	100	4413300	0	100	0.12
48	0	0	100	3645300	0	100	0.07
49	0	0	100	3096100	0	100	0.03
50	0	0	100	2501800	0	100	0.00
TOTAL	32	100		7743386400	100		

Calc = 34.33%
Crit = 24.04%
Reject Ho

Argyll IISB and Slope (Kolmogorov-Smirnov)

Slope Categories	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0	0	0	0	677113600	9	9	-8.74
1	0	0	0	231056300	3	12	-11.73
2	0	0	0	444735300	6	17	-17.47
3	0	0	0	394852600	5	23	-22.57
4	0	0	0	304863200	4	27	-26.51
5	1	33	33	537401200	7	33	-0.11
6	0	0	33	380733100	5	38	-5.03
7	0	0	33	328949900	4	43	-9.28
8	0	0	33	459740900	6	49	-15.22
9	1	33	67	294668800	4	52	14.31
10	0	0	67	304812600	4	56	10.37
11	0	0	67	310035100	4	60	6.37
12	0	0	67	338532100	4	65	2.00
13	0	0	67	197916400	3	67	-0.56
14	0	0	67	260414900	3	71	-3.92
15	0	0	67	207756100	3	73	-6.60
16	1	33	100	219371300	3	76	23.90
17	0	0	100	163570100	2	78	21.78
18	0	0	100	175629700	2	80	19.52
19	0	0	100	134482800	2	82	17.78
20	0	0	100	146188600	2	84	15.89
21	0	0	100	129777600	2	86	14.22
22	0	0	100	104584400	1	87	12.87
23	0	0	100	114764800	1	89	11.38
24	0	0	100	98609400	1	90	10.11
25	0	0	100	84419600	1	91	9.02
26	0	0	100	80492400	1	92	7.98
27	0	0	100	73529300	1	93	7.03
28	0	0	100	69674100	1	94	6.13
29	0	0	100	56552500	1	95	5.40
30	0	0	100	53226200	1	95	4.71
31	0	0	100	49635800	1	96	4.07
32	0	0	100	45445700	1	97	3.48
33	0	0	100	40208600	1	97	2.97
34	0	0	100	33421700	0	97	2.53
35	0	0	100	30553800	0	98	2.14
36	0	0	100	27572700	0	98	1.78
37	0	0	100	22432000	0	99	1.49
38	0	0	100	19326700	0	99	1.24
39	0	0	100	18071700	0	99	1.01
40	0	0	100	13990200	0	99	0.83
41	0	0	100	11759800	0	99	0.68
42	0	0	100	10911700	0	99	0.54
43	0	0	100	9135500	0	100	0.42
44	0	0	100	7240600	0	100	0.33
45	0	0	100	6345100	0	100	0.24
46	0	0	100	5223400	0	100	0.18
47	0	0	100	4413300	0	100	0.12
48	0	0	100	3645300	0	100	0.07
49	0	0	100	3096100	0	100	0.03
50	0	0	100	2501800	0	100	0.00
TOTAL	3	100		7743386400	100		

Calc = 23.9%

Crit = 78.52%

Cannot Reject Ho

Argyll IISA and Slope (Kolmogorov-Smirnov)

Slope Categories	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0	0	0	0	677113600	9	9	-8.74
1	3	17	17	231056300	3	12	4.94
2	1	6	22	444735300	6	17	4.75
3	3	17	39	394852600	5	23	16.32
4	2	11	50	304863200	4	27	23.49
5	1	6	56	537401200	7	33	22.11
6	1	6	61	380733100	5	38	22.75
7	1	6	67	328949900	4	43	24.05
8	0	0	67	459740900	6	49	18.12
9	3	17	83	294668800	4	52	30.98
10	1	6	89	304812600	4	56	32.60
11	0	0	89	310035100	4	60	28.59
12	0	0	89	338532100	4	65	24.22
13	2	11	100	197916400	3	67	32.78
14	0	0	100	260414900	3	71	29.41
15	0	0	100	207756100	3	73	26.73
16	0	0	100	219371300	3	76	23.90
17	0	0	100	163570100	2	78	21.78
18	0	0	100	175629700	2	80	19.52
19	0	0	100	134482800	2	82	17.78
20	0	0	100	146188600	2	84	15.89
21	0	0	100	129777600	2	86	14.22
22	0	0	100	104584400	1	87	12.87
23	0	0	100	114764800	1	89	11.38
24	0	0	100	98609400	1	90	10.11
25	0	0	100	84419600	1	91	9.02
26	0	0	100	80492400	1	92	7.98
27	0	0	100	73529300	1	93	7.03
28	0	0	100	69674100	1	94	6.13
29	0	0	100	56552500	1	95	5.40
30	0	0	100	53226200	1	95	4.71
31	0	0	100	49635800	1	96	4.07
32	0	0	100	45445700	1	97	3.48
33	0	0	100	40208600	1	97	2.97
34	0	0	100	33421700	0	97	2.53
35	0	0	100	30553800	0	98	2.14
36	0	0	100	27572700	0	98	1.78
37	0	0	100	22432000	0	99	1.49
38	0	0	100	19326700	0	99	1.24
39	0	0	100	18071700	0	99	1.01
40	0	0	100	13990200	0	99	0.83
41	0	0	100	11759800	0	99	0.68
42	0	0	100	10911700	0	99	0.54
43	0	0	100	9135500	0	100	0.42
44	0	0	100	7240600	0	100	0.33
45	0	0	100	6345100	0	100	0.24
46	0	0	100	5223400	0	100	0.18
47	0	0	100	4413300	0	100	0.12
48	0	0	100	3645300	0	100	0.07
49	0	0	100	3096100	0	100	0.03
50	0	0	100	2501800	0	100	0.00
TOTAL	18	100		7743386400	100		

Calc = 32.78%
Crit = 32.06%
Reject Ho

Argyll PB and Slope (Kolmogorov-Smirnov)

Slope Categories	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0	1	20	20	677113600	9	9	11.26
1	1	20	40	231056300	3	12	28.27
2	0	0	40	444735300	6	17	22.53
3	3	60	100	394852600	5	23	77.43
4	0	0	100	304863200	4	27	73.49
5	0	0	100	537401200	7	33	66.55
6	0	0	100	380733100	5	38	61.63
7	0	0	100	328949900	4	43	57.39
8	0	0	100	459740900	6	49	51.45
9	0	0	100	294668800	4	52	47.64
10	0	0	100	304812600	4	56	43.71
11	0	0	100	310035100	4	60	39.70
12	0	0	100	338532100	4	65	35.33
13	0	0	100	197916400	3	67	32.78
14	0	0	100	260414900	3	71	29.41
15	0	0	100	207756100	3	73	26.73
16	0	0	100	219371300	3	76	23.90
17	0	0	100	163570100	2	78	21.78
18	0	0	100	175629700	2	80	19.52
19	0	0	100	134482800	2	82	17.78
20	0	0	100	146188600	2	84	15.89
21	0	0	100	129777600	2	86	14.22
22	0	0	100	104584400	1	87	12.87
23	0	0	100	114764800	1	89	11.38
24	0	0	100	98609400	1	90	10.11
25	0	0	100	84419600	1	91	9.02
26	0	0	100	80492400	1	92	7.98
27	0	0	100	73529300	1	93	7.03
28	0	0	100	69674100	1	94	6.13
29	0	0	100	56552500	1	95	5.40
30	0	0	100	53226200	1	95	4.71
31	0	0	100	49635800	1	96	4.07
32	0	0	100	45445700	1	97	3.48
33	0	0	100	40208600	1	97	2.97
34	0	0	100	33421700	0	97	2.53
35	0	0	100	30553800	0	98	2.14
36	0	0	100	27572700	0	98	1.78
37	0	0	100	22432000	0	99	1.49
38	0	0	100	19326700	0	99	1.24
39	0	0	100	18071700	0	99	1.01
40	0	0	100	13990200	0	99	0.83
41	0	0	100	11759800	0	99	0.68
42	0	0	100	10911700	0	99	0.54
43	0	0	100	9135500	0	100	0.42
44	0	0	100	7240600	0	100	0.33
45	0	0	100	6345100	0	100	0.24
46	0	0	100	5223400	0	100	0.18
47	0	0	100	4413300	0	100	0.12
48	0	0	100	3645300	0	100	0.07
49	0	0	100	3096100	0	100	0.03
50	0	0	100	2501800	0	100	0.00
TOTAL	5	100		7743386400	100		

Calc = 77.43%
Crit = 60.82%
Reject Ho

Argyll PA and Slope (Kolmogorov-Smirnov)

Slope Categories	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0	3	5	5	677113600	9	9	-3.48
1	1	2	7	231056300	3	12	-4.71
2	5	9	16	444735300	6	17	-1.68
3	6	11	26	394852600	5	23	3.74
4	6	11	37	304863200	4	27	10.33
5	9	16	53	537401200	7	33	19.18
6	6	11	63	380733100	5	38	24.79
7	1	2	65	328949900	4	43	22.30
8	5	9	74	459740900	6	49	25.13
9	4	7	81	294668800	4	52	28.35
10	3	5	86	304812600	4	56	29.67
11	0	0	86	310035100	4	60	25.67
12	4	7	93	338532100	4	65	28.31
13	1	2	95	197916400	3	67	27.51
14	0	0	95	260414900	3	71	24.15
15	1	2	96	207756100	3	73	23.22
16	2	4	100	219371300	3	76	23.90
17	0	0	100	163570100	2	78	21.78
18	0	0	100	175629700	2	80	19.52
19	0	0	100	134482800	2	82	17.78
20	0	0	100	146188600	2	84	15.89
21	0	0	100	129777600	2	86	14.22
22	0	0	100	104584400	1	87	12.87
23	0	0	100	114764800	1	89	11.38
24	0	0	100	98609400	1	90	10.11
25	0	0	100	84419600	1	91	9.02
26	0	0	100	80492400	1	92	7.98
27	0	0	100	73529300	1	93	7.03
28	0	0	100	69674100	1	94	6.13
29	0	0	100	56552500	1	95	5.40
30	0	0	100	53226200	1	95	4.71
31	0	0	100	49635800	1	96	4.07
32	0	0	100	45445700	1	97	3.48
33	0	0	100	40208600	1	97	2.97
34	0	0	100	33421700	0	97	2.53
35	0	0	100	30553800	0	98	2.14
36	0	0	100	27572700	0	98	1.78
37	0	0	100	22432000	0	99	1.49
38	0	0	100	19326700	0	99	1.24
39	0	0	100	18071700	0	99	1.01
40	0	0	100	13990200	0	99	0.83
41	0	0	100	11759800	0	99	0.68
42	0	0	100	10911700	0	99	0.54
43	0	0	100	9135500	0	100	0.42
44	0	0	100	7240600	0	100	0.33
45	0	0	100	6345100	0	100	0.24
46	0	0	100	5223400	0	100	0.18
47	0	0	100	4413300	0	100	0.12
48	0	0	100	3645300	0	100	0.07
49	0	0	100	3096100	0	100	0.03
50	0	0	100	2501800	0	100	0.00
TOTAL	57	100		7743386400	100		

Calc = 29.67%
Crit = 18.01%
Reject Ho

Argyll AFCB and Slope (Kolmogorov-Smirnov)

Slope Categories	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0	0	0	0	677113600	9	9	-8.74
1	2	9	9	231056300	3	12	-2.64
2	2	9	18	444735300	6	17	0.71
3	4	18	36	394852600	5	23	13.79
4	0	0	36	304863200	4	27	9.86
5	2	9	45	537401200	7	33	12.01
6	3	14	59	380733100	5	38	20.73
7	2	9	68	328949900	4	43	25.57
8	0	0	68	459740900	6	49	19.63
9	1	5	73	294668800	4	52	20.37
10	0	0	73	304812600	4	56	16.44
11	3	14	86	310035100	4	60	26.07
12	1	5	91	338532100	4	65	26.24
13	1	5	95	197916400	3	67	28.23
14	1	5	100	260414900	3	71	29.41
15	0	0	100	207756100	3	73	26.73
16	0	0	100	219371300	3	76	23.90
17	0	0	100	163570100	2	78	21.78
18	0	0	100	175629700	2	80	19.52
19	0	0	100	134482800	2	82	17.78
20	0	0	100	146188600	2	84	15.89
21	0	0	100	129777600	2	86	14.22
22	0	0	100	104584400	1	87	12.87
23	0	0	100	114764800	1	89	11.38
24	0	0	100	98609400	1	90	10.11
25	0	0	100	84419600	1	91	9.02
26	0	0	100	80492400	1	92	7.98
27	0	0	100	73529300	1	93	7.03
28	0	0	100	69674100	1	94	6.13
29	0	0	100	56552500	1	95	5.40
30	0	0	100	53226200	1	95	4.71
31	0	0	100	49635800	1	96	4.07
32	0	0	100	45445700	1	97	3.48
33	0	0	100	40208600	1	97	2.97
34	0	0	100	33421700	0	97	2.53
35	0	0	100	30553800	0	98	2.14
36	0	0	100	27572700	0	98	1.78
37	0	0	100	22432000	0	99	1.49
38	0	0	100	19326700	0	99	1.24
39	0	0	100	18071700	0	99	1.01
40	0	0	100	13990200	0	99	0.83
41	0	0	100	11759800	0	99	0.68
42	0	0	100	10911700	0	99	0.54
43	0	0	100	9135500	0	100	0.42
44	0	0	100	7240600	0	100	0.33
45	0	0	100	6345100	0	100	0.24
46	0	0	100	5223400	0	100	0.18
47	0	0	100	4413300	0	100	0.12
48	0	0	100	3645300	0	100	0.07
49	0	0	100	3096100	0	100	0.03
50	0	0	100	2501800	0	100	0.00
TOTAL	22	100		7743386400	100		

Calc = 29.41%
Crit = 29.00%
Reject Ho

Argyll AFCA and Slope (Kolmogorov-Smirnov)

Slope Categories	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0	1	17	17	677113600	9	9	7.92
1	0	0	17	231056300	3	12	4.94
2	0	0	17	444735300	6	17	-0.81
3	1	17	33	394852600	5	23	10.76
4	0	0	33	304863200	4	27	6.83
5	1	17	50	537401200	7	33	16.55
6	0	0	50	380733100	5	38	11.63
7	0	0	50	328949900	4	43	7.39
8	0	0	50	459740900	6	49	1.45
9	0	0	50	294668800	4	52	-2.36
10	0	0	50	304812600	4	56	-6.29
11	0	0	50	310035100	4	60	-10.30
12	0	0	50	338532100	4	65	-14.67
13	1	17	67	197916400	3	67	-0.56
14	0	0	67	260414900	3	71	-3.92
15	1	17	83	207756100	3	73	10.06
16	0	0	83	219371300	3	76	7.23
17	0	0	83	163570100	2	78	5.12
18	0	0	83	175629700	2	80	2.85
19	0	0	83	134482800	2	82	1.11
20	0	0	83	146188600	2	84	-0.77
21	0	0	83	129777600	2	86	-2.45
22	0	0	83	104584400	1	87	-3.80
23	0	0	83	114764800	1	89	-5.28
24	0	0	83	98609400	1	90	-6.56
25	0	0	83	84419600	1	91	-7.65
26	0	0	83	80492400	1	92	-8.69
27	1	17	100	73529300	1	93	7.03
28	0	0	100	69674100	1	94	6.13
29	0	0	100	56552500	1	95	5.40
30	0	0	100	53226200	1	95	4.71
31	0	0	100	49635800	1	96	4.07
32	0	0	100	45445700	1	97	3.48
33	0	0	100	40208600	1	97	2.97
34	0	0	100	33421700	0	97	2.53
35	0	0	100	30553800	0	98	2.14
36	0	0	100	27572700	0	98	1.78
37	0	0	100	22432000	0	99	1.49
38	0	0	100	19326700	0	99	1.24
39	0	0	100	18071700	0	99	1.01
40	0	0	100	13990200	0	99	0.83
41	0	0	100	11759800	0	99	0.68
42	0	0	100	10911700	0	99	0.54
43	0	0	100	9135500	0	100	0.42
44	0	0	100	7240600	0	100	0.33
45	0	0	100	6345100	0	100	0.24
46	0	0	100	5223400	0	100	0.18
47	0	0	100	4413300	0	100	0.12
48	0	0	100	3645300	0	100	0.07
49	0	0	100	3096100	0	100	0.03
50	0	0	100	2501800	0	100	0.00
TOTAL	6	100		7743386400	100		

Calc = 16.55%

Crit = 55.52%

Cannot Reject Ho

Argyll AFIR and Slope (Kolmogorov-Smirnov)

Slope Categories	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0	0	0	0	677113600	9	9	-8.74
1	1	13	13	231056300	3	12	0.77
2	1	13	25	444735300	6	17	7.53
3	0	0	25	394852600	5	23	2.43
4	0	0	25	304863200	4	27	-1.51
5	1	13	38	537401200	7	33	4.05
6	0	0	38	380733100	5	38	-0.87
7	0	0	38	328949900	4	43	-5.11
8	1	13	50	459740900	6	49	1.45
9	1	13	63	294668800	4	52	10.14
10	0	0	63	304812600	4	56	6.21
11	0	0	63	310035100	4	60	2.20
12	0	0	63	338532100	4	65	-2.17
13	0	0	63	197916400	3	67	-4.72
14	1	13	75	260414900	3	71	4.41
15	0	0	75	207756100	3	73	1.73
16	0	0	75	219371300	3	76	-1.10
17	0	0	75	163570100	2	78	-3.22
18	0	0	75	175629700	2	80	-5.48
19	1	13	88	134482800	2	82	5.28
20	0	0	88	146188600	2	84	3.39
21	1	13	100	129777600	2	86	14.22
22	0	0	100	104584400	1	87	12.87
23	0	0	100	114764800	1	89	11.38
24	0	0	100	98609400	1	90	10.11
25	0	0	100	84419600	1	91	9.02
26	0	0	100	80492400	1	92	7.98
27	0	0	100	73529300	1	93	7.03
28	0	0	100	69674100	1	94	6.13
29	0	0	100	56552500	1	95	5.40
30	0	0	100	53226200	1	95	4.71
31	0	0	100	49635800	1	96	4.07
32	0	0	100	45445700	1	97	3.48
33	0	0	100	40208600	1	97	2.97
34	0	0	100	33421700	0	97	2.53
35	0	0	100	30553800	0	98	2.14
36	0	0	100	27572700	0	98	1.78
37	0	0	100	22432000	0	99	1.49
38	0	0	100	19326700	0	99	1.24
39	0	0	100	18071700	0	99	1.01
40	0	0	100	13990200	0	99	0.83
41	0	0	100	11759800	0	99	0.68
42	0	0	100	10911700	0	99	0.54
43	0	0	100	9135500	0	100	0.42
44	0	0	100	7240600	0	100	0.33
45	0	0	100	6345100	0	100	0.24
46	0	0	100	5223400	0	100	0.18
47	0	0	100	4413300	0	100	0.12
48	0	0	100	3645300	0	100	0.07
49	0	0	100	3096100	0	100	0.03
50	0	0	100	2501800	0	100	0.00
TOTAL	8	100		7743386400	100		

Calc = 14.22%

Crit = 48.08%

Cannot Reject Ho

Argyll CSB and Aspect (Chi-Squared)

Category	Oi	Area Distribution	% of Area Distribution	Ei	% of Site Distribution	Oi - Ei	()2	/
Flat	1	823621400	10	12	1	-11	122	10
N	9	1178121300	14	17	7	-8	68	4
NE	3	755092000	9	11	2	-8	65	6
E	4	790780900	10	12	3	-8	57	5
SE	12	1015736000	12	15	10	-3	8	1
S	17	839801000	10	12	14	5	22	2
SW	47	875186300	11	13	39	34	1169	91
W	25	888307500	11	13	21	12	144	11
NW	3	1098464000	13	16	2	-13	171	11
Total	121	8265110400	100	121	100			140.193

df = 8
Calc = 140.193
Crit = 15.507 at 0.5
Reject Ho

Argyll CSA and Aspect (Chi-Squared)

Category	Oi	Area Distribution	% of Area Distribution	Ei	% of Site Distribution	Oi - Ei	()2	/
Flat	3	823621400	10	5	6	-2	5	1
N	3	1178121300	14	8	6	-5	21	3
NE	3	755092000	9	5	6	-2	3	1
E	2	790780900	10	5	4	-3	9	2
SE	4	1015736000	12	7	8	-3	6	1
S	5	839801000	10	5	9	0	0	0
SW	18	875186300	11	6	34	12	153	27
W	10	888307500	11	6	19	4	19	3
NW	5	1098464000	13	7	9	-2	4	1
Total	53	8265110400	100	53	100			38.478

df = 8
Calc = 38.48
Crit = 15.507 at 0.5
Reject Ho

Argyll CSAEB and Aspect (Kolmogorov-Smirnov)

Not enough samples

Argyll CSAEA and Aspect (Kolmogorov-Smirnov)

Not enough samples

Argyll All curvilinear earth constructed sites and Aspect (Kolmogorov-Smirnov)

Not enough samples

Argyll RSB and Aspect (Chi-Squared)

Not enough samples

Argyll RSA and Aspect (Chi-Squared)

Not enough samples

Argyll ICSB and Aspect (Chi-Squared)

Not enough samples

Argyll ICSA and Aspect (Chi-Squared)

Category	Oi	Area Distribution	% of Area Distribution	Ei	% of Site Distribution	Oi - Ei	()2	/
Flat	1	930947600	12	5	2	-4	17	3
N/NE/E	4	2212492700	28	12	9	-8	65	5
SE	2	1021417200	13	6	5	-4	13	2
S	6	842170700	11	5	14	1	2	0
SW	20	876840100	11	5	47	15	231	48
W	8	889917600	11	5	19	3	10	2
NW	2	1101610900	14	6	5	-4	16	3
Total	43	7875396800	100	43	100			64.453

df = 6

Calc = 64.45

Crit = 12.59 at 0.5

Reject Ho

Argyll IRSB and Aspect (Chi-Squared)

Not enough samples

Argyll IRSA and Aspect (Chi-Squared)

Category	Oi	Area Distribution	% of Area Distribution	Ei	% of Site Distribution	Oi - Ei	()2	/
Flat/NW	3	2032558500	26	8	9	-5	28	3
N/NE/E	4	2212492700	28	9	13	-5	25	3
SE/S	7	1863587900	24	8	22	-1	0	0
SW/W	18	1766757700	22	7	56	11	117	16
Total	32	7875396800	100	32	100			22.47

df = 3

Calc = 22.47

Crit = 7.81 at 0.5

Reject Ho

Argyll IISB and Aspect (Chi-Squared)

Not enough samples

Argyll IISA and Aspect (Chi-Squared)

Not enough samples

Argyll PB and Aspect (Chi-Squared)

Not enough samples

Argyll PA and Aspect (Chi-Squared)

Not enough samples

Argyll AFCB and Aspect (Chi-Squared)

Category	Oi	Area Distribution	% of Area Distribution	Ei	% of Site Distribution	Oi - Ei	()2	/
Flat/N/NW	4	2690862300	34.1679584	8	18.18181818	-3.517	12.36894	1.645473
NE/E/SE	2	2575606100	32.7044613	7	9.090909091	-5.19498	26.98783	4
S/SW/W	16	2608928400	33.1275803	7	72.72727273	8.711932	75.89776	10
Total	22	7875396800	100	22	100			16

df = 2

Calc = 15.81

Crit = 5.99 at 0.5

Reject Ho

Argyll AFCA and Aspect (Chi-Squared)

Not enough samples

Argyll AFIR and Aspect (Chi-Squared)

Not enough samples

Statistical Analyses of Sites in Northern Ireland and Environmental Variables.

Northern Ireland CSA and Altitude (Kolmogorov-Smirnov)

Altitude Bands (m)	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0-10	0	0	0	352682200	4	4	-4.07
11-20	1	3	3	563654500	7	11	-7.72
21-30	0	0	3	522083300	6	17	-13.74
31-40	2	6	9	555402200	6	23	-14.44
41-50	1	3	11	518167900	6	29	-17.56
51-60	0	0	11	468554300	5	34	-22.96
61-70	1	3	14	428777600	5	39	-25.05
71-80	2	6	20	437642700	5	44	-24.39
81-90	3	9	29	452041600	5	50	-21.03
91-100	7	20	49	440894000	5	55	-6.12
101-110	6	17	66	411753500	5	59	6.27
111-120	0	0	66	363270800	4	64	2.08
121-130	5	14	80	316308700	4	67	12.71
131-140	1	3	83	264856100	3	70	12.51
141-150	1	3	86	234783200	3	73	12.66
151-160	0	0	86	213025500	2	76	10.20
161-170	0	0	86	190724800	2	78	8.00
171-180	1	3	89	164181000	2	80	8.97
181-190	0	0	89	155604700	2	81	7.17
191-200	1	3	91	146625400	2	83	8.34
201-210	3	9	100	137997200	2	85	15.32
211-220	0	0	100	127700000	1	86	13.84
221-230	0	0	100	119174400	1	88	12.47
231-240	0	0	100	106019500	1	89	11.24
241-250	0	0	100	88675400	1	90	10.22
251-260	0	0	100	80278500	1	91	9.29
261-270	0	0	100	73573800	1	92	8.45
271-280	0	0	100	69594800	1	92	7.64
281-290	0	0	100	66805700	1	93	6.87
291-300	0	0	100	62413700	1	94	6.15
301-310	0	0	100	59418100	1	95	5.47
311-320	0	0	100	58103400	1	95	4.79
321-330	0	0	100	54787700	1	96	4.16
331-340	0	0	100	52741700	1	96	3.55
341-350	0	0	100	49269000	1	97	2.99
351-360	0	0	100	41644700	0	97	2.51
361-370	0	0	100	35072000	0	98	2.10
371-380	0	0	100	27114400	0	98	1.79
381-390	0	0	100	21291100	0	98	1.54
391-400	0	0	100	17698600	0	99	1.34
401-410	0	0	100	14979300	0	99	1.16
411-420	0	0	100	13411900	0	99	1.01
421-430	0	0	100	11386600	0	99	0.88
431-440	0	0	100	9975300	0	99	0.76
441-450	0	0	100	9162200	0	99	0.66
451-460	0	0	100	8124700	0	99	0.56
461-470	0	0	100	7146900	0	100	0.48
471-480	0	0	100	6265600	0	100	0.41
481-490	0	0	100	5379000	0	100	0.35
491-500	0	0	100	4925400	0	100	0.29
501-510	0	0	100	4383100	0	100	0.24
511-520	0	0	100	3846400	0	100	0.20
521-530	0	0	100	3351500	0	100	0.16
531-540	0	0	100	3018900	0	100	0.12
541-550	0	0	100	2539800	0	100	0.09
551-560	0	0	100	2063800	0	100	0.07
561-570	0	0	100	1809900	0	100	0.05
571-580	0	0	100	1578900	0	100	0.03
581-590	0	0	100	1325700	0	100	0.01
591-600	0	0	100	1250000	0	100	0.00
TOTAL	35	100		8666332600	100		

Calc = 25.05%

Crit = 22.99%

Reject Ho

Northern Ireland CSAEA and Altitude (Kolmogorov-Smirnov)

Altitude Bands (m)	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0-10	2	2	2	352682200	4	4	-2.11
11-20	2	2	4	563654500	7	11	-6.65
21-30	3	3	7	522083300	6	17	-9.74
31-40	6	6	13	555402200	6	23	-10.26
41-50	7	7	20	518167900	6	29	-9.38
51-60	3	3	23	468554300	5	34	-11.84
61-70	5	5	27	428777600	5	39	-11.89
71-80	9	9	36	437642700	5	44	-8.12
81-90	3	3	39	452041600	5	50	-10.39
91-100	8	8	47	440894000	5	55	-7.63
101-110	6	6	53	411753500	5	59	-6.50
111-120	7	7	60	363270800	4	64	-3.83
121-130	6	6	66	316308700	4	67	-1.60
131-140	5	5	71	264856100	3	70	0.25
141-150	5	5	75	234783200	3	73	2.44
151-160	8	8	83	213025500	2	76	7.82
161-170	6	6	89	190724800	2	78	11.51
171-180	2	2	91	164181000	2	80	11.57
181-190	1	1	92	155604700	2	81	10.76
191-200	0	0	92	146625400	2	83	9.06
201-210	4	4	96	137997200	2	85	11.39
211-220	1	1	97	127700000	1	86	10.90
221-230	2	2	99	119174400	1	88	11.49
231-240	0	0	99	106019500	1	89	10.26
241-250	0	0	99	88675400	1	90	9.24
251-260	0	0	99	80278500	1	91	8.31
261-270	0	0	99	73573800	1	92	7.46
271-280	1	1	100	69594800	1	92	7.64
281-290	0	0	100	66805700	1	93	6.87
291-300	0	0	100	62413700	1	94	6.15
301-310	0	0	100	59418100	1	95	5.47
311-320	0	0	100	58103400	1	95	4.79
321-330	0	0	100	54787700	1	96	4.16
331-340	0	0	100	52741700	1	96	3.55
341-350	0	0	100	49269000	1	97	2.99
351-360	0	0	100	41644700	0	97	2.51
361-370	0	0	100	35072000	0	98	2.10
371-380	0	0	100	27114400	0	98	1.79
381-390	0	0	100	21291100	0	98	1.54
391-400	0	0	100	17698600	0	99	1.34
401-410	0	0	100	14979300	0	99	1.16
411-420	0	0	100	13411900	0	99	1.01
421-430	0	0	100	11386600	0	99	0.88
431-440	0	0	100	9975300	0	99	0.76
441-450	0	0	100	9162200	0	99	0.66
451-460	0	0	100	8124700	0	99	0.56
461-470	0	0	100	7146900	0	100	0.48
471-480	0	0	100	6265600	0	100	0.41
481-490	0	0	100	5379000	0	100	0.35
491-500	0	0	100	4925400	0	100	0.29
501-510	0	0	100	4383100	0	100	0.24
511-520	0	0	100	3846400	0	100	0.20
521-530	0	0	100	3351500	0	100	0.16
531-540	0	0	100	3018900	0	100	0.12
541-550	0	0	100	2539800	0	100	0.09
551-560	0	0	100	2063800	0	100	0.07
561-570	0	0	100	1809900	0	100	0.05
571-580	0	0	100	1578900	0	100	0.03
581-590	0	0	100	1325700	0	100	0.01
591-600	0	0	100	1250000	0	100	0.00
TOTAL	102	100		8666332600	100		

Calc = 11.57%

Crit = 13.47%

Cannot Reject Ho

Northern Ireland Multivallate CSAEA and Altitude (Kolmogorov-Smirnov)

Altitude Bands (m)	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0-10	0	0	0	352682200	4	4	-4.07
11-20	0	0	0	563654500	7	11	-10.57
21-30	0	0	0	522083300	6	17	-16.60
31-40	0	0	0	555402200	6	23	-23.01
41-50	1	17	17	518167900	6	29	-12.32
51-60	0	0	17	468554300	5	34	-17.73
61-70	1	17	33	428777600	5	39	-6.01
71-80	0	0	33	437642700	5	44	-11.06
81-90	0	0	33	452041600	5	50	-16.27
91-100	0	0	33	440894000	5	55	-21.36
101-110	0	0	33	411753500	5	59	-26.11
111-120	0	0	33	363270800	4	64	-30.30
121-130	1	17	50	316308700	4	67	-17.29
131-140	1	17	67	264856100	3	70	-3.68
141-150	0	0	67	234783200	3	73	-6.38
151-160	2	33	100	213025500	2	76	24.49
161-170	0	0	100	190724800	2	78	22.29
171-180	0	0	100	164181000	2	80	20.40
181-190	0	0	100	155604700	2	81	18.60
191-200	0	0	100	146625400	2	83	16.91
201-210	0	0	100	137997200	2	85	15.32
211-220	0	0	100	127700000	1	86	13.84
221-230	0	0	100	119174400	1	88	12.47
231-240	0	0	100	106019500	1	89	11.24
241-250	0	0	100	88675400	1	90	10.22
251-260	0	0	100	80278500	1	91	9.29
261-270	0	0	100	73573800	1	92	8.45
271-280	0	0	100	69594800	1	92	7.64
281-290	0	0	100	66805700	1	93	6.87
291-300	0	0	100	62413700	1	94	6.15
301-310	0	0	100	59418100	1	95	5.47
311-320	0	0	100	58103400	1	95	4.79
321-330	0	0	100	54787700	1	96	4.16
331-340	0	0	100	52741700	1	96	3.55
341-350	0	0	100	49269000	1	97	2.99
351-360	0	0	100	41644700	0	97	2.51
361-370	0	0	100	35072000	0	98	2.10
371-380	0	0	100	27114400	0	98	1.79
381-390	0	0	100	21291100	0	98	1.54
391-400	0	0	100	17698600	0	99	1.34
401-410	0	0	100	14979300	0	99	1.16
411-420	0	0	100	13411900	0	99	1.01
421-430	0	0	100	11386600	0	99	0.88
431-440	0	0	100	9975300	0	99	0.76
441-450	0	0	100	9162200	0	99	0.66
451-460	0	0	100	8124700	0	99	0.56
461-470	0	0	100	7146900	0	100	0.48
471-480	0	0	100	6265600	0	100	0.41
481-490	0	0	100	5379000	0	100	0.35
491-500	0	0	100	4925400	0	100	0.29
501-510	0	0	100	4383100	0	100	0.24
511-520	0	0	100	3846400	0	100	0.20
521-530	0	0	100	3351500	0	100	0.16
531-540	0	0	100	3018900	0	100	0.12
541-550	0	0	100	2539800	0	100	0.09
551-560	0	0	100	2063800	0	100	0.07
561-570	0	0	100	1809900	0	100	0.05
571-580	0	0	100	1578900	0	100	0.03
581-590	0	0	100	1325700	0	100	0.01
591-600	0	0	100	1250000	0	100	0.00
TOTAL	6	100		8666332600	100		

Calc = 30.30%

Crit = 55.52 %

Cannot Reject Ho

Northern Ireland CEB and Altitude (Kolmogorov-Smirnov)

Altitude Bands (m)	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0-10	0	0	0	352682200	4	4	-4.07
11-20	0	0	0	563654500	7	11	-10.57
21-30	1	17	17	522083300	6	17	0.07
31-40	0	0	17	555402200	6	23	-6.34
41-50	0	0	17	518167900	6	29	-12.32
51-60	0	0	17	468554300	5	34	-17.73
61-70	1	17	33	428777600	5	39	-6.01
71-80	0	0	33	437642700	5	44	-11.06
81-90	0	0	33	452041600	5	50	-16.27
91-100	2	33	67	440894000	5	55	11.97
101-110	0	0	67	411753500	5	59	7.22
111-120	0	0	67	363270800	4	64	3.03
121-130	0	0	67	316308700	4	67	-0.62
131-140	1	17	83	264856100	3	70	12.99
141-150	0	0	83	234783200	3	73	10.28
151-160	0	0	83	213025500	2	76	7.82
161-170	0	0	83	190724800	2	78	5.62
171-180	1	17	100	164181000	2	80	20.40
181-190	0	0	100	155604700	2	81	18.60
191-200	0	0	100	146625400	2	83	16.91
201-210	0	0	100	137997200	2	85	15.32
211-220	0	0	100	127700000	1	86	13.84
221-230	0	0	100	119174400	1	88	12.47
231-240	0	0	100	106019500	1	89	11.24
241-250	0	0	100	88675400	1	90	10.22
251-260	0	0	100	80278500	1	91	9.29
261-270	0	0	100	73573800	1	92	8.45
271-280	0	0	100	69594800	1	92	7.64
281-290	0	0	100	66805700	1	93	6.87
291-300	0	0	100	62413700	1	94	6.15
301-310	0	0	100	59418100	1	95	5.47
311-320	0	0	100	58103400	1	95	4.79
321-330	0	0	100	54787700	1	96	4.16
331-340	0	0	100	52741700	1	96	3.55
341-350	0	0	100	49269000	1	97	2.99
351-360	0	0	100	41644700	0	97	2.51
361-370	0	0	100	35072000	0	98	2.10
371-380	0	0	100	27114400	0	98	1.79
381-390	0	0	100	21291100	0	98	1.54
391-400	0	0	100	17698600	0	99	1.34
401-410	0	0	100	14979300	0	99	1.16
411-420	0	0	100	13411900	0	99	1.01
421-430	0	0	100	11386600	0	99	0.88
431-440	0	0	100	9975300	0	99	0.76
441-450	0	0	100	9162200	0	99	0.66
451-460	0	0	100	8124700	0	99	0.56
461-470	0	0	100	7146900	0	100	0.48
471-480	0	0	100	6265600	0	100	0.41
481-490	0	0	100	5379000	0	100	0.35
491-500	0	0	100	4925400	0	100	0.29
501-510	0	0	100	4383100	0	100	0.24
511-520	0	0	100	3846400	0	100	0.20
521-530	0	0	100	3351500	0	100	0.16
531-540	0	0	100	3018900	0	100	0.12
541-550	0	0	100	2539800	0	100	0.09
551-560	0	0	100	2063800	0	100	0.07
561-570	0	0	100	1809900	0	100	0.05
571-580	0	0	100	1578900	0	100	0.03
581-590	0	0	100	1325700	0	100	0.01
591-600	0	0	100	1250000	0	100	0.00
TOTAL	6	100		8666332600	100		

Calc = 20.40%

Crit = 55.52%

Cannot Reject Ho

Northern Ireland CEA and Altitude (Kolmogorov-Smirnov)

Altitude Bands (m)	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0-10	22	2	2	352682200	4	4	-2.11
11-20	57	5	7	563654500	7	11	-3.54
21-30	62	6	13	522083300	6	17	-4.04
31-40	63	6	18	555402200	6	23	-4.84
41-50	57	5	23	518167900	6	29	-5.74
51-60	76	7	30	468554300	5	34	-4.38
61-70	66	6	36	428777600	5	39	-3.45
71-80	94	8	44	437642700	5	44	-0.13
81-90	121	11	55	452041600	5	50	5.43
91-100	108	10	65	440894000	5	55	9.95
101-110	113	10	75	411753500	5	59	15.27
111-120	90	8	83	363270800	4	64	19.09
121-130	46	4	87	316308700	4	67	19.53
131-140	43	4	91	264856100	3	70	20.31
141-150	29	3	93	234783200	3	73	20.18
151-160	25	2	95	213025500	2	76	19.95
161-170	16	1	97	190724800	2	78	19.17
171-180	13	1	98	164181000	2	80	18.44
181-190	9	1	99	155604700	2	81	17.44
191-200	2	0	99	146625400	2	83	15.93
201-210	5	0	99	137997200	2	85	14.78
211-220	3	0	100	127700000	1	86	13.57
221-230	1	0	100	119174400	1	88	12.29
231-240	1	0	100	106019500	1	89	11.15
241-250	0	0	100	88675400	1	90	10.13
251-260	1	0	100	80278500	1	91	9.29
261-270	0	0	100	73573800	1	92	8.45
271-280	0	0	100	69594800	1	92	7.64
281-290	0	0	100	66805700	1	93	6.87
291-300	0	0	100	62413700	1	94	6.15
301-310	0	0	100	59418100	1	95	5.47
311-320	0	0	100	58103400	1	95	4.79
321-330	0	0	100	54787700	1	96	4.16
331-340	0	0	100	52741700	1	96	3.55
341-350	0	0	100	49269000	1	97	2.99
351-360	0	0	100	41644700	0	97	2.51
361-370	0	0	100	35072000	0	98	2.10
371-380	0	0	100	27114400	0	98	1.79
381-390	0	0	100	21291100	0	98	1.54
391-400	0	0	100	17698600	0	99	1.34
401-410	0	0	100	14979300	0	99	1.16
411-420	0	0	100	13411900	0	99	1.01
421-430	0	0	100	11386600	0	99	0.88
431-440	0	0	100	9975300	0	99	0.76
441-450	0	0	100	9162200	0	99	0.66
451-460	0	0	100	8124700	0	99	0.56
461-470	0	0	100	7146900	0	100	0.48
471-480	0	0	100	6265600	0	100	0.41
481-490	0	0	100	5379000	0	100	0.35
491-500	0	0	100	4925400	0	100	0.29
501-510	0	0	100	4383100	0	100	0.24
511-520	0	0	100	3846400	0	100	0.20
521-530	0	0	100	3351500	0	100	0.16
531-540	0	0	100	3018900	0	100	0.12
541-550	0	0	100	2539800	0	100	0.09
551-560	0	0	100	2063800	0	100	0.07
561-570	0	0	100	1809900	0	100	0.05
571-580	0	0	100	1578900	0	100	0.03
581-590	0	0	100	1325700	0	100	0.01
591-600	0	0	100	1250000	0	100	0.00
TOTAL	1123	100		8666332600	100		

Calc = 20.31%
Crit = 04.06%
Reject Ho

Northern Ireland Univallate CEA and Altitude (Kolmogorov-Smirnov)

Altitude Bands (m)	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0-10	17	2	2	352682200	4	4	-2.30
11-20	47	5	7	563654500	7	11	-3.90
21-30	57	6	13	522083300	6	17	-3.98
31-40	53	6	18	555402200	6	23	-4.86
41-50	52	5	24	518167900	6	29	-5.42
51-60	64	7	30	468554300	5	34	-4.15
61-70	53	6	36	428777600	5	39	-3.57
71-80	81	8	44	437642700	5	44	-0.18
81-90	102	11	55	452041600	5	50	5.24
91-100	96	10	65	440894000	5	55	10.17
101-110	95	10	75	411753500	5	59	15.32
111-120	76	8	83	363270800	4	64	19.05
121-130	43	4	87	316308700	4	67	19.89
131-140	36	4	91	264856100	3	70	20.59
141-150	26	3	94	234783200	3	73	20.59
151-160	22	2	96	213025500	2	76	20.42
161-170	11	1	97	190724800	2	78	19.37
171-180	11	1	98	164181000	2	80	18.62
181-190	6	1	99	155604700	2	81	17.45
191-200	2	0	99	146625400	2	83	15.97
201-210	4	0	99	137997200	2	85	14.79
211-220	2	0	100	127700000	1	86	13.53
221-230	1	0	100	119174400	1	88	12.26
231-240	1	0	100	106019500	1	89	11.14
241-250	0	0	100	88675400	1	90	10.12
251-260	1	0	100	80278500	1	91	9.29
261-270	0	0	100	73573800	1	92	8.45
271-280	0	0	100	69594800	1	92	7.64
281-290	0	0	100	66805700	1	93	6.87
291-300	0	0	100	62413700	1	94	6.15
301-310	0	0	100	59418100	1	95	5.47
311-320	0	0	100	58103400	1	95	4.79
321-330	0	0	100	54787700	1	96	4.16
331-340	0	0	100	52741700	1	96	3.55
341-350	0	0	100	49269000	1	97	2.99
351-360	0	0	100	41644700	0	97	2.51
361-370	0	0	100	35072000	0	98	2.10
371-380	0	0	100	27114400	0	98	1.79
381-390	0	0	100	21291100	0	98	1.54
391-400	0	0	100	17698600	0	99	1.34
401-410	0	0	100	14979300	0	99	1.16
411-420	0	0	100	13411900	0	99	1.01
421-430	0	0	100	11386600	0	99	0.88
431-440	0	0	100	9975300	0	99	0.76
441-450	0	0	100	9162200	0	99	0.66
451-460	0	0	100	8124700	0	99	0.56
461-470	0	0	100	7146900	0	100	0.48
471-480	0	0	100	6265600	0	100	0.41
481-490	0	0	100	5379000	0	100	0.35
491-500	0	0	100	4925400	0	100	0.29
501-510	0	0	100	4383100	0	100	0.24
511-520	0	0	100	3846400	0	100	0.20
521-530	0	0	100	3351500	0	100	0.16
531-540	0	0	100	3018900	0	100	0.12
541-550	0	0	100	2539800	0	100	0.09
551-560	0	0	100	2063800	0	100	0.07
561-570	0	0	100	1809900	0	100	0.05
571-580	0	0	100	1578900	0	100	0.03
581-590	0	0	100	1325700	0	100	0.01
591-600	0	0	100	1250000	0	100	0.00
TOTAL	959	100		8666332600	100		

Calc = 20.59%

Crit = 04.39%

Reject Ho

Northern Ireland Multivallate CEA and Altitude (Kolmogorov-Smirnov)

Altitude Bands (m)	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0-10	5	3	3	352682200	4	4	-1.02
11-20	10	6	9	563654500	7	11	-1.43
21-30	5	3	12	522083300	6	17	-4.40
31-40	10	6	18	555402200	6	23	-4.71
41-50	5	3	21	518167900	6	29	-7.64
51-60	12	7	29	468554300	5	34	-5.73
61-70	13	8	37	428777600	5	39	-2.75
71-80	13	8	45	437642700	5	44	0.12
81-90	19	12	56	452041600	5	50	6.49
91-100	12	7	63	440894000	5	55	8.72
101-110	18	11	74	411753500	5	59	14.95
111-120	14	9	83	363270800	4	64	19.29
121-130	3	2	85	316308700	4	67	17.47
131-140	7	4	89	264856100	3	70	18.68
141-150	3	2	91	234783200	3	73	17.80
151-160	3	2	93	213025500	2	76	17.17
161-170	5	3	96	190724800	2	78	18.02
171-180	2	1	97	164181000	2	80	17.35
181-190	3	2	99	155604700	2	81	17.38
191-200	0	0	99	146625400	2	83	15.69
201-210	1	1	99	137997200	2	85	14.71
211-220	1	1	100	127700000	1	86	13.84
221-230	0	0	100	119174400	1	88	12.47
231-240	0	0	100	106019500	1	89	11.24
241-250	0	0	100	88675400	1	90	10.22
251-260	0	0	100	80278500	1	91	9.29
261-270	0	0	100	73573800	1	92	8.45
271-280	0	0	100	69594800	1	92	7.64
281-290	0	0	100	66805700	1	93	6.87
291-300	0	0	100	62413700	1	94	6.15
301-310	0	0	100	59418100	1	95	5.47
311-320	0	0	100	58103400	1	95	4.79
321-330	0	0	100	54787700	1	96	4.16
331-340	0	0	100	52741700	1	96	3.55
341-350	0	0	100	49269000	1	97	2.99
351-360	0	0	100	41644700	0	97	2.51
361-370	0	0	100	35072000	0	98	2.10
371-380	0	0	100	27114400	0	98	1.79
381-390	0	0	100	21291100	0	98	1.54
391-400	0	0	100	17698600	0	99	1.34
401-410	0	0	100	14979300	0	99	1.16
411-420	0	0	100	13411900	0	99	1.01
421-430	0	0	100	11386600	0	99	0.88
431-440	0	0	100	9975300	0	99	0.76
441-450	0	0	100	9162200	0	99	0.66
451-460	0	0	100	8124700	0	99	0.56
461-470	0	0	100	7146900	0	100	0.48
471-480	0	0	100	6265600	0	100	0.41
481-490	0	0	100	5379000	0	100	0.35
491-500	0	0	100	4925400	0	100	0.29
501-510	0	0	100	4383100	0	100	0.24
511-520	0	0	100	3846400	0	100	0.20
521-530	0	0	100	3351500	0	100	0.16
531-540	0	0	100	3018900	0	100	0.12
541-550	0	0	100	2539800	0	100	0.09
551-560	0	0	100	2063800	0	100	0.07
561-570	0	0	100	1809900	0	100	0.05
571-580	0	0	100	1578900	0	100	0.03
581-590	0	0	100	1325700	0	100	0.01
591-600	0	0	100	1250000	0	100	0.00
TOTAL	164	100		8666332600	100		

Calc = 19.29%
Crit = 10.62%
Reject Ho

Northern Ireland All Rectilinear and Altitude (Kolmogorov-Smirnov)

Altitude Bands (m)	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0-10	0	0	0	352682200	4	4	-4.07
11-20	0	0	0	563654500	7	11	-10.57
21-30	1	7	7	522083300	6	17	-9.93
31-40	0	0	7	555402200	6	23	-16.34
41-50	1	7	13	518167900	6	29	-15.65
51-60	1	7	20	468554300	5	34	-14.39
61-70	0	0	20	428777600	5	39	-19.34
71-80	1	7	27	437642700	5	44	-17.72
81-90	1	7	33	452041600	5	50	-16.27
91-100	1	7	40	440894000	5	55	-14.69
101-110	0	0	40	411753500	5	59	-19.44
111-120	2	13	53	363270800	4	64	-10.30
121-130	0	0	53	316308700	4	67	-13.95
131-140	2	13	67	264856100	3	70	-3.68
141-150	1	7	73	234783200	3	73	0.28
151-160	1	7	80	213025500	2	76	4.49
161-170	0	0	80	190724800	2	78	2.29
171-180	1	7	87	164181000	2	80	7.06
181-190	1	7	93	155604700	2	81	11.93
191-200	1	7	100	146625400	2	83	16.91
201-210	0	0	100	137997200	2	85	15.32
211-220	0	0	100	127700000	1	86	13.84
221-230	0	0	100	119174400	1	88	12.47
231-240	0	0	100	106019500	1	89	11.24
241-250	0	0	100	88675400	1	90	10.22
251-260	0	0	100	80278500	1	91	9.29
261-270	0	0	100	73573800	1	92	8.45
271-280	0	0	100	69594800	1	92	7.64
281-290	0	0	100	66805700	1	93	6.87
291-300	0	0	100	62413700	1	94	6.15
301-310	0	0	100	59418100	1	95	5.47
311-320	0	0	100	58103400	1	95	4.79
321-330	0	0	100	54787700	1	96	4.16
331-340	0	0	100	52741700	1	96	3.55
341-350	0	0	100	49269000	1	97	2.99
351-360	0	0	100	41644700	0	97	2.51
361-370	0	0	100	35072000	0	98	2.10
371-380	0	0	100	27114400	0	98	1.79
381-390	0	0	100	21291100	0	98	1.54
391-400	0	0	100	17698600	0	99	1.34
401-410	0	0	100	14979300	0	99	1.16
411-420	0	0	100	13411900	0	99	1.01
421-430	0	0	100	11386600	0	99	0.88
431-440	0	0	100	9975300	0	99	0.76
441-450	0	0	100	9162200	0	99	0.66
451-460	0	0	100	8124700	0	99	0.56
461-470	0	0	100	7146900	0	100	0.48
471-480	0	0	100	6265600	0	100	0.41
481-490	0	0	100	5379000	0	100	0.35
491-500	0	0	100	4925400	0	100	0.29
501-510	0	0	100	4383100	0	100	0.24
511-520	0	0	100	3846400	0	100	0.20
521-530	0	0	100	3351500	0	100	0.16
531-540	0	0	100	3018900	0	100	0.12
541-550	0	0	100	2539800	0	100	0.09
551-560	0	0	100	2063800	0	100	0.07
561-570	0	0	100	1809900	0	100	0.05
571-580	0	0	100	1578900	0	100	0.03
581-590	0	0	100	1325700	0	100	0.01
591-600	0	0	100	1250000	0	100	0.00
TOTAL	15	100		8666332600	100		

Calc = 19.44%
Crit = 35.12%
Cannot Reject Ho

Northern Ireland All Irregular above 180m2 and Altitude (Kolmogorov-Smirnov)

Altitude Bands (m)	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0-10	0	0	0	352682200	4	4	-4.07
11-20	0	0	0	563654500	7	11	-10.57
21-30	1	5	5	522083300	6	17	-11.84
31-40	1	5	10	555402200	6	23	-13.48
41-50	1	5	14	518167900	6	29	-14.70
51-60	0	0	14	468554300	5	34	-20.11
61-70	1	5	19	428777600	5	39	-20.29
71-80	1	5	24	437642700	5	44	-20.58
81-90	2	10	33	452041600	5	50	-16.27
91-100	3	14	48	440894000	5	55	-7.07
101-110	2	10	57	411753500	5	59	-2.30
111-120	1	5	62	363270800	4	64	-1.73
121-130	3	14	76	316308700	4	67	8.90
131-140	2	10	86	264856100	3	70	15.37
141-150	1	5	90	234783200	3	73	17.42
151-160	0	0	90	213025500	2	76	14.97
161-170	1	5	95	190724800	2	78	17.53
171-180	0	0	95	164181000	2	80	15.63
181-190	0	0	95	155604700	2	81	13.84
191-200	0	0	95	146625400	2	83	12.15
201-210	0	0	95	137997200	2	85	10.55
211-220	1	5	100	127700000	1	86	13.84
221-230	0	0	100	119174400	1	88	12.47
231-240	0	0	100	106019500	1	89	11.24
241-250	0	0	100	88675400	1	90	10.22
251-260	0	0	100	80278500	1	91	9.29
261-270	0	0	100	73573800	1	92	8.45
271-280	0	0	100	69594800	1	92	7.64
281-290	0	0	100	66805700	1	93	6.87
291-300	0	0	100	62413700	1	94	6.15
301-310	0	0	100	59418100	1	95	5.47
311-320	0	0	100	58103400	1	95	4.79
321-330	0	0	100	54787700	1	96	4.16
331-340	0	0	100	52741700	1	96	3.55
341-350	0	0	100	49269000	1	97	2.99
351-360	0	0	100	41644700	0	97	2.51
361-370	0	0	100	35072000	0	98	2.10
371-380	0	0	100	27114400	0	98	1.79
381-390	0	0	100	21291100	0	98	1.54
391-400	0	0	100	17698600	0	99	1.34
401-410	0	0	100	14979300	0	99	1.16
411-420	0	0	100	13411900	0	99	1.01
421-430	0	0	100	11386600	0	99	0.88
431-440	0	0	100	9975300	0	99	0.76
441-450	0	0	100	9162200	0	99	0.66
451-460	0	0	100	8124700	0	99	0.56
461-470	0	0	100	7146900	0	100	0.48
471-480	0	0	100	6265600	0	100	0.41
481-490	0	0	100	5379000	0	100	0.35
491-500	0	0	100	4925400	0	100	0.29
501-510	0	0	100	4383100	0	100	0.24
511-520	0	0	100	3846400	0	100	0.20
521-530	0	0	100	3351500	0	100	0.16
531-540	0	0	100	3018900	0	100	0.12
541-550	0	0	100	2539800	0	100	0.09
551-560	0	0	100	2063800	0	100	0.07
561-570	0	0	100	1809900	0	100	0.05
571-580	0	0	100	1578900	0	100	0.03
581-590	0	0	100	1325700	0	100	0.01
591-600	0	0	100	1250000	0	100	0.00
TOTAL	21	100		8666332600	100		

Calc = 20.58%
Crit = 29.68%
Cannot Reject Ho

Northern Ireland All ICA and Altitude (Kolmogorov-Smirnov)

Altitude Bands (m)	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0-10	0	0	0	352682200	4	4	-4.07
11-20	0	0	0	563654500	7	11	-10.57
21-30	1	10	10	522083300	6	17	-6.60
31-40	0	0	10	555402200	6	23	-13.01
41-50	0	0	10	518167900	6	29	-18.99
51-60	0	0	10	468554300	5	34	-24.39
61-70	1	10	20	428777600	5	39	-19.34
71-80	1	10	30	437642700	5	44	-14.39
81-90	0	0	30	452041600	5	50	-19.61
91-100	0	0	30	440894000	5	55	-24.69
101-110	1	10	40	411753500	5	59	-19.44
111-120	1	10	50	363270800	4	64	-13.64
121-130	2	20	70	316308700	4	67	2.71
131-140	2	20	90	264856100	3	70	19.66
141-150	1	10	100	234783200	3	73	26.95
151-160	0	0	100	213025500	2	76	24.49
161-170	0	0	100	190724800	2	78	22.29
171-180	0	0	100	164181000	2	80	20.40
181-190	0	0	100	155604700	2	81	18.60
191-200	0	0	100	146625400	2	83	16.91
201-210	0	0	100	137997200	2	85	15.32
211-220	0	0	100	127700000	1	86	13.84
221-230	0	0	100	119174400	1	88	12.47
231-240	0	0	100	106019500	1	89	11.24
241-250	0	0	100	88675400	1	90	10.22
251-260	0	0	100	80278500	1	91	9.29
261-270	0	0	100	73573800	1	92	8.45
271-280	0	0	100	69594800	1	92	7.64
281-290	0	0	100	66805700	1	93	6.87
291-300	0	0	100	62413700	1	94	6.15
301-310	0	0	100	59418100	1	95	5.47
311-320	0	0	100	58103400	1	95	4.79
321-330	0	0	100	54787700	1	96	4.16
331-340	0	0	100	52741700	1	96	3.55
341-350	0	0	100	49269000	1	97	2.99
351-360	0	0	100	41644700	0	97	2.51
361-370	0	0	100	35072000	0	98	2.10
371-380	0	0	100	27114400	0	98	1.79
381-390	0	0	100	21291100	0	98	1.54
391-400	0	0	100	17698600	0	99	1.34
401-410	0	0	100	14979300	0	99	1.16
411-420	0	0	100	13411900	0	99	1.01
421-430	0	0	100	11386600	0	99	0.88
431-440	0	0	100	9975300	0	99	0.76
441-450	0	0	100	9162200	0	99	0.66
451-460	0	0	100	8124700	0	99	0.56
461-470	0	0	100	7146900	0	100	0.48
471-480	0	0	100	6265600	0	100	0.41
481-490	0	0	100	5379000	0	100	0.35
491-500	0	0	100	4925400	0	100	0.29
501-510	0	0	100	4383100	0	100	0.24
511-520	0	0	100	3846400	0	100	0.20
521-530	0	0	100	3351500	0	100	0.16
531-540	0	0	100	3018900	0	100	0.12
541-550	0	0	100	2539800	0	100	0.09
551-560	0	0	100	2063800	0	100	0.07
561-570	0	0	100	1809900	0	100	0.05
571-580	0	0	100	1578900	0	100	0.03
581-590	0	0	100	1325700	0	100	0.01
591-600	0	0	100	1250000	0	100	0.00
TOTAL	10	100		8666332600	100		

Calc = 26.95%

Crit = 43.00%

Cannot Reject Ho

Northern Ireland All IRA and Altitude (Kolmogorov-Smirnov)

Altitude Bands (m)	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0-10	0	0	0	352682200	4	4	-4.07
11-20	0	0	0	563654500	7	11	-10.57
21-30	0	0	0	522083300	6	17	-16.60
31-40	1	14	14	555402200	6	23	-8.72
41-50	1	14	29	518167900	6	29	-0.41
51-60	0	0	29	468554300	5	34	-5.82
61-70	0	0	29	428777600	5	39	-10.77
71-80	0	0	29	437642700	5	44	-15.82
81-90	1	14	43	452041600	5	50	-6.75
91-100	1	14	57	440894000	5	55	2.45
101-110	1	14	71	411753500	5	59	11.98
111-120	0	0	71	363270800	4	64	7.79
121-130	1	14	86	316308700	4	67	18.43
131-140	0	0	86	264856100	3	70	15.37
141-150	0	0	86	234783200	3	73	12.66
151-160	0	0	86	213025500	2	76	10.20
161-170	0	0	86	190724800	2	78	8.00
171-180	0	0	86	164181000	2	80	6.11
181-190	0	0	86	155604700	2	81	4.31
191-200	0	0	86	146625400	2	83	2.62
201-210	0	0	86	137997200	2	85	1.03
211-220	1	14	100	127700000	1	86	13.84
221-230	0	0	100	119174400	1	88	12.47
231-240	0	0	100	106019500	1	89	11.24
241-250	0	0	100	88675400	1	90	10.22
251-260	0	0	100	80278500	1	91	9.29
261-270	0	0	100	73573800	1	92	8.45
271-280	0	0	100	69594800	1	92	7.64
281-290	0	0	100	66805700	1	93	6.87
291-300	0	0	100	62413700	1	94	6.15
301-310	0	0	100	59418100	1	95	5.47
311-320	0	0	100	58103400	1	95	4.79
321-330	0	0	100	54787700	1	96	4.16
331-340	0	0	100	52741700	1	96	3.55
341-350	0	0	100	49269000	1	97	2.99
351-360	0	0	100	41644700	0	97	2.51
361-370	0	0	100	35072000	0	98	2.10
371-380	0	0	100	27114400	0	98	1.79
381-390	0	0	100	21291100	0	98	1.54
391-400	0	0	100	17698600	0	99	1.34
401-410	0	0	100	14979300	0	99	1.16
411-420	0	0	100	13411900	0	99	1.01
421-430	0	0	100	11386600	0	99	0.88
431-440	0	0	100	9975300	0	99	0.76
441-450	0	0	100	9162200	0	99	0.66
451-460	0	0	100	8124700	0	99	0.56
461-470	0	0	100	7146900	0	100	0.48
471-480	0	0	100	6265600	0	100	0.41
481-490	0	0	100	5379000	0	100	0.35
491-500	0	0	100	4925400	0	100	0.29
501-510	0	0	100	4383100	0	100	0.24
511-520	0	0	100	3846400	0	100	0.20
521-530	0	0	100	3351500	0	100	0.16
531-540	0	0	100	3018900	0	100	0.12
541-550	0	0	100	2539800	0	100	0.09
551-560	0	0	100	2063800	0	100	0.07
561-570	0	0	100	1809900	0	100	0.05
571-580	0	0	100	1578900	0	100	0.03
581-590	0	0	100	1325700	0	100	0.01
591-600	0	0	100	1250000	0	100	0.00
TOTAL	7	100		8666332600	100		

Calc = 18.43%

Crit = 51.40%

Cannot Reject Ho

Northern Ireland PA and Altitude (Kolmogorov-Smirnov)

Altitude Bands (m)	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0-10	3	18	18	352682200	4	4	13.58
11-20	1	6	24	563654500	7	11	12.96
21-30	2	12	35	522083300	6	17	18.70
31-40	0	0	35	555402200	6	23	12.29
41-50	0	0	35	518167900	6	29	6.31
51-60	2	12	47	468554300	5	34	12.67
61-70	1	6	53	428777600	5	39	13.60
71-80	0	0	53	437642700	5	44	8.55
81-90	1	6	59	452041600	5	50	9.22
91-100	0	0	59	440894000	5	55	4.13
101-110	2	12	71	411753500	5	59	11.14
111-120	0	0	71	363270800	4	64	6.95
121-130	0	0	71	316308700	4	67	3.30
131-140	1	6	76	264856100	3	70	6.13
141-150	0	0	76	234783200	3	73	3.42
151-160	1	6	82	213025500	2	76	6.84
161-170	0	0	82	190724800	2	78	4.64
171-180	0	0	82	164181000	2	80	2.75
181-190	0	0	82	155604700	2	81	0.95
191-200	0	0	82	146625400	2	83	-0.74
201-210	0	0	82	137997200	2	85	-2.33
211-220	0	0	82	127700000	1	86	-3.80
221-230	0	0	82	119174400	1	88	-5.18
231-240	0	0	82	106019500	1	89	-6.40
241-250	0	0	82	88675400	1	90	-7.43
251-260	0	0	82	80278500	1	91	-8.35
261-270	0	0	82	73573800	1	92	-9.20
271-280	1	6	88	69594800	1	92	-4.12
281-290	0	0	88	66805700	1	93	-4.89
291-300	1	6	94	62413700	1	94	0.27
301-310	0	0	94	59418100	1	95	-0.42
311-320	0	0	94	58103400	1	95	-1.09
321-330	0	0	94	54787700	1	96	-1.72
331-340	0	0	94	52741700	1	96	-2.33
341-350	0	0	94	49269000	1	97	-2.90
351-360	1	6	100	41644700	0	97	2.51
361-370	0	0	100	35072000	0	98	2.10
371-380	0	0	100	27114400	0	98	1.79
381-390	0	0	100	21291100	0	98	1.54
391-400	0	0	100	17698600	0	99	1.34
401-410	0	0	100	14979300	0	99	1.16
411-420	0	0	100	13411900	0	99	1.01
421-430	0	0	100	11386600	0	99	0.88
431-440	0	0	100	9975300	0	99	0.76
441-450	0	0	100	9162200	0	99	0.66
451-460	0	0	100	8124700	0	99	0.56
461-470	0	0	100	7146900	0	100	0.48
471-480	0	0	100	6265600	0	100	0.41
481-490	0	0	100	5379000	0	100	0.35
491-500	0	0	100	4925400	0	100	0.29
501-510	0	0	100	4383100	0	100	0.24
511-520	0	0	100	3846400	0	100	0.20
521-530	0	0	100	3351500	0	100	0.16
531-540	0	0	100	3018900	0	100	0.12
541-550	0	0	100	2539800	0	100	0.09
551-560	0	0	100	2063800	0	100	0.07
561-570	0	0	100	1809900	0	100	0.05
571-580	0	0	100	1578900	0	100	0.03
581-590	0	0	100	1325700	0	100	0.01
591-600	0	0	100	1250000	0	100	0.00
TOTAL	17	100		8666332600	100		

Calc = 18.70%

Crit = 32.98%

Cannot Reject Ho

Northern Ireland All sites with architectural features and Altitude (Kolmogorov-Smirnov)

Altitude Bands (m)	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0-10	0	0	0	352682200	4	4	-4.07
11-20	0	0	0	563654500	7	11	-10.57
21-30	0	0	0	522083300	6	17	-16.60
31-40	0	0	0	555402200	6	23	-23.01
41-50	0	0	0	518167900	6	29	-28.99
51-60	0	0	0	468554300	5	34	-34.39
61-70	0	0	0	428777600	5	39	-39.34
71-80	0	0	0	437642700	5	44	-44.39
81-90	0	0	0	452041600	5	50	-49.61
91-100	0	0	0	440894000	5	55	-54.69
101-110	0	0	0	411753500	5	59	-59.44
111-120	1	50	50	363270800	4	64	-13.64
121-130	0	0	50	316308700	4	67	-17.29
131-140	1	50	100	264856100	3	70	29.66
141-150	0	0	100	234783200	3	73	26.95
151-160	0	0	100	213025500	2	76	24.49
161-170	0	0	100	190724800	2	78	22.29
171-180	0	0	100	164181000	2	80	20.40
181-190	0	0	100	155604700	2	81	18.60
191-200	0	0	100	146625400	2	83	16.91
201-210	0	0	100	137997200	2	85	15.32
211-220	0	0	100	127700000	1	86	13.84
221-230	0	0	100	119174400	1	88	12.47
231-240	0	0	100	106019500	1	89	11.24
241-250	0	0	100	88675400	1	90	10.22
251-260	0	0	100	80278500	1	91	9.29
261-270	0	0	100	73573800	1	92	8.45
271-280	0	0	100	69594800	1	92	7.64
281-290	0	0	100	66805700	1	93	6.87
291-300	0	0	100	62413700	1	94	6.15
301-310	0	0	100	59418100	1	95	5.47
311-320	0	0	100	58103400	1	95	4.79
321-330	0	0	100	54787700	1	96	4.16
331-340	0	0	100	52741700	1	96	3.55
341-350	0	0	100	49269000	1	97	2.99
351-360	0	0	100	41644700	0	97	2.51
361-370	0	0	100	35072000	0	98	2.10
371-380	0	0	100	27114400	0	98	1.79
381-390	0	0	100	21291100	0	98	1.54
391-400	0	0	100	17698600	0	99	1.34
401-410	0	0	100	14979300	0	99	1.16
411-420	0	0	100	13411900	0	99	1.01
421-430	0	0	100	11386600	0	99	0.88
431-440	0	0	100	9975300	0	99	0.76
441-450	0	0	100	9162200	0	99	0.66
451-460	0	0	100	8124700	0	99	0.56
461-470	0	0	100	7146900	0	100	0.48
471-480	0	0	100	6265600	0	100	0.41
481-490	0	0	100	5379000	0	100	0.35
491-500	0	0	100	4925400	0	100	0.29
501-510	0	0	100	4383100	0	100	0.24
511-520	0	0	100	3846400	0	100	0.20
521-530	0	0	100	3351500	0	100	0.16
531-540	0	0	100	3018900	0	100	0.12
541-550	0	0	100	2539800	0	100	0.09
551-560	0	0	100	2063800	0	100	0.07
561-570	0	0	100	1809900	0	100	0.05
571-580	0	0	100	1578900	0	100	0.03
581-590	0	0	100	1325700	0	100	0.01
591-600	0	0	100	1250000	0	100	0.00
TOTAL	2	100		8666332600	100		

Calc = 59.44%

Crit = 96.17%

Cannot Reject Ho

Northern Ireland CSA and Slope (Kolmogorov-Smirnov)

Slope Categories	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0	2	6	6	1625793500	19	19	-13.05
1	1	3	9	601754900	7	26	-17.13
2	9	26	34	1713357800	20	45	-11.19
3	8	23	57	1600546200	18	64	-6.80
4	6	17	74	621173200	7	71	3.18
5	1	3	77	959984300	11	82	-5.04
6	1	3	80	391841300	5	87	-6.71
7	1	3	83	195615600	2	89	-6.11
8	1	3	86	349219500	4	93	-7.28
9	2	6	91	92073700	1	94	-2.63
10	1	3	94	105233000	1	95	-0.99
11	0	0	94	90654800	1	96	-2.03
12	0	0	94	75028200	1	97	-2.90
13	0	0	94	21771700	0	97	-3.15
14	1	3	97	41083600	0	98	-0.77
15	1	3	100	32539800	0	98	1.72
16	0	0	100	24538800	0	99	1.43
17	0	0	100	19367100	0	99	1.21
18	0	0	100	14041900	0	99	1.05
19	0	0	100	13690200	0	99	0.89
20	0	0	100	12125700	0	99	0.75
21	0	0	100	11306800	0	99	0.62
22	0	0	100	6976000	0	99	0.54
23	0	0	100	6642400	0	100	0.46
24	0	0	100	7257800	0	100	0.38
25	0	0	100	4567500	0	100	0.32
26	0	0	100	4775300	0	100	0.27
27	0	0	100	3934100	0	100	0.22
28	0	0	100	3424300	0	100	0.18
29	0	0	100	2831800	0	100	0.15
30	0	0	100	2383300	0	100	0.12
31	0	0	100	2093600	0	100	0.10
32	0	0	100	1585200	0	100	0.08
33	0	0	100	1606300	0	100	0.06
34	0	0	100	1057300	0	100	0.05
35	0	0	100	939700	0	100	0.04
36	0	0	100	759500	0	100	0.03
37	0	0	100	592200	0	100	0.02
38	0	0	100	489400	0	100	0.02
39	0	0	100	376000	0	100	0.01
40	0	0	100	312600	0	100	0.01
41	0	0	100	229600	0	100	0.01
42	0	0	100	185400	0	100	0.01
43	0	0	100	164800	0	100	0.00
44	0	0	100	106800	0	100	0.00
45	0	0	100	103200	0	100	0.00
46	0	0	100	68400	0	100	0.00
47	0	0	100	50800	0	100	0.00
48	0	0	100	37900	0	100	0.00
49	0	0	100	24100	0	100	0.00
50	0	0	100	15700	0	100	0.00
TOTAL	35	100		8666332600	100		

Calc = 17.13%
Crit = 22.99%
Cannot reject Ho

Northern Ireland CSAEA and Slope (Kolmogorov-Smirnov)

Slope Categories	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0	8	8	8	1625793500	19	19	-10.92
1	8	8	16	601754900	7	26	-10.02
2	27	26	42	1713357800	20	45	-3.32
3	17	17	59	1600546200	18	64	-5.12
4	7	7	66	621173200	7	71	-5.42
5	14	14	79	959984300	11	82	-2.78
6	7	7	86	391841300	5	87	-0.43
7	4	4	90	195615600	2	89	1.23
8	6	6	96	349219500	4	93	3.08
9	2	2	98	92073700	1	94	3.98
10	0	0	98	105233000	1	95	2.77
11	2	2	100	90654800	1	96	3.68
12	0	0	100	75028200	1	97	2.82
13	0	0	100	21771700	0	97	2.56
14	0	0	100	41083600	0	98	2.09
15	0	0	100	32539800	0	98	1.72
16	0	0	100	24538800	0	99	1.43
17	0	0	100	19367100	0	99	1.21
18	0	0	100	14041900	0	99	1.05
19	0	0	100	13690200	0	99	0.89
20	0	0	100	12125700	0	99	0.75
21	0	0	100	11306800	0	99	0.62
22	0	0	100	6976000	0	99	0.54
23	0	0	100	6642400	0	100	0.46
24	0	0	100	7257800	0	100	0.38
25	0	0	100	4567500	0	100	0.32
26	0	0	100	4775300	0	100	0.27
27	0	0	100	3934100	0	100	0.22
28	0	0	100	3424300	0	100	0.18
29	0	0	100	2831800	0	100	0.15
30	0	0	100	2383300	0	100	0.12
31	0	0	100	2093600	0	100	0.10
32	0	0	100	1585200	0	100	0.08
33	0	0	100	1606300	0	100	0.06
34	0	0	100	1057300	0	100	0.05
35	0	0	100	939700	0	100	0.04
36	0	0	100	759500	0	100	0.03
37	0	0	100	592200	0	100	0.02
38	0	0	100	489400	0	100	0.02
39	0	0	100	376000	0	100	0.01
40	0	0	100	312600	0	100	0.01
41	0	0	100	229600	0	100	0.01
42	0	0	100	185400	0	100	0.01
43	0	0	100	164800	0	100	0.00
44	0	0	100	106800	0	100	0.00
45	0	0	100	103200	0	100	0.00
46	0	0	100	68400	0	100	0.00
47	0	0	100	50800	0	100	0.00
48	0	0	100	37900	0	100	0.00
49	0	0	100	24100	0	100	0.00
50	0	0	100	15700	0	100	0.00
TOTAL	102	100	100	8666332600	100		

Calc = 10.92%
Crit = 13.47%
Cannot reject Ho

Northern Ireland Multivallate CSAEA and Slope (Kolmogorov-Smirnov)

Slope Categories	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0	0	0	0	1625793500	19	19	-18.76
1	1	17	17	601754900	7	26	-9.04
2	1	17	33	1713357800	20	45	-12.14
3	1	17	50	1600546200	18	64	-13.94
4	1	17	67	621173200	7	71	-4.44
5	1	17	83	959984300	11	82	1.15
6	1	17	100	391841300	5	87	13.29
7	0	0	100	195615600	2	89	11.03
8	0	0	100	349219500	4	93	7.00
9	0	0	100	92073700	1	94	5.94
10	0	0	100	105233000	1	95	4.73
11	0	0	100	90654800	1	96	3.68
12	0	0	100	75028200	1	97	2.82
13	0	0	100	21771700	0	97	2.56
14	0	0	100	41083600	0	98	2.09
15	0	0	100	32539800	0	98	1.72
16	0	0	100	24538800	0	99	1.43
17	0	0	100	19367100	0	99	1.21
18	0	0	100	14041900	0	99	1.05
19	0	0	100	13690200	0	99	0.89
20	0	0	100	12125700	0	99	0.75
21	0	0	100	11306800	0	99	0.62
22	0	0	100	6976000	0	99	0.54
23	0	0	100	6642400	0	100	0.46
24	0	0	100	7257800	0	100	0.38
25	0	0	100	4567500	0	100	0.32
26	0	0	100	4775300	0	100	0.27
27	0	0	100	3934100	0	100	0.22
28	0	0	100	3424300	0	100	0.18
29	0	0	100	2831800	0	100	0.15
30	0	0	100	2383300	0	100	0.12
31	0	0	100	2093600	0	100	0.10
32	0	0	100	1585200	0	100	0.08
33	0	0	100	1606300	0	100	0.06
34	0	0	100	1057300	0	100	0.05
35	0	0	100	939700	0	100	0.04
36	0	0	100	759500	0	100	0.03
37	0	0	100	592200	0	100	0.02
38	0	0	100	489400	0	100	0.02
39	0	0	100	376000	0	100	0.01
40	0	0	100	312600	0	100	0.01
41	0	0	100	229600	0	100	0.01
42	0	0	100	185400	0	100	0.01
43	0	0	100	164800	0	100	0.00
44	0	0	100	106800	0	100	0.00
45	0	0	100	103200	0	100	0.00
46	0	0	100	68400	0	100	0.00
47	0	0	100	50800	0	100	0.00
48	0	0	100	37900	0	100	0.00
49	0	0	100	24100	0	100	0.00
50	0	0	100	15700	0	100	0.00
TOTAL	6	100		8666332600	100		

Calc = 18.76%
Crit = 55.52%
Cannot Reject Ho

Northern Ireland CEB and Slope (Kolmogorov-Smirnov)

Slope Categories	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0	0	0	0	1625793500	19	19	-18.76
1	2	33	33	601754900	7	26	7.63
2	2	33	67	1713357800	20	45	21.19
3	0	0	67	1600546200	18	64	2.72
4	0	0	67	621173200	7	71	-4.44
5	1	17	83	959984300	11	82	1.15
6	0	0	83	391841300	5	87	-3.38
7	0	0	83	195615600	2	89	-5.63
8	0	0	83	349219500	4	93	-9.66
9	0	0	83	92073700	1	94	-10.72
10	0	0	83	105233000	1	95	-11.94
11	0	0	83	90654800	1	96	-12.98
12	0	0	83	75028200	1	97	-13.85
13	0	0	83	21771700	0	97	-14.10
14	0	0	83	41083600	0	98	-14.58
15	0	0	83	32539800	0	98	-14.95
16	0	0	83	24538800	0	99	-15.23
17	1	17	100	19367100	0	99	1.21
18	0	0	100	14041900	0	99	1.05
19	0	0	100	13690200	0	99	0.89
20	0	0	100	12125700	0	99	0.75
21	0	0	100	11306800	0	99	0.62
22	0	0	100	6976000	0	99	0.54
23	0	0	100	6642400	0	100	0.46
24	0	0	100	7257800	0	100	0.38
25	0	0	100	4567500	0	100	0.32
26	0	0	100	4775300	0	100	0.27
27	0	0	100	3934100	0	100	0.22
28	0	0	100	3424300	0	100	0.18
29	0	0	100	2831800	0	100	0.15
30	0	0	100	2383300	0	100	0.12
31	0	0	100	2093600	0	100	0.10
32	0	0	100	1585200	0	100	0.08
33	0	0	100	1606300	0	100	0.06
34	0	0	100	1057300	0	100	0.05
35	0	0	100	939700	0	100	0.04
36	0	0	100	759500	0	100	0.03
37	0	0	100	592200	0	100	0.02
38	0	0	100	489400	0	100	0.02
39	0	0	100	376000	0	100	0.01
40	0	0	100	312600	0	100	0.01
41	0	0	100	229600	0	100	0.01
42	0	0	100	185400	0	100	0.01
43	0	0	100	164800	0	100	0.00
44	0	0	100	106800	0	100	0.00
45	0	0	100	103200	0	100	0.00
46	0	0	100	68400	0	100	0.00
47	0	0	100	50800	0	100	0.00
48	0	0	100	37900	0	100	0.00
49	0	0	100	24100	0	100	0.00
50	0	0	100	15700	0	100	0.00
TOTAL	6	100		8666332600	100		

Calc = 21.19%
Crit = 55.52%
Cannot reject Ho

Northern Ireland CEA and Slope (Kolmogorov-Smirnov)

Slope Categories	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0	175	16	16	1625793500	19	19	-3.18
1	116	10	26	601754900	7	26	0.21
2	278	25	51	1713357800	20	45	5.19
3	197	18	68	1600546200	18	64	4.27
4	89	8	76	621173200	7	71	5.03
5	123	11	87	959984300	11	82	4.90
6	55	5	92	391841300	5	87	5.28
7	21	2	94	195615600	2	89	4.89
8	31	3	97	349219500	4	93	3.62
9	11	1	98	92073700	1	94	3.54
10	8	1	98	105233000	1	95	3.04
11	11	1	99	90654800	1	96	2.97
12	3	0	100	75028200	1	97	2.37
13	3	0	100	21771700	0	97	2.39
14	2	0	100	41083600	0	98	2.09
15	0	0	100	32539800	0	98	1.72
16	0	0	100	24538800	0	99	1.43
17	0	0	100	19367100	0	99	1.21
18	0	0	100	14041900	0	99	1.05
19	0	0	100	13690200	0	99	0.89
20	0	0	100	12125700	0	99	0.75
21	0	0	100	11306800	0	99	0.62
22	0	0	100	6976000	0	99	0.54
23	0	0	100	6642400	0	100	0.46
24	0	0	100	7257800	0	100	0.38
25	0	0	100	4567500	0	100	0.32
26	0	0	100	4775300	0	100	0.27
27	0	0	100	3934100	0	100	0.22
28	0	0	100	3424300	0	100	0.18
29	0	0	100	2831800	0	100	0.15
30	0	0	100	2383300	0	100	0.12
31	0	0	100	2093600	0	100	0.10
32	0	0	100	1585200	0	100	0.08
33	0	0	100	1606300	0	100	0.06
34	0	0	100	1057300	0	100	0.05
35	0	0	100	939700	0	100	0.04
36	0	0	100	759500	0	100	0.03
37	0	0	100	592200	0	100	0.02
38	0	0	100	489400	0	100	0.02
39	0	0	100	376000	0	100	0.01
40	0	0	100	312600	0	100	0.01
41	0	0	100	229600	0	100	0.01
42	0	0	100	185400	0	100	0.01
43	0	0	100	164800	0	100	0.00
44	0	0	100	106800	0	100	0.00
45	0	0	100	103200	0	100	0.00
46	0	0	100	68400	0	100	0.00
47	0	0	100	50800	0	100	0.00
48	0	0	100	37900	0	100	0.00
49	0	0	100	24100	0	100	0.00
50	0	0	100	15700	0	100	0.00
TOTAL	1123	100		8666332600	100		

Calc = 5.28%
Crit = 4.05%
Reject Ho

Northern Ireland Univallate CEA and Slope (Kolmogorov-Smirnov)

Slope Categories	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0	149	16	16	1625793500	19	19	-3.22
1	98	10	26	601754900	7	26	0.05
2	234	24	50	1713357800	20	45	4.68
3	174	18	68	1600546200	18	64	4.36
4	76	8	76	621173200	7	71	5.12
5	107	11	87	959984300	11	82	5.20
6	43	4	92	391841300	5	87	5.16
7	18	2	94	195615600	2	89	4.78
8	27	3	97	349219500	4	93	3.56
9	8	1	97	92073700	1	94	3.34
10	8	1	98	105233000	1	95	2.96
11	9	1	99	90654800	1	96	2.85
12	3	0	99	75028200	1	97	2.29
13	3	0	100	21771700	0	97	2.36
14	2	0	100	41083600	0	98	2.09
15	0	0	100	32539800	0	98	1.72
16	0	0	100	24538800	0	99	1.43
17	0	0	100	19367100	0	99	1.21
18	0	0	100	14041900	0	99	1.05
19	0	0	100	13690200	0	99	0.89
20	0	0	100	12125700	0	99	0.75
21	0	0	100	11306800	0	99	0.62
22	0	0	100	6976000	0	99	0.54
23	0	0	100	6642400	0	100	0.46
24	0	0	100	7257800	0	100	0.38
25	0	0	100	4567500	0	100	0.32
26	0	0	100	4775300	0	100	0.27
27	0	0	100	3934100	0	100	0.22
28	0	0	100	3424300	0	100	0.18
29	0	0	100	2831800	0	100	0.15
30	0	0	100	2383300	0	100	0.12
31	0	0	100	2093600	0	100	0.10
32	0	0	100	1585200	0	100	0.08
33	0	0	100	1606300	0	100	0.06
34	0	0	100	1057300	0	100	0.05
35	0	0	100	939700	0	100	0.04
36	0	0	100	759500	0	100	0.03
37	0	0	100	592200	0	100	0.02
38	0	0	100	489400	0	100	0.02
39	0	0	100	376000	0	100	0.01
40	0	0	100	312600	0	100	0.01
41	0	0	100	229600	0	100	0.01
42	0	0	100	185400	0	100	0.01
43	0	0	100	164800	0	100	0.00
44	0	0	100	106800	0	100	0.00
45	0	0	100	103200	0	100	0.00
46	0	0	100	68400	0	100	0.00
47	0	0	100	50800	0	100	0.00
48	0	0	100	37900	0	100	0.00
49	0	0	100	24100	0	100	0.00
50	0	0	100	15700	0	100	0.00
TOTAL	959	100		8666332600	100		

Calc = 5.20%
Crit = 4.39%
Reject Ho

Northern Ireland Multivallate CEA and Slope (Kolmogorov-Smirnov)

Slope Categories	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0	26	16	16	1625793500	19	19	-2.91
1	18	11	27	601754900	7	26	1.13
2	44	27	54	1713357800	20	45	8.18
3	23	14	68	1600546200	18	64	3.74
4	13	8	76	621173200	7	71	4.50
5	16	10	85	959984300	11	82	3.18
6	12	7	93	391841300	5	87	5.97
7	3	2	95	195615600	2	89	5.55
8	4	2	97	349219500	4	93	3.96
9	3	2	99	92073700	1	94	4.72
10	0	0	99	105233000	1	95	3.51
11	2	1	100	90654800	1	96	3.68
12	0	0	100	75028200	1	97	2.82
13	0	0	100	21771700	0	97	2.56
14	0	0	100	41083600	0	98	2.09
15	0	0	100	32539800	0	98	1.72
16	0	0	100	24538800	0	99	1.43
17	0	0	100	19367100	0	99	1.21
18	0	0	100	14041900	0	99	1.05
19	0	0	100	13690200	0	99	0.89
20	0	0	100	12125700	0	99	0.75
21	0	0	100	11306800	0	99	0.62
22	0	0	100	6976000	0	99	0.54
23	0	0	100	6642400	0	100	0.46
24	0	0	100	7257800	0	100	0.38
25	0	0	100	4567500	0	100	0.32
26	0	0	100	4775300	0	100	0.27
27	0	0	100	3934100	0	100	0.22
28	0	0	100	3424300	0	100	0.18
29	0	0	100	2831800	0	100	0.15
30	0	0	100	2383300	0	100	0.12
31	0	0	100	2093600	0	100	0.10
32	0	0	100	1585200	0	100	0.08
33	0	0	100	1606300	0	100	0.06
34	0	0	100	1057300	0	100	0.05
35	0	0	100	939700	0	100	0.04
36	0	0	100	759500	0	100	0.03
37	0	0	100	592200	0	100	0.02
38	0	0	100	489400	0	100	0.02
39	0	0	100	376000	0	100	0.01
40	0	0	100	312600	0	100	0.01
41	0	0	100	229600	0	100	0.01
42	0	0	100	185400	0	100	0.01
43	0	0	100	164800	0	100	0.00
44	0	0	100	106800	0	100	0.00
45	0	0	100	103200	0	100	0.00
46	0	0	100	68400	0	100	0.00
47	0	0	100	50800	0	100	0.00
48	0	0	100	37900	0	100	0.00
49	0	0	100	24100	0	100	0.00
50	0	0	100	15700	0	100	0.00
TOTAL	164	100		8666332600	100		

Calc = 8.18%
Crit = 10.62%
Cannot Reject Ho

Northern Ireland All Rectilinear sites above 180m2 and Slope (Kolmogorov-Smirnov)

Slope Categories	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0	0	0	0	1625793500	19	19	-18.76
1	1	7	7	601754900	7	26	-19.04
2	4	27	33	1713357800	20	45	-12.14
3	2	13	47	1600546200	18	64	-17.28
4	1	7	53	621173200	7	71	-17.78
5	1	7	60	959984300	11	82	-22.19
6	1	7	67	391841300	5	87	-20.04
7	1	7	73	195615600	2	89	-15.63
8	1	7	80	349219500	4	93	-13.00
9	1	7	87	92073700	1	94	-7.39
10	0	0	87	105233000	1	95	-8.61
11	0	0	87	90654800	1	96	-9.65
12	1	7	93	75028200	1	97	-3.85
13	0	0	93	21771700	0	97	-4.10
14	1	7	100	41083600	0	98	2.09
15	0	0	100	32539800	0	98	1.72
16	0	0	100	24538800	0	99	1.43
17	0	0	100	19367100	0	99	1.21
18	0	0	100	14041900	0	99	1.05
19	0	0	100	13690200	0	99	0.89
20	0	0	100	12125700	0	99	0.75
21	0	0	100	11306800	0	99	0.62
22	0	0	100	6976000	0	99	0.54
23	0	0	100	6642400	0	100	0.46
24	0	0	100	7257800	0	100	0.38
25	0	0	100	4567500	0	100	0.32
26	0	0	100	4775300	0	100	0.27
27	0	0	100	3934100	0	100	0.22
28	0	0	100	3424300	0	100	0.18
29	0	0	100	2831800	0	100	0.15
30	0	0	100	2383300	0	100	0.12
31	0	0	100	2093600	0	100	0.10
32	0	0	100	1585200	0	100	0.08
33	0	0	100	1606300	0	100	0.06
34	0	0	100	1057300	0	100	0.05
35	0	0	100	939700	0	100	0.04
36	0	0	100	759500	0	100	0.03
37	0	0	100	592200	0	100	0.02
38	0	0	100	489400	0	100	0.02
39	0	0	100	376000	0	100	0.01
40	0	0	100	312600	0	100	0.01
41	0	0	100	229600	0	100	0.01
42	0	0	100	185400	0	100	0.01
43	0	0	100	164800	0	100	0.00
44	0	0	100	106800	0	100	0.00
45	0	0	100	103200	0	100	0.00
46	0	0	100	68400	0	100	0.00
47	0	0	100	50800	0	100	0.00
48	0	0	100	37900	0	100	0.00
49	0	0	100	24100	0	100	0.00
50	0	0	100	15700	0	100	0.00
TOTAL	15	100		8666332600	100		

Calc =22.19%
Crit = 35.11%
Cannot Reject Ho

Northern Ireland All Irregular sites above 180m2 and Slope (Kolmogorov-Smirnov)

Slope Categories	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0	5	24	24	1625793500	19	19	5.05
1	2	10	33	601754900	7	26	7.63
2	1	5	38	1713357800	20	45	-7.38
3	5	24	62	1600546200	18	64	-2.04
4	3	14	76	621173200	7	71	5.08
5	1	5	81	959984300	11	82	-1.23
6	0	0	81	391841300	5	87	-5.76
7	1	5	86	195615600	2	89	-3.25
8	2	10	95	349219500	4	93	2.24
9	0	0	95	92073700	1	94	1.18
10	0	0	95	105233000	1	95	-0.03
11	0	0	95	90654800	1	96	-1.08
12	0	0	95	75028200	1	97	-1.95
13	1	5	100	21771700	0	97	2.56
14	0	0	100	41083600	0	98	2.09
15	0	0	100	32539800	0	98	1.72
16	0	0	100	24538800	0	99	1.43
17	0	0	100	19367100	0	99	1.21
18	0	0	100	14041900	0	99	1.05
19	0	0	100	13690200	0	99	0.89
20	0	0	100	12125700	0	99	0.75
21	0	0	100	11306800	0	99	0.62
22	0	0	100	6976000	0	99	0.54
23	0	0	100	6642400	0	100	0.46
24	0	0	100	7257800	0	100	0.38
25	0	0	100	4567500	0	100	0.32
26	0	0	100	4775300	0	100	0.27
27	0	0	100	3934100	0	100	0.22
28	0	0	100	3424300	0	100	0.18
29	0	0	100	2831800	0	100	0.15
30	0	0	100	2383300	0	100	0.12
31	0	0	100	2093600	0	100	0.10
32	0	0	100	1585200	0	100	0.08
33	0	0	100	1606300	0	100	0.06
34	0	0	100	1057300	0	100	0.05
35	0	0	100	939700	0	100	0.04
36	0	0	100	759500	0	100	0.03
37	0	0	100	592200	0	100	0.02
38	0	0	100	489400	0	100	0.02
39	0	0	100	376000	0	100	0.01
40	0	0	100	312600	0	100	0.01
41	0	0	100	229600	0	100	0.01
42	0	0	100	185400	0	100	0.01
43	0	0	100	164800	0	100	0.00
44	0	0	100	106800	0	100	0.00
45	0	0	100	103200	0	100	0.00
46	0	0	100	68400	0	100	0.00
47	0	0	100	50800	0	100	0.00
48	0	0	100	37900	0	100	0.00
49	0	0	100	24100	0	100	0.00
50	0	0	100	15700	0	100	0.00
TOTAL	21	100		8666332600	100		

Calc =7.63%
Crit = 29.68%
Cannot Reject Ho

Northern Ireland All ICA and Slope (Kolmogorov-Smirnov)

Slope Categories	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0	3	30	30	1625793500	19	19	11.24
1	1	10	40	601754900	7	26	14.30
2	1	10	50	1713357800	20	45	4.53
3	2	20	70	1600546200	18	64	6.06
4	2	20	90	621173200	7	71	18.89
5	0	0	90	959984300	11	82	7.81
6	0	0	90	391841300	5	87	3.29
7	0	0	90	195615600	2	89	1.03
8	1	10	100	349219500	4	93	7.00
9	0	0	100	92073700	1	94	5.94
10	0	0	100	105233000	1	95	4.73
11	0	0	100	90654800	1	96	3.68
12	0	0	100	75028200	1	97	2.82
13	0	0	100	21771700	0	97	2.56
14	0	0	100	41083600	0	98	2.09
15	0	0	100	32539800	0	98	1.72
16	0	0	100	24538800	0	99	1.43
17	0	0	100	19367100	0	99	1.21
18	0	0	100	14041900	0	99	1.05
19	0	0	100	13690200	0	99	0.89
20	0	0	100	12125700	0	99	0.75
21	0	0	100	11306800	0	99	0.62
22	0	0	100	6976000	0	99	0.54
23	0	0	100	6642400	0	100	0.46
24	0	0	100	7257800	0	100	0.38
25	0	0	100	4567500	0	100	0.32
26	0	0	100	4775300	0	100	0.27
27	0	0	100	3934100	0	100	0.22
28	0	0	100	3424300	0	100	0.18
29	0	0	100	2831800	0	100	0.15
30	0	0	100	2383300	0	100	0.12
31	0	0	100	2093600	0	100	0.10
32	0	0	100	1585200	0	100	0.08
33	0	0	100	1606300	0	100	0.06
34	0	0	100	1057300	0	100	0.05
35	0	0	100	939700	0	100	0.04
36	0	0	100	759500	0	100	0.03
37	0	0	100	592200	0	100	0.02
38	0	0	100	489400	0	100	0.02
39	0	0	100	376000	0	100	0.01
40	0	0	100	312600	0	100	0.01
41	0	0	100	229600	0	100	0.01
42	0	0	100	185400	0	100	0.01
43	0	0	100	164800	0	100	0.00
44	0	0	100	106800	0	100	0.00
45	0	0	100	103200	0	100	0.00
46	0	0	100	68400	0	100	0.00
47	0	0	100	50800	0	100	0.00
48	0	0	100	37900	0	100	0.00
49	0	0	100	24100	0	100	0.00
50	0	0	100	15700	0	100	0.00
TOTAL	10	100		8666332600	100		

Calc =18.89%
Crit = 43.00%
Cannot Reject Ho

Northern Ireland All IRA and Slope (Kolmogorov-Smirnov)

Slope Categories	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0	1	14	14	1625793500	19	19	-4.47
1	1	14	29	601754900	7	26	2.87
2	0	0	29	1713357800	20	45	-16.90
3	1	14	43	1600546200	18	64	-21.09
4	1	14	57	621173200	7	71	-13.97
5	0	0	57	959984300	11	82	-25.04
6	0	0	57	391841300	5	87	-29.57
7	1	14	71	195615600	2	89	-17.54
8	1	14	86	349219500	4	93	-7.28
9	0	0	86	92073700	1	94	-8.34
10	0	0	86	105233000	1	95	-9.56
11	0	0	86	90654800	1	96	-10.60
12	0	0	86	75028200	1	97	-11.47
13	1	14	100	21771700	0	97	2.56
14	0	0	100	41083600	0	98	2.09
15	0	0	100	32539800	0	98	1.72
16	0	0	100	24538800	0	99	1.43
17	0	0	100	19367100	0	99	1.21
18	0	0	100	14041900	0	99	1.05
19	0	0	100	13690200	0	99	0.89
20	0	0	100	12125700	0	99	0.75
21	0	0	100	11306800	0	99	0.62
22	0	0	100	6976000	0	99	0.54
23	0	0	100	6642400	0	100	0.46
24	0	0	100	7257800	0	100	0.38
25	0	0	100	4567500	0	100	0.32
26	0	0	100	4775300	0	100	0.27
27	0	0	100	3934100	0	100	0.22
28	0	0	100	3424300	0	100	0.18
29	0	0	100	2831800	0	100	0.15
30	0	0	100	2383300	0	100	0.12
31	0	0	100	2093600	0	100	0.10
32	0	0	100	1585200	0	100	0.08
33	0	0	100	1606300	0	100	0.06
34	0	0	100	1057300	0	100	0.05
35	0	0	100	939700	0	100	0.04
36	0	0	100	759500	0	100	0.03
37	0	0	100	592200	0	100	0.02
38	0	0	100	489400	0	100	0.02
39	0	0	100	376000	0	100	0.01
40	0	0	100	312600	0	100	0.01
41	0	0	100	229600	0	100	0.01
42	0	0	100	185400	0	100	0.01
43	0	0	100	164800	0	100	0.00
44	0	0	100	106800	0	100	0.00
45	0	0	100	103200	0	100	0.00
46	0	0	100	68400	0	100	0.00
47	0	0	100	50800	0	100	0.00
48	0	0	100	37900	0	100	0.00
49	0	0	100	24100	0	100	0.00
50	0	0	100	15700	0	100	0.00
TOTAL	7	100		8666332600	100		

Calc =29.57%

Crit = 51.40%

Cannot Reject Ho

Northern Ireland PA and Slope (Kolmogorov-Smirnov)

Slope Categories	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0	1	6	6	1625793500	19	19	-12.88
1	0	0	6	601754900	7	26	-19.82
2	5	29	35	1713357800	20	45	-10.18
3	2	12	47	1600546200	18	64	-16.88
4	0	0	47	621173200	7	71	-24.05
5	2	12	59	959984300	11	82	-23.36
6	1	6	65	391841300	5	87	-22.00
7	1	6	71	195615600	2	89	-18.38
8	1	6	76	349219500	4	93	-16.52
9	0	0	76	92073700	1	94	-17.59
10	1	6	82	105233000	1	95	-12.92
11	0	0	82	90654800	1	96	-13.97
12	1	6	88	75028200	1	97	-8.95
13	0	0	88	21771700	0	97	-9.20
14	0	0	88	41083600	0	98	-9.67
15	0	0	88	32539800	0	98	-10.05
16	0	0	88	24538800	0	99	-10.33
17	0	0	88	19367100	0	99	-10.56
18	0	0	88	14041900	0	99	-10.72
19	0	0	88	13690200	0	99	-10.88
20	0	0	88	12125700	0	99	-11.02
21	0	0	88	11306800	0	99	-11.15
22	0	0	88	6976000	0	99	-11.23
23	0	0	88	6642400	0	100	-11.30
24	0	0	88	7257800	0	100	-11.39
25	0	0	88	4567500	0	100	-11.44
26	0	0	88	4775300	0	100	-11.50
27	0	0	88	3934100	0	100	-11.54
28	0	0	88	3424300	0	100	-11.58
29	0	0	88	2831800	0	100	-11.61
30	0	0	88	2383300	0	100	-11.64
31	1	6	94	2093600	0	100	-5.78
32	0	0	94	1585200	0	100	-5.80
33	0	0	94	1606300	0	100	-5.82
34	0	0	94	1057300	0	100	-5.83
35	1	6	100	939700	0	100	0.04
36	0	0	100	759500	0	100	0.03
37	0	0	100	592200	0	100	0.02
38	0	0	100	489400	0	100	0.02
39	0	0	100	376000	0	100	0.01
40	0	0	100	312600	0	100	0.01
41	0	0	100	229600	0	100	0.01
42	0	0	100	185400	0	100	0.01
43	0	0	100	164800	0	100	0.00
44	0	0	100	106800	0	100	0.00
45	0	0	100	103200	0	100	0.00
46	0	0	100	68400	0	100	0.00
47	0	0	100	50800	0	100	0.00
48	0	0	100	37900	0	100	0.00
49	0	0	100	24100	0	100	0.00
50	0	0	100	15700	0	100	0.00
TOTAL	17	100		8666332600	100		

Calc =24.05%

Crit = 32.98%

Cannot Reject Ho

Northern Ireland All sites with architectural features and Slope (Kolmogorov-Smirnov)

Slope Categories	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0	0	0	0	1625793500	19	19	-18.76
1	0	0	0	601754900	7	26	-25.70
2	0	0	0	1713357800	20	45	-45.47
3	0	0	0	1600546200	18	64	-63.94
4	0	0	0	621173200	7	71	-71.11
5	0	0	0	959984300	11	82	-82.19
6	0	0	0	391841300	5	87	-86.71
7	0	0	0	195615600	2	89	-88.97
8	0	0	0	349219500	4	93	-93.00
9	1	50	50	92073700	1	94	-44.06
10	1	50	100	105233000	1	95	4.73
11	0	0	100	90654800	1	96	3.68
12	0	0	100	75028200	1	97	2.82
13	0	0	100	21771700	0	97	2.56
14	0	0	100	41083600	0	98	2.09
15	0	0	100	32539800	0	98	1.72
16	0	0	100	24538800	0	99	1.43
17	0	0	100	19367100	0	99	1.21
18	0	0	100	14041900	0	99	1.05
19	0	0	100	13690200	0	99	0.89
20	0	0	100	12125700	0	99	0.75
21	0	0	100	11306800	0	99	0.62
22	0	0	100	6976000	0	99	0.54
23	0	0	100	6642400	0	100	0.46
24	0	0	100	7257800	0	100	0.38
25	0	0	100	4567500	0	100	0.32
26	0	0	100	4775300	0	100	0.27
27	0	0	100	3934100	0	100	0.22
28	0	0	100	3424300	0	100	0.18
29	0	0	100	2831800	0	100	0.15
30	0	0	100	2383300	0	100	0.12
31	0	0	100	2093600	0	100	0.10
32	0	0	100	1585200	0	100	0.08
33	0	0	100	1606300	0	100	0.06
34	0	0	100	1057300	0	100	0.05
35	0	0	100	939700	0	100	0.04
36	0	0	100	759500	0	100	0.03
37	0	0	100	592200	0	100	0.02
38	0	0	100	489400	0	100	0.02
39	0	0	100	376000	0	100	0.01
40	0	0	100	312600	0	100	0.01
41	0	0	100	229600	0	100	0.01
42	0	0	100	185400	0	100	0.01
43	0	0	100	164800	0	100	0.00
44	0	0	100	106800	0	100	0.00
45	0	0	100	103200	0	100	0.00
46	0	0	100	68400	0	100	0.00
47	0	0	100	50800	0	100	0.00
48	0	0	100	37900	0	100	0.00
49	0	0	100	24100	0	100	0.00
50	0	0	100	15700	0	100	0.00
TOTAL	2	100		8666332600	100		

Calc =93.00%

Crit =96.17%

Cannot Reject Ho

Northern Ireland CSA and Aspect (Chi-Squared)

Category	Oi	Area Distribution	% of Area Distribution	Ei	% of Site Distribution	Oi - Ei	()2	/
Flat	2	1625793500	19	7	6	-5	21	3
N/NE	14	1716383400	20	7	40	7	50	7
E/SE	8	1844032700	21	7	23	1	0	0
S/SW	4	1661350800	19	7	11	-3	7	1
W/NW	7	1818772200	21	7	20	0	0	0
Total	35	6847560400	100	35	100			11.518

df = 4
Calc = 11.52
Crit = 9.488 at 0.05

Northern Ireland CSAEA and Aspect (Chi-Squared)

Category	Oi	Area Distribution	% of Area Distribution	Ei	% of Site Distribution	Oi - Ei	()2	/
Flat	13	1625793500	19	19	13	-6	38	2
N	12	768362400	9	9	12	3	9	1
NE	12	948021000	11	11	12	1	1	0
E	10	863408600	10	10	10	0	0	0
SE	10	980624100	11	12	10	-2	2	0
S	11	724431100	8	9	11	2	6	1
SW	5	936919700	11	11	5	-6	36	3
W	13	817465900	9	10	13	3	11	1
NW	16	1001306300	12	12	16	4	18	2
Total	102	8666332600	100	102	100			9.912

df = 8
Calc = 9.12
Crit = 15.507 at 0.05
Cannot reject Ho

Northern Ireland Multivallate CSAEA and Aspect (Chi-Squared)
Not enough samples

Northern Ireland CEB and Aspect (Chi-Squared)
Not enough samples

Northern Ireland CEA and Aspect (Chi-Squared)

Category	Oi	Area Distribution	% of Area Distribution	Ei	% of Site Distribution	Oi - Ei	()2	/
Flat	245	1625793500	19	180	26	65	4237	24
N	162	768362400	9	85	17	77	5925	70
NE	112	948021000	11	105	12	7	50	0
E	58	863408600	10	96	6	-38	1409	15
SE	80	980624100	11	109	8	-29	813	7
S	48	724431100	8	80	5	-32	1035	13
SW	99	936919700	11	104	10	-5	22	0
W	95	817465900	9	90	10	5	21	0
NW	224	1001306300	12	111	23	113	12814	116
Total	1123	8666332600	100	959	100			244.95

df = 8
Calc = 131.61
Crit = 15.507 at 0.05
Reject Ho

Northern Ireland Univallate CEA and Aspect (Chi-Squared)

Category	Oi	Area Distribution	% of Area Distribution	Ei	% of Site Distribution	Oi - Ei	()2	/
Flat	212	1625793500	19	180	22	32	1030	6
N	134	768362400	9	85	14	49	2398	28
NE	98	948021000	11	105	10	-7	48	0
E	53	863408600	10	96	6	-43	1810	19
SE	73	980624100	11	109	8	-36	1261	12
S	44	724431100	8	80	5	-36	1308	16
SW	85	936919700	11	104	9	-19	349	3
W	78	817465900	9	90	8	-12	155	2
NW	182	1001306300	12	111	19	71	5069	46
Total	959	8666332600	100	959	100			132.10

df = 8
Calc = 131.61
Crit = 15.507 at 0.05
Reject Ho

Northern Ireland Multivallate CEA and Aspect (Chi-Squared)

Category	Oi	Area Distribution	% of Area Distribution	Ei	% of Site Distribution	Oi - Ei	()2	/
Flat	33	1625793500	19	31	20	2	5	0
N	28	768362400	9	15	17	13	181	12
NE	14	948021000	11	18	9	-4	16	1
E	5	863408600	10	16	3	-11	129	8
SE	7	980624100	11	19	4	-12	134	7
S	4	724431100	8	14	2	-10	94	7
SW	14	936919700	11	18	9	-4	14	1
W	17	817465900	9	15	10	2	2	0
NW	42	1001306300	12	19	26	23	531	28
Total	164	8666332600	100	164	100			64.41

df = 8
Calc = 64.41
Crit = 15.507 at 0.05
Reject Ho

Northern Ireland All Rectilinear sites above 180m2 and Aspect (Chi-Squared)
Not enough samples

Northern Ireland All Irregular sites above 180m2 and Aspect (Chi-Squared)
Not enough samples

Northern Ireland All ICA and Aspect (Chi-Squared)
Not enough samples

Northern Ireland All IRA and Aspect (Chi-Squared)
Not enough samples

Northern Ireland PA and Aspect (Chi-Squared)
Not enough samples

Northern Ireland All sites with architectural features and Aspect (Chi-Squared)
Not enough samples

Statistical Analyses of Sites in Co. Donegal and Environmental Variables.

Co. Donegal CSB and Altitude (Kolmogorov-Smirnov)

Altitude Bands (m)	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0-10	2	7	7	301666000	6	6	0.42
11-20	0	0	7	232584200	5	11	-4.39
21-30	4	13	20	227555700	5	16	4.23
31-40	2	7	27	231290200	5	21	6.11
41-50	2	7	33	227488700	5	25	8.06
51-60	3	10	43	216465300	4	30	13.58
61-70	1	3	47	207932200	4	34	12.61
71-80	1	3	50	212238000	4	38	11.55
81-90	2	7	57	203447200	4	43	14.01
91-100	2	7	63	194277400	4	47	16.65
101-110	2	7	70	191067000	4	51	19.36
111-120	3	10	80	185785700	4	54	25.51
121-130	2	7	87	179858400	4	58	28.46
131-140	0	0	87	168599200	3	62	24.97
141-150	0	0	87	162934500	3	65	21.59
151-160	2	7	93	152253100	3	68	25.11
161-170	0	0	93	147758800	3	71	22.05
171-180	0	0	93	137167300	3	74	19.21
181-190	1	3	97	128183600	3	77	19.89
191-200	0	0	97	120923200	3	79	17.39
201-210	0	0	97	110923800	2	82	15.09
211-220	1	3	100	97783800	2	84	16.40
221-230	0	0	100	87620800	2	85	14.59
231-240	0	0	100	76680600	2	87	13.00
241-250	0	0	100	67479000	1	88	11.60
251-260	0	0	100	62086100	1	90	10.32
261-270	0	0	100	55610400	1	91	9.16
271-280	0	0	100	49192500	1	92	8.15
281-290	0	0	100	43511400	1	93	7.24
291-300	0	0	100	37994400	1	94	6.46
301-310	0	0	100	35114600	1	94	5.73
311-320	0	0	100	30496400	1	95	5.10
321-330	0	0	100	27765200	1	95	4.53
331-340	0	0	100	25529100	1	96	4.00
341-350	0	0	100	22732200	0	96	3.53
351-360	0	0	100	20929000	0	97	3.09
361-370	0	0	100	19036300	0	97	2.70
371-380	0	0	100	16366600	0	98	2.36
381-390	0	0	100	13416100	0	98	2.08
391-400	0	0	100	11826900	0	98	1.84
401-410	0	0	100	11262600	0	98	1.60
411-420	0	0	100	9921400	0	99	1.40
421-430	0	0	100	8868400	0	99	1.21
431-440	0	0	100	7899300	0	99	1.05
441-450	0	0	100	7681300	0	99	0.89
451-460	0	0	100	7049200	0	99	0.75
461-470	0	0	100	6103600	0	99	0.62
471-480	0	0	100	4987400	0	99	0.52
481-490	0	0	100	3935800	0	100	0.44
491-500	0	0	100	3277900	0	100	0.37
501-510	0	0	100	2843100	0	100	0.31
511-520	0	0	100	2553000	0	100	0.26
521-530	0	0	100	2250200	0	100	0.21
531-540	0	0	100	2045100	0	100	0.17
541-550	0	0	100	1819200	0	100	0.13
551-560	0	0	100	1630900	0	100	0.10
561-570	0	0	100	1594400	0	100	0.06
571-580	0	0	100	1326100	0	100	0.03
581-590	0	0	100	932700	0	100	0.02
591-600	0	0	100	756500	0	100	0.00
TOTAL	30	100		4830309000	100	100	

Calc = 28.46%

Crit = 24.83%

Reject Ho

Co. Donegal CSA and Altitude (Kolmogorov-Smirnov)

Altitude Bands (m)	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0-10	7	7	7	301666000	6	6	1.12
11-20	8	8	16	232584200	5	11	4.73
21-30	6	6	22	227555700	5	16	6.33
31-40	10	11	33	231290200	5	21	12.07
41-50	7	7	40	227488700	5	25	14.73
51-60	7	7	47	216465300	4	30	17.62
61-70	6	6	54	207932200	4	34	19.63
71-80	8	8	62	212238000	4	38	23.66
81-90	9	9	72	203447200	4	43	28.92
91-100	9	9	81	194277400	4	47	34.37
101-110	3	3	84	191067000	4	51	33.57
111-120	3	3	87	185785700	4	54	32.88
121-130	1	1	88	179858400	4	58	30.21
131-140	1	1	89	168599200	3	62	27.77
141-150	1	1	91	162934500	3	65	25.45
151-160	2	2	93	152253100	3	68	24.41
161-170	1	1	94	147758800	3	71	22.40
171-180	1	1	95	137167300	3	74	20.61
181-190	2	2	97	128183600	3	77	20.07
191-200	0	0	97	120923200	3	79	17.56
201-210	0	0	97	110923800	2	82	15.27
211-220	1	1	98	97783800	2	84	14.29
221-230	1	1	99	87620800	2	85	13.53
231-240	0	0	99	76680600	2	87	11.94
241-250	1	1	100	67479000	1	88	11.60
251-260	0	0	100	62086100	1	90	10.32
261-270	0	0	100	55610400	1	91	9.16
271-280	0	0	100	49192500	1	92	8.15
281-290	0	0	100	43511400	1	93	7.24
291-300	0	0	100	37994400	1	94	6.46
301-310	0	0	100	35114600	1	94	5.73
311-320	0	0	100	30496400	1	95	5.10
321-330	0	0	100	27765200	1	95	4.53
331-340	0	0	100	25529100	1	96	4.00
341-350	0	0	100	22732200	0	96	3.53
351-360	0	0	100	20929000	0	97	3.09
361-370	0	0	100	19036300	0	97	2.70
371-380	0	0	100	16366600	0	98	2.36
381-390	0	0	100	13416100	0	98	2.08
391-400	0	0	100	11826900	0	98	1.84
401-410	0	0	100	11262600	0	98	1.60
411-420	0	0	100	9921400	0	99	1.40
421-430	0	0	100	8868400	0	99	1.21
431-440	0	0	100	7899300	0	99	1.05
441-450	0	0	100	7681300	0	99	0.89
451-460	0	0	100	7049200	0	99	0.75
461-470	0	0	100	6103600	0	99	0.62
471-480	0	0	100	4987400	0	99	0.52
481-490	0	0	100	3935800	0	100	0.44
491-500	0	0	100	3277900	0	100	0.37
501-510	0	0	100	2843100	0	100	0.31
511-520	0	0	100	2553000	0	100	0.26
521-530	0	0	100	2250200	0	100	0.21
531-540	0	0	100	2045100	0	100	0.17
541-550	0	0	100	1819200	0	100	0.13
551-560	0	0	100	1630900	0	100	0.10
561-570	0	0	100	1594400	0	100	0.06
571-580	0	0	100	1326100	0	100	0.03
581-590	0	0	100	932700	0	100	0.02
591-600	0	0	100	756500	0	100	0.00
TOTAL	95	100		4830309000	100	100	

Calc = 34.37%

Crit =13.95%

Reject Ho

Co. Donegal CSAEB and Altitude (Kolmogorov-Smirnov)

Altitude Bands (m)	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0-10	0	0	0	301666000	6	6	-6.25
11-20	0	0	0	232584200	5	11	-11.06
21-30	0	0	0	227555700	5	16	-15.77
31-40	0	0	0	231290200	5	21	-20.56
41-50	0	0	0	227488700	5	25	-25.27
51-60	1	33	33	216465300	4	30	3.58
61-70	0	0	33	207932200	4	34	-0.72
71-80	0	0	33	212238000	4	38	-5.12
81-90	0	0	33	203447200	4	43	-9.33
91-100	0	0	33	194277400	4	47	-13.35
101-110	0	0	33	191067000	4	51	-17.31
111-120	1	33	67	185785700	4	54	12.18
121-130	0	0	67	179858400	4	58	8.46
131-140	1	33	100	168599200	3	62	38.30
141-150	0	0	100	162934500	3	65	34.93
151-160	0	0	100	152253100	3	68	31.78
161-170	0	0	100	147758800	3	71	28.72
171-180	0	0	100	137167300	3	74	25.88
181-190	0	0	100	128183600	3	77	23.22
191-200	0	0	100	120923200	3	79	20.72
201-210	0	0	100	110923800	2	82	18.42
211-220	0	0	100	97783800	2	84	16.40
221-230	0	0	100	87620800	2	85	14.59
231-240	0	0	100	76680600	2	87	13.00
241-250	0	0	100	67479000	1	88	11.60
251-260	0	0	100	62086100	1	90	10.32
261-270	0	0	100	55610400	1	91	9.16
271-280	0	0	100	49192500	1	92	8.15
281-290	0	0	100	43511400	1	93	7.24
291-300	0	0	100	37994400	1	94	6.46
301-310	0	0	100	35114600	1	94	5.73
311-320	0	0	100	30496400	1	95	5.10
321-330	0	0	100	27765200	1	95	4.53
331-340	0	0	100	25529100	1	96	4.00
341-350	0	0	100	22732200	0	96	3.53
351-360	0	0	100	20929000	0	97	3.09
361-370	0	0	100	19036300	0	97	2.70
371-380	0	0	100	16366600	0	98	2.36
381-390	0	0	100	13416100	0	98	2.08
391-400	0	0	100	11826900	0	98	1.84
401-410	0	0	100	11262600	0	98	1.60
411-420	0	0	100	9921400	0	99	1.40
421-430	0	0	100	8868400	0	99	1.21
431-440	0	0	100	7899300	0	99	1.05
441-450	0	0	100	7681300	0	99	0.89
451-460	0	0	100	7049200	0	99	0.75
461-470	0	0	100	6103600	0	99	0.62
471-480	0	0	100	4987400	0	99	0.52
481-490	0	0	100	3935800	0	100	0.44
491-500	0	0	100	3277900	0	100	0.37
501-510	0	0	100	2843100	0	100	0.31
511-520	0	0	100	2553000	0	100	0.26
521-530	0	0	100	2250200	0	100	0.21
531-540	0	0	100	2045100	0	100	0.17
541-550	0	0	100	1819200	0	100	0.13
551-560	0	0	100	1630900	0	100	0.10
561-570	0	0	100	1594400	0	100	0.06
571-580	0	0	100	1326100	0	100	0.03
581-590	0	0	100	932700	0	100	0.02
591-600	0	0	100	756500	0	100	0.00
TOTAL	3	100		4830309000	100	100	

Calc = 38.30%

Crit =78.52%

Cannot Reject Ho

Co. Donegal CSAEA and Altitude (Kolmogorov-Smirnov)

Altitude Bands (m)	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0-10	2	8	8	301666000	6	6	1.45
11-20	1	4	12	232584200	5	11	0.48
21-30	1	4	15	227555700	5	16	-0.39
31-40	2	8	23	231290200	5	21	2.52
41-50	3	12	35	227488700	5	25	9.35
51-60	5	19	54	216465300	4	30	24.10
61-70	3	12	65	207932200	4	34	31.33
71-80	4	15	81	212238000	4	38	42.32
81-90	2	8	88	203447200	4	43	45.80
91-100	1	4	92	194277400	4	47	45.62
101-110	0	0	92	191067000	4	51	41.67
111-120	0	0	92	185785700	4	54	37.82
121-130	0	0	92	179858400	4	58	34.10
131-140	0	0	92	168599200	3	62	30.61
141-150	1	4	96	162934500	3	65	31.08
151-160	0	0	96	152253100	3	68	27.93
161-170	0	0	96	147758800	3	71	24.87
171-180	1	4	100	137167300	3	74	25.88
181-190	0	0	100	128183600	3	77	23.22
191-200	0	0	100	120923200	3	79	20.72
201-210	0	0	100	110923800	2	82	18.42
211-220	0	0	100	97783800	2	84	16.40
221-230	0	0	100	87620800	2	85	14.59
231-240	0	0	100	76680600	2	87	13.00
241-250	0	0	100	67479000	1	88	11.60
251-260	0	0	100	62086100	1	90	10.32
261-270	0	0	100	55610400	1	91	9.16
271-280	0	0	100	49192500	1	92	8.15
281-290	0	0	100	43511400	1	93	7.24
291-300	0	0	100	37994400	1	94	6.46
301-310	0	0	100	35114600	1	94	5.73
311-320	0	0	100	30496400	1	95	5.10
321-330	0	0	100	27765200	1	95	4.53
331-340	0	0	100	25529100	1	96	4.00
341-350	0	0	100	22732200	0	96	3.53
351-360	0	0	100	20929000	0	97	3.09
361-370	0	0	100	19036300	0	97	2.70
371-380	0	0	100	16366600	0	98	2.36
381-390	0	0	100	13416100	0	98	2.08
391-400	0	0	100	11826900	0	98	1.84
401-410	0	0	100	11262600	0	98	1.60
411-420	0	0	100	9921400	0	99	1.40
421-430	0	0	100	8868400	0	99	1.21
431-440	0	0	100	7899300	0	99	1.05
441-450	0	0	100	7681300	0	99	0.89
451-460	0	0	100	7049200	0	99	0.75
461-470	0	0	100	6103600	0	99	0.62
471-480	0	0	100	4987400	0	99	0.52
481-490	0	0	100	3935800	0	100	0.44
491-500	0	0	100	3277900	0	100	0.37
501-510	0	0	100	2843100	0	100	0.31
511-520	0	0	100	2553000	0	100	0.26
521-530	0	0	100	2250200	0	100	0.21
531-540	0	0	100	2045100	0	100	0.17
541-550	0	0	100	1819200	0	100	0.13
551-560	0	0	100	1630900	0	100	0.10
561-570	0	0	100	1594400	0	100	0.06
571-580	0	0	100	1326100	0	100	0.03
581-590	0	0	100	932700	0	100	0.02
591-600	0	0	100	756500	0	100	0.00
TOTAL	26	100		4830309000	100	100	

Calc = 45.80%
Crit = 26.67%
Reject Ho

Co. Donegal CEB and Altitude (Kolmogorov-Smirnov)

Altitude Bands (m)	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0-10	1	11	11	301666000	6	6	4.87
11-20	0	0	11	232584200	5	11	0.05
21-30	2	22	33	227555700	5	16	17.56
31-40	1	11	44	231290200	5	21	23.88
41-50	0	0	44	227488700	5	25	19.18
51-60	0	0	44	216465300	4	30	14.69
61-70	1	11	56	207932200	4	34	21.50
71-80	0	0	56	212238000	4	38	17.11
81-90	2	22	78	203447200	4	43	35.12
91-100	1	11	89	194277400	4	47	42.21
101-110	0	0	89	191067000	4	51	38.25
111-120	1	11	100	185785700	4	54	45.51
121-130	0	0	100	179858400	4	58	41.79
131-140	0	0	100	168599200	3	62	38.30
141-150	0	0	100	162934500	3	65	34.93
151-160	0	0	100	152253100	3	68	31.78
161-170	0	0	100	147758800	3	71	28.72
171-180	0	0	100	137167300	3	74	25.88
181-190	0	0	100	128183600	3	77	23.22
191-200	0	0	100	120923200	3	79	20.72
201-210	0	0	100	110923800	2	82	18.42
211-220	0	0	100	97783800	2	84	16.40
221-230	0	0	100	87620800	2	85	14.59
231-240	0	0	100	76680600	2	87	13.00
241-250	0	0	100	67479000	1	88	11.60
251-260	0	0	100	62086100	1	90	10.32
261-270	0	0	100	55610400	1	91	9.16
271-280	0	0	100	49192500	1	92	8.15
281-290	0	0	100	43511400	1	93	7.24
291-300	0	0	100	37994400	1	94	6.46
301-310	0	0	100	35114600	1	94	5.73
311-320	0	0	100	30496400	1	95	5.10
321-330	0	0	100	27765200	1	95	4.53
331-340	0	0	100	25529100	1	96	4.00
341-350	0	0	100	22732200	0	96	3.53
351-360	0	0	100	20929000	0	97	3.09
361-370	0	0	100	19036300	0	97	2.70
371-380	0	0	100	16366600	0	98	2.36
381-390	0	0	100	13416100	0	98	2.08
391-400	0	0	100	11826900	0	98	1.84
401-410	0	0	100	11262600	0	98	1.60
411-420	0	0	100	9921400	0	99	1.40
421-430	0	0	100	8868400	0	99	1.21
431-440	0	0	100	7899300	0	99	1.05
441-450	0	0	100	7681300	0	99	0.89
451-460	0	0	100	7049200	0	99	0.75
461-470	0	0	100	6103600	0	99	0.62
471-480	0	0	100	4987400	0	99	0.52
481-490	0	0	100	3935800	0	100	0.44
491-500	0	0	100	3277900	0	100	0.37
501-510	0	0	100	2843100	0	100	0.31
511-520	0	0	100	2553000	0	100	0.26
521-530	0	0	100	2250200	0	100	0.21
531-540	0	0	100	2045100	0	100	0.17
541-550	0	0	100	1819200	0	100	0.13
551-560	0	0	100	1630900	0	100	0.10
561-570	0	0	100	1594400	0	100	0.06
571-580	0	0	100	1326100	0	100	0.03
581-590	0	0	100	932700	0	100	0.02
591-600	0	0	100	756500	0	100	0.00
TOTAL	9	100		4830309000	100	100	

Calc = 45.51%
Crit = 45.33%
Reject Ho

Co. Donegal CEA and Altitude (Kolmogorov-Smirnov)

Altitude Bands (m)	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0-10	8	7	7	301666000	6	6	0.31
11-20	16	13	20	232584200	5	11	8.61
21-30	11	9	29	227555700	5	16	12.92
31-40	16	13	42	231290200	5	21	21.24
41-50	11	9	51	227488700	5	25	25.55
51-60	7	6	57	216465300	4	30	26.81
61-70	11	9	66	207932200	4	34	31.52
71-80	10	8	74	212238000	4	38	35.32
81-90	4	3	77	203447200	4	43	34.39
91-100	7	6	83	194277400	4	47	36.10
101-110	6	5	88	191067000	4	51	37.07
111-120	4	3	91	185785700	4	54	36.50
121-130	6	5	96	179858400	4	58	37.69
131-140	1	1	97	168599200	3	62	35.02
141-150	0	0	97	162934500	3	65	31.65
151-160	2	2	98	152253100	3	68	30.14
161-170	0	0	98	147758800	3	71	27.08
171-180	0	0	98	137167300	3	74	24.24
181-190	1	1	99	128183600	3	77	22.40
191-200	0	0	99	120923200	3	79	19.90
201-210	1	1	100	110923800	2	82	18.42
211-220	0	0	100	97783800	2	84	16.40
221-230	0	0	100	87620800	2	85	14.59
231-240	0	0	100	76680600	2	87	13.00
241-250	0	0	100	67479000	1	88	11.60
251-260	0	0	100	62086100	1	90	10.32
261-270	0	0	100	55610400	1	91	9.16
271-280	0	0	100	49192500	1	92	8.15
281-290	0	0	100	43511400	1	93	7.24
291-300	0	0	100	37994400	1	94	6.46
301-310	0	0	100	35114600	1	94	5.73
311-320	0	0	100	30496400	1	95	5.10
321-330	0	0	100	27765200	1	95	4.53
331-340	0	0	100	25529100	1	96	4.00
341-350	0	0	100	22732200	0	96	3.53
351-360	0	0	100	20929000	0	97	3.09
361-370	0	0	100	19036300	0	97	2.70
371-380	0	0	100	16366600	0	98	2.36
381-390	0	0	100	13416100	0	98	2.08
391-400	0	0	100	11826900	0	98	1.84
401-410	0	0	100	11262600	0	98	1.60
411-420	0	0	100	9921400	0	99	1.40
421-430	0	0	100	8868400	0	99	1.21
431-440	0	0	100	7899300	0	99	1.05
441-450	0	0	100	7681300	0	99	0.89
451-460	0	0	100	7049200	0	99	0.75
461-470	0	0	100	6103600	0	99	0.62
471-480	0	0	100	4987400	0	99	0.52
481-490	0	0	100	3935800	0	100	0.44
491-500	0	0	100	3277900	0	100	0.37
501-510	0	0	100	2843100	0	100	0.31
511-520	0	0	100	2553000	0	100	0.26
521-530	0	0	100	2250200	0	100	0.21
531-540	0	0	100	2045100	0	100	0.17
541-550	0	0	100	1819200	0	100	0.13
551-560	0	0	100	1630900	0	100	0.10
561-570	0	0	100	1594400	0	100	0.06
571-580	0	0	100	1326100	0	100	0.03
581-590	0	0	100	932700	0	100	0.02
591-600	0	0	100	756500	0	100	0.00
TOTAL	122	100		4830309000	100	100	

Calc = 37.69%

Crit =12.31%

Reject Ho

Co. Donegal All Rectilinear sites above 180m2 and Altitude (Kolmogorov-Smirnov)

Altitude Bands (m)	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0-10	1	11	11	301666000	6	6	4.87
11-20	5	56	67	232584200	5	11	55.61
21-30	1	11	78	227555700	5	16	62.01
31-40	0	0	78	231290200	5	21	57.22
41-50	0	0	78	227488700	5	25	52.51
51-60	0	0	78	216465300	4	30	48.03
61-70	1	11	89	207932200	4	34	54.83
71-80	0	0	89	212238000	4	38	50.44
81-90	0	0	89	203447200	4	43	46.23
91-100	0	0	89	194277400	4	47	42.21
101-110	0	0	89	191067000	4	51	38.25
111-120	0	0	89	185785700	4	54	34.40
121-130	1	11	100	179858400	4	58	41.79
131-140	0	0	100	168599200	3	62	38.30
141-150	0	0	100	162934500	3	65	34.93
151-160	0	0	100	152253100	3	68	31.78
161-170	0	0	100	147758800	3	71	28.72
171-180	0	0	100	137167300	3	74	25.88
181-190	0	0	100	128183600	3	77	23.22
191-200	0	0	100	120923200	3	79	20.72
201-210	0	0	100	110923800	2	82	18.42
211-220	0	0	100	97783800	2	84	16.40
221-230	0	0	100	87620800	2	85	14.59
231-240	0	0	100	76680600	2	87	13.00
241-250	0	0	100	67479000	1	88	11.60
251-260	0	0	100	62086100	1	90	10.32
261-270	0	0	100	55610400	1	91	9.16
271-280	0	0	100	49192500	1	92	8.15
281-290	0	0	100	43511400	1	93	7.24
291-300	0	0	100	37994400	1	94	6.46
301-310	0	0	100	35114600	1	94	5.73
311-320	0	0	100	30496400	1	95	5.10
321-330	0	0	100	27765200	1	95	4.53
331-340	0	0	100	25529100	1	96	4.00
341-350	0	0	100	22732200	0	96	3.53
351-360	0	0	100	20929000	0	97	3.09
361-370	0	0	100	19036300	0	97	2.70
371-380	0	0	100	16366600	0	98	2.36
381-390	0	0	100	13416100	0	98	2.08
391-400	0	0	100	11826900	0	98	1.84
401-410	0	0	100	11262600	0	98	1.60
411-420	0	0	100	9921400	0	99	1.40
421-430	0	0	100	8868400	0	99	1.21
431-440	0	0	100	7899300	0	99	1.05
441-450	0	0	100	7681300	0	99	0.89
451-460	0	0	100	7049200	0	99	0.75
461-470	0	0	100	6103600	0	99	0.62
471-480	0	0	100	4987400	0	99	0.52
481-490	0	0	100	3935800	0	100	0.44
491-500	0	0	100	3277900	0	100	0.37
501-510	0	0	100	2843100	0	100	0.31
511-520	0	0	100	2553000	0	100	0.26
521-530	0	0	100	2250200	0	100	0.21
531-540	0	0	100	2045100	0	100	0.17
541-550	0	0	100	1819200	0	100	0.13
551-560	0	0	100	1630900	0	100	0.10
561-570	0	0	100	1594400	0	100	0.06
571-580	0	0	100	1326100	0	100	0.03
581-590	0	0	100	932700	0	100	0.02
591-600	0	0	100	756500	0	100	0.00
TOTAL	9	100		4830309000	100	100	

Calc = 62.01%

Crit =45.33%

Reject Ho

Co. Donegal RSA and Altitude (Kolmogorov-Smirnov)

Altitude Bands (m)	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0-10	0	0	0	301666000	6	6	-6.25
11-20	3	60	60	232584200	5	11	48.94
21-30	1	20	80	227555700	5	16	64.23
31-40	0	0	80	231290200	5	21	59.44
41-50	0	0	80	227488700	5	25	54.73
51-60	0	0	80	216465300	4	30	50.25
61-70	0	0	80	207932200	4	34	45.94
71-80	0	0	80	212238000	4	38	41.55
81-90	0	0	80	203447200	4	43	37.34
91-100	0	0	80	194277400	4	47	33.32
101-110	0	0	80	191067000	4	51	29.36
111-120	0	0	80	185785700	4	54	25.51
121-130	1	20	100	179858400	4	58	41.79
131-140	0	0	100	168599200	3	62	38.30
141-150	0	0	100	162934500	3	65	34.93
151-160	0	0	100	152253100	3	68	31.78
161-170	0	0	100	147758800	3	71	28.72
171-180	0	0	100	137167300	3	74	25.88
181-190	0	0	100	128183600	3	77	23.22
191-200	0	0	100	120923200	3	79	20.72
201-210	0	0	100	110923800	2	82	18.42
211-220	0	0	100	97783800	2	84	16.40
221-230	0	0	100	87620800	2	85	14.59
231-240	0	0	100	76680600	2	87	13.00
241-250	0	0	100	67479000	1	88	11.60
251-260	0	0	100	62086100	1	90	10.32
261-270	0	0	100	55610400	1	91	9.16
271-280	0	0	100	49192500	1	92	8.15
281-290	0	0	100	43511400	1	93	7.24
291-300	0	0	100	37994400	1	94	6.46
301-310	0	0	100	35114600	1	94	5.73
311-320	0	0	100	30496400	1	95	5.10
321-330	0	0	100	27765200	1	95	4.53
331-340	0	0	100	25529100	1	96	4.00
341-350	0	0	100	22732200	0	96	3.53
351-360	0	0	100	20929000	0	97	3.09
361-370	0	0	100	19036300	0	97	2.70
371-380	0	0	100	16366600	0	98	2.36
381-390	0	0	100	13416100	0	98	2.08
391-400	0	0	100	11826900	0	98	1.84
401-410	0	0	100	11262600	0	98	1.60
411-420	0	0	100	9921400	0	99	1.40
421-430	0	0	100	8868400	0	99	1.21
431-440	0	0	100	7899300	0	99	1.05
441-450	0	0	100	7681300	0	99	0.89
451-460	0	0	100	7049200	0	99	0.75
461-470	0	0	100	6103600	0	99	0.62
471-480	0	0	100	4987400	0	99	0.52
481-490	0	0	100	3935800	0	100	0.44
491-500	0	0	100	3277900	0	100	0.37
501-510	0	0	100	2843100	0	100	0.31
511-520	0	0	100	2553000	0	100	0.26
521-530	0	0	100	2250200	0	100	0.21
531-540	0	0	100	2045100	0	100	0.17
541-550	0	0	100	1819200	0	100	0.13
551-560	0	0	100	1630900	0	100	0.10
561-570	0	0	100	1594400	0	100	0.06
571-580	0	0	100	1326100	0	100	0.03
581-590	0	0	100	932700	0	100	0.02
591-600	0	0	100	756500	0	100	0.00
TOTAL	5	100		4830309000	100	100	

Calc = 64.23%

Crit =60.82%

Reject Ho

Co. Donegal All Irregular sites above 180m2 and Altitude (Kolmogorov-Smirnov)

Altitude Bands (m)	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0-10	4	24	24	301666000	6	6	17.28
11-20	0	0	24	232584200	5	11	12.47
21-30	0	0	24	227555700	5	16	7.76
31-40	1	6	29	231290200	5	21	8.85
41-50	0	0	29	227488700	5	25	4.14
51-60	1	6	35	216465300	4	30	5.54
61-70	0	0	35	207932200	4	34	1.24
71-80	1	6	41	212238000	4	38	2.73
81-90	1	6	47	203447200	4	43	4.40
91-100	2	12	59	194277400	4	47	12.14
101-110	0	0	59	191067000	4	51	8.18
111-120	2	12	71	185785700	4	54	16.10
121-130	2	12	82	179858400	4	58	24.14
131-140	1	6	88	168599200	3	62	26.54
141-150	0	0	88	162934500	3	65	23.16
151-160	0	0	88	152253100	3	68	20.01
161-170	1	6	94	147758800	3	71	22.83
171-180	0	0	94	137167300	3	74	19.99
181-190	1	6	100	128183600	3	77	23.22
191-200	0	0	100	120923200	3	79	20.72
201-210	0	0	100	110923800	2	82	18.42
211-220	0	0	100	97783800	2	84	16.40
221-230	0	0	100	87620800	2	85	14.59
231-240	0	0	100	76680600	2	87	13.00
241-250	0	0	100	67479000	1	88	11.60
251-260	0	0	100	62086100	1	90	10.32
261-270	0	0	100	55610400	1	91	9.16
271-280	0	0	100	49192500	1	92	8.15
281-290	0	0	100	43511400	1	93	7.24
291-300	0	0	100	37994400	1	94	6.46
301-310	0	0	100	35114600	1	94	5.73
311-320	0	0	100	30496400	1	95	5.10
321-330	0	0	100	27765200	1	95	4.53
331-340	0	0	100	25529100	1	96	4.00
341-350	0	0	100	22732200	0	96	3.53
351-360	0	0	100	20929000	0	97	3.09
361-370	0	0	100	19036300	0	97	2.70
371-380	0	0	100	16366600	0	98	2.36
381-390	0	0	100	13416100	0	98	2.08
391-400	0	0	100	11826900	0	98	1.84
401-410	0	0	100	11262600	0	98	1.60
411-420	0	0	100	9921400	0	99	1.40
421-430	0	0	100	8868400	0	99	1.21
431-440	0	0	100	7899300	0	99	1.05
441-450	0	0	100	7681300	0	99	0.89
451-460	0	0	100	7049200	0	99	0.75
461-470	0	0	100	6103600	0	99	0.62
471-480	0	0	100	4987400	0	99	0.52
481-490	0	0	100	3935800	0	100	0.44
491-500	0	0	100	3277900	0	100	0.37
501-510	0	0	100	2843100	0	100	0.31
511-520	0	0	100	2553000	0	100	0.26
521-530	0	0	100	2250200	0	100	0.21
531-540	0	0	100	2045100	0	100	0.17
541-550	0	0	100	1819200	0	100	0.13
551-560	0	0	100	1630900	0	100	0.10
561-570	0	0	100	1594400	0	100	0.06
571-580	0	0	100	1326100	0	100	0.03
581-590	0	0	100	932700	0	100	0.02
591-600	0	0	100	756500	0	100	0.00
TOTAL	17	100		4830309000	100	100	

Calc = 26.54%

Crit =32.98%

Cannot Reject Ho

Co. Donegal All Irregular drystone sites above 180m2 and Altitude (Kolmogorov-Smirnov)

Altitude Bands (m)	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0-10	0	0	0	301666000	6	6	-6.25
11-20	0	0	0	232584200	5	11	-11.06
21-30	0	0	0	227555700	5	16	-15.77
31-40	1	20	20	231290200	5	21	-0.56
41-50	0	0	20	227488700	5	25	-5.27
51-60	0	0	20	216465300	4	30	-9.75
61-70	0	0	20	207932200	4	34	-14.06
71-80	0	0	20	212238000	4	38	-18.45
81-90	0	0	20	203447200	4	43	-22.66
91-100	1	20	40	194277400	4	47	-6.68
101-110	0	0	40	191067000	4	51	-10.64
111-120	1	20	60	185785700	4	54	5.51
121-130	0	0	60	179858400	4	58	1.79
131-140	0	0	60	168599200	3	62	-1.70
141-150	0	0	60	162934500	3	65	-5.07
151-160	0	0	60	152253100	3	68	-8.22
161-170	1	20	80	147758800	3	71	8.72
171-180	0	0	80	137167300	3	74	5.88
181-190	1	20	100	128183600	3	77	23.22
191-200	0	0	100	120923200	3	79	20.72
201-210	0	0	100	110923800	2	82	18.42
211-220	0	0	100	97783800	2	84	16.40
221-230	0	0	100	87620800	2	85	14.59
231-240	0	0	100	76680600	2	87	13.00
241-250	0	0	100	67479000	1	88	11.60
251-260	0	0	100	62086100	1	90	10.32
261-270	0	0	100	55610400	1	91	9.16
271-280	0	0	100	49192500	1	92	8.15
281-290	0	0	100	43511400	1	93	7.24
291-300	0	0	100	37994400	1	94	6.46
301-310	0	0	100	35114600	1	94	5.73
311-320	0	0	100	30496400	1	95	5.10
321-330	0	0	100	27765200	1	95	4.53
331-340	0	0	100	25529100	1	96	4.00
341-350	0	0	100	22732200	0	96	3.53
351-360	0	0	100	20929000	0	97	3.09
361-370	0	0	100	19036300	0	97	2.70
371-380	0	0	100	16366600	0	98	2.36
381-390	0	0	100	13416100	0	98	2.08
391-400	0	0	100	11826900	0	98	1.84
401-410	0	0	100	11262600	0	98	1.60
411-420	0	0	100	9921400	0	99	1.40
421-430	0	0	100	8868400	0	99	1.21
431-440	0	0	100	7899300	0	99	1.05
441-450	0	0	100	7681300	0	99	0.89
451-460	0	0	100	7049200	0	99	0.75
461-470	0	0	100	6103600	0	99	0.62
471-480	0	0	100	4987400	0	99	0.52
481-490	0	0	100	3935800	0	100	0.44
491-500	0	0	100	3277900	0	100	0.37
501-510	0	0	100	2843100	0	100	0.31
511-520	0	0	100	2553000	0	100	0.26
521-530	0	0	100	2250200	0	100	0.21
531-540	0	0	100	2045100	0	100	0.17
541-550	0	0	100	1819200	0	100	0.13
551-560	0	0	100	1630900	0	100	0.10
561-570	0	0	100	1594400	0	100	0.06
571-580	0	0	100	1326100	0	100	0.03
581-590	0	0	100	932700	0	100	0.02
591-600	0	0	100	756500	0	100	0.00
TOTAL	5	100		4830309000	100	100	

Calc = 23.22%

Crit =60.82%

Cannot Reject Ho

Co. Donegal All Irregular earth constructed sites and Altitude (Kolmogorov-Smirnov)

Altitude Bands (m)	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0-10	2	50	50	301666000	6	6	43.75
11-20	0	0	50	232584200	5	11	38.94
21-30	0	0	50	227555700	5	16	34.23
31-40	0	0	50	231290200	5	21	29.44
41-50	0	0	50	227488700	5	25	24.73
51-60	0	0	50	216465300	4	30	20.25
61-70	0	0	50	207932200	4	34	15.94
71-80	1	25	75	212238000	4	38	36.55
81-90	0	0	75	203447200	4	43	32.34
91-100	0	0	75	194277400	4	47	28.32
101-110	0	0	75	191067000	4	51	24.36
111-120	0	0	75	185785700	4	54	20.51
121-130	1	25	100	179858400	4	58	41.79
131-140	0	0	100	168599200	3	62	38.30
141-150	0	0	100	162934500	3	65	34.93
151-160	0	0	100	152253100	3	68	31.78
161-170	0	0	100	147758800	3	71	28.72
171-180	0	0	100	137167300	3	74	25.88
181-190	0	0	100	128183600	3	77	23.22
191-200	0	0	100	120923200	3	79	20.72
201-210	0	0	100	110923800	2	82	18.42
211-220	0	0	100	97783800	2	84	16.40
221-230	0	0	100	87620800	2	85	14.59
231-240	0	0	100	76680600	2	87	13.00
241-250	0	0	100	67479000	1	88	11.60
251-260	0	0	100	62086100	1	90	10.32
261-270	0	0	100	55610400	1	91	9.16
271-280	0	0	100	49192500	1	92	8.15
281-290	0	0	100	43511400	1	93	7.24
291-300	0	0	100	37994400	1	94	6.46
301-310	0	0	100	35114600	1	94	5.73
311-320	0	0	100	30496400	1	95	5.10
321-330	0	0	100	27765200	1	95	4.53
331-340	0	0	100	25529100	1	96	4.00
341-350	0	0	100	22732200	0	96	3.53
351-360	0	0	100	20929000	0	97	3.09
361-370	0	0	100	19036300	0	97	2.70
371-380	0	0	100	16366600	0	98	2.36
381-390	0	0	100	13416100	0	98	2.08
391-400	0	0	100	11826900	0	98	1.84
401-410	0	0	100	11262600	0	98	1.60
411-420	0	0	100	9921400	0	99	1.40
421-430	0	0	100	8868400	0	99	1.21
431-440	0	0	100	7899300	0	99	1.05
441-450	0	0	100	7681300	0	99	0.89
451-460	0	0	100	7049200	0	99	0.75
461-470	0	0	100	6103600	0	99	0.62
471-480	0	0	100	4987400	0	99	0.52
481-490	0	0	100	3935800	0	100	0.44
491-500	0	0	100	3277900	0	100	0.37
501-510	0	0	100	2843100	0	100	0.31
511-520	0	0	100	2553000	0	100	0.26
521-530	0	0	100	2250200	0	100	0.21
531-540	0	0	100	2045100	0	100	0.17
541-550	0	0	100	1819200	0	100	0.13
551-560	0	0	100	1630900	0	100	0.10
561-570	0	0	100	1594400	0	100	0.06
571-580	0	0	100	1326100	0	100	0.03
581-590	0	0	100	932700	0	100	0.02
591-600	0	0	100	756500	0	100	0.00
TOTAL	4	100		4830309000	100	100	

Calc = 43.75%

Crit =68.00%

Cannot Reject Ho

Co. Donegal PA and Altitude (Kolmogorov-Smirnov)

Altitude Bands (m)	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0-10	19	59	59	301666000	6	6	53.13
11-20	6	19	78	232584200	5	11	67.06
21-30	1	3	81	227555700	5	16	65.48
31-40	0	0	81	231290200	5	21	60.69
41-50	1	3	84	227488700	5	25	59.11
51-60	0	0	84	216465300	4	30	54.62
61-70	0	0	84	207932200	4	34	50.32
71-80	0	0	84	212238000	4	38	45.93
81-90	0	0	84	203447200	4	43	41.71
91-100	0	0	84	194277400	4	47	37.69
101-110	1	3	88	191067000	4	51	36.86
111-120	2	6	94	185785700	4	54	39.26
121-130	2	6	100	179858400	4	58	41.79
131-140	0	0	100	168599200	3	62	38.30
141-150	0	0	100	162934500	3	65	34.93
151-160	0	0	100	152253100	3	68	31.78
161-170	0	0	100	147758800	3	71	28.72
171-180	0	0	100	137167300	3	74	25.88
181-190	0	0	100	128183600	3	77	23.22
191-200	0	0	100	120923200	3	79	20.72
201-210	0	0	100	110923800	2	82	18.42
211-220	0	0	100	97783800	2	84	16.40
221-230	0	0	100	87620800	2	85	14.59
231-240	0	0	100	76680600	2	87	13.00
241-250	0	0	100	67479000	1	88	11.60
251-260	0	0	100	62086100	1	90	10.32
261-270	0	0	100	55610400	1	91	9.16
271-280	0	0	100	49192500	1	92	8.15
281-290	0	0	100	43511400	1	93	7.24
291-300	0	0	100	37994400	1	94	6.46
301-310	0	0	100	35114600	1	94	5.73
311-320	0	0	100	30496400	1	95	5.10
321-330	0	0	100	27765200	1	95	4.53
331-340	0	0	100	25529100	1	96	4.00
341-350	0	0	100	22732200	0	96	3.53
351-360	0	0	100	20929000	0	97	3.09
361-370	0	0	100	19036300	0	97	2.70
371-380	0	0	100	16366600	0	98	2.36
381-390	0	0	100	13416100	0	98	2.08
391-400	0	0	100	11826900	0	98	1.84
401-410	0	0	100	11262600	0	98	1.60
411-420	0	0	100	9921400	0	99	1.40
421-430	0	0	100	8868400	0	99	1.21
431-440	0	0	100	7899300	0	99	1.05
441-450	0	0	100	7681300	0	99	0.89
451-460	0	0	100	7049200	0	99	0.75
461-470	0	0	100	6103600	0	99	0.62
471-480	0	0	100	4987400	0	99	0.52
481-490	0	0	100	3935800	0	100	0.44
491-500	0	0	100	3277900	0	100	0.37
501-510	0	0	100	2843100	0	100	0.31
511-520	0	0	100	2553000	0	100	0.26
521-530	0	0	100	2250200	0	100	0.21
531-540	0	0	100	2045100	0	100	0.17
541-550	0	0	100	1819200	0	100	0.13
551-560	0	0	100	1630900	0	100	0.10
561-570	0	0	100	1594400	0	100	0.06
571-580	0	0	100	1326100	0	100	0.03
581-590	0	0	100	932700	0	100	0.02
591-600	0	0	100	756500	0	100	0.00
TOTAL	32	100		4830309000	100	100	

Calc = 67.06%
Crit =24.04%
Reject Ho

Co. Donegal All sites with architectural features and Altitude (Kolmogorov-Smirnov)

Altitude Bands (m)	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0-10	0	0	0	301666000	6	6	-6.25
11-20	0	0	0	232584200	5	11	-11.06
21-30	0	0	0	227555700	5	16	-15.77
31-40	0	0	0	231290200	5	21	-20.56
41-50	0	0	0	227488700	5	25	-25.27
51-60	0	0	0	216465300	4	30	-29.75
61-70	2	40	40	207932200	4	34	5.94
71-80	0	0	40	212238000	4	38	1.55
81-90	2	40	80	203447200	4	43	37.34
91-100	0	0	80	194277400	4	47	33.32
101-110	0	0	80	191067000	4	51	29.36
111-120	0	0	80	185785700	4	54	25.51
121-130	0	0	80	179858400	4	58	21.79
131-140	0	0	80	168599200	3	62	18.30
141-150	0	0	80	162934500	3	65	14.93
151-160	0	0	80	152253100	3	68	11.78
161-170	0	0	80	147758800	3	71	8.72
171-180	0	0	80	137167300	3	74	5.88
181-190	0	0	80	128183600	3	77	3.22
191-200	0	0	80	120923200	3	79	0.72
201-210	0	0	80	110923800	2	82	-1.58
211-220	1	20	100	97783800	2	84	16.40
221-230	0	0	100	87620800	2	85	14.59
231-240	0	0	100	76680600	2	87	13.00
241-250	0	0	100	67479000	1	88	11.60
251-260	0	0	100	62086100	1	90	10.32
261-270	0	0	100	55610400	1	91	9.16
271-280	0	0	100	49192500	1	92	8.15
281-290	0	0	100	43511400	1	93	7.24
291-300	0	0	100	37994400	1	94	6.46
301-310	0	0	100	35114600	1	94	5.73
311-320	0	0	100	30496400	1	95	5.10
321-330	0	0	100	27765200	1	95	4.53
331-340	0	0	100	25529100	1	96	4.00
341-350	0	0	100	22732200	0	96	3.53
351-360	0	0	100	20929000	0	97	3.09
361-370	0	0	100	19036300	0	97	2.70
371-380	0	0	100	16366600	0	98	2.36
381-390	0	0	100	13416100	0	98	2.08
391-400	0	0	100	11826900	0	98	1.84
401-410	0	0	100	11262600	0	98	1.60
411-420	0	0	100	9921400	0	99	1.40
421-430	0	0	100	8868400	0	99	1.21
431-440	0	0	100	7899300	0	99	1.05
441-450	0	0	100	7681300	0	99	0.89
451-460	0	0	100	7049200	0	99	0.75
461-470	0	0	100	6103600	0	99	0.62
471-480	0	0	100	4987400	0	99	0.52
481-490	0	0	100	3935800	0	100	0.44
491-500	0	0	100	3277900	0	100	0.37
501-510	0	0	100	2843100	0	100	0.31
511-520	0	0	100	2553000	0	100	0.26
521-530	0	0	100	2250200	0	100	0.21
531-540	0	0	100	2045100	0	100	0.17
541-550	0	0	100	1819200	0	100	0.13
551-560	0	0	100	1630900	0	100	0.10
561-570	0	0	100	1594400	0	100	0.06
571-580	0	0	100	1326100	0	100	0.03
581-590	0	0	100	932700	0	100	0.02
591-600	0	0	100	756500	0	100	0.00
TOTAL	5	100		4830309000	100	100	

Calc = 37.34%

Crit =60.82%

Cannot Reject Ho

Co. Donegal CSB and Slope (Kolmogorov-Smirnov)

Slope Categories	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0	1	3	3	453139900	9	9	-6.05
1	6	20	23	208424900	4	14	9.64
2	5	17	40	684855100	14	28	12.12
3	3	10	50	720302700	15	43	7.21
4	2	7	57	372660400	8	51	6.16
5	3	10	67	667782700	14	64	2.34
6	4	13	80	328395400	7	71	8.87
7	1	3	83	184419100	4	75	8.39
8	0	0	83	362277900	8	82	0.88
9	1	3	87	109394900	2	85	1.95
10	1	3	90	131449700	3	87	2.56
11	1	3	93	123414200	3	90	3.34
12	1	3	97	110315100	2	92	4.39
13	0	0	97	32884400	1	93	3.71
14	0	0	97	63512100	1	94	2.40
15	1	3	100	50312300	1	95	4.69
16	0	0	100	38402700	1	96	3.89
17	0	0	100	29774100	1	97	3.28
18	0	0	100	21808800	0	97	2.83
19	0	0	100	21177500	0	98	2.39
20	0	0	100	17236500	0	98	2.03
21	0	0	100	15883900	0	98	1.70
22	0	0	100	10398700	0	99	1.49
23	0	0	100	9914900	0	99	1.28
24	0	0	100	10003700	0	99	1.07
25	0	0	100	6444200	0	99	0.94
26	0	0	100	6824300	0	99	0.80
27	0	0	100	5601900	0	99	0.68
28	0	0	100	4626300	0	99	0.59
29	0	0	100	4002400	0	99	0.50
30	0	0	100	3242600	0	100	0.44
31	0	0	100	3085000	0	100	0.37
32	0	0	100	2645200	0	100	0.32
33	0	0	100	2606200	0	100	0.26
34	0	0	100	1927600	0	100	0.22
35	0	0	100	1852800	0	100	0.19
36	0	0	100	1557200	0	100	0.15
37	0	0	100	1328800	0	100	0.13
38	0	0	100	1094700	0	100	0.10
39	0	0	100	916700	0	100	0.08
40	0	0	100	790900	0	100	0.07
41	0	0	100	620900	0	100	0.06
42	0	0	100	579100	0	100	0.04
43	0	0	100	529300	0	100	0.03
44	0	0	100	372100	0	100	0.02
45	0	0	100	402400	0	100	0.02
46	0	0	100	302400	0	100	0.01
47	0	0	100	271000	0	100	0.00
48	0	0	100	217500	0	100	0.00
49	0	0	100	174300	0	100	0.00
50	0	0	100	151600	0	100	-0.01
TOTAL	30			4829983100			

Calc = 12.12%
Crit = 24.83%
Cannot Reject Ho

Co. Donegal CSA and Slope (Kolmogorov-Smirnov)

Slope Categories	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0	5	5	5	453139900	9	9	-4.12
1	9	9	15	208424900	4	14	1.04
2	25	26	41	684855100	14	28	13.18
3	13	14	55	720302700	15	43	11.95
4	16	17	72	372660400	8	51	21.07
5	7	7	79	667782700	14	64	14.62
6	5	5	84	328395400	7	71	13.08
7	3	3	87	184419100	4	75	12.42
8	2	2	89	362277900	8	82	7.02
9	1	1	91	109394900	2	85	5.81
10	1	1	92	131449700	3	87	4.14
11	3	3	95	123414200	3	90	4.75
12	1	1	96	110315100	2	92	3.52
13	0	0	96	32884400	1	93	2.83
14	0	0	96	63512100	1	94	1.52
15	3	3	99	50312300	1	95	3.64
16	0	0	99	38402700	1	96	2.84
17	1	1	100	29774100	1	97	3.28
18	0	0	100	21808800	0	97	2.83
19	0	0	100	21177500	0	98	2.39
20	0	0	100	17236500	0	98	2.03
21	0	0	100	15883900	0	98	1.70
22	0	0	100	10398700	0	99	1.49
23	0	0	100	9914900	0	99	1.28
24	0	0	100	10003700	0	99	1.07
25	0	0	100	6444200	0	99	0.94
26	0	0	100	6824300	0	99	0.80
27	0	0	100	5601900	0	99	0.68
28	0	0	100	4626300	0	99	0.59
29	0	0	100	4002400	0	99	0.50
30	0	0	100	3242600	0	100	0.44
31	0	0	100	3085000	0	100	0.37
32	0	0	100	2645200	0	100	0.32
33	0	0	100	2606200	0	100	0.26
34	0	0	100	1927600	0	100	0.22
35	0	0	100	1852800	0	100	0.19
36	0	0	100	1557200	0	100	0.15
37	0	0	100	1328800	0	100	0.13
38	0	0	100	1094700	0	100	0.10
39	0	0	100	916700	0	100	0.08
40	0	0	100	790900	0	100	0.07
41	0	0	100	620900	0	100	0.06
42	0	0	100	579100	0	100	0.04
43	0	0	100	529300	0	100	0.03
44	0	0	100	372100	0	100	0.02
45	0	0	100	402400	0	100	0.02
46	0	0	100	302400	0	100	0.01
47	0	0	100	271000	0	100	0.00
48	0	0	100	217500	0	100	0.00
49	0	0	100	174300	0	100	0.00
50	0	0	100	151600	0	100	-0.01
TOTAL	95			4829983100			

Calc = 21.07%
Crit = 13.95%
Reject Ho

Co. Donegal CSAEB and Slope (Kolmogorov-Smirnov)

Slope Categories	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0	0	0	0	453139900	9	9	-9.38
1	1	33	33	208424900	4	14	19.64
2	1	33	67	684855100	14	28	38.79
3	0	0	67	720302700	15	43	23.88
4	1	33	100	372660400	8	51	49.49
5	0	0	100	667782700	14	64	35.67
6	0	0	100	328395400	7	71	28.87
7	0	0	100	184419100	4	75	25.05
8	0	0	100	362277900	8	82	17.55
9	0	0	100	109394900	2	85	15.29
10	0	0	100	131449700	3	87	12.56
11	0	0	100	123414200	3	90	10.01
12	0	0	100	110315100	2	92	7.73
13	0	0	100	32884400	1	93	7.04
14	0	0	100	63512100	1	94	5.73
15	0	0	100	50312300	1	95	4.69
16	0	0	100	38402700	1	96	3.89
17	0	0	100	29774100	1	97	3.28
18	0	0	100	21808800	0	97	2.83
19	0	0	100	21177500	0	98	2.39
20	0	0	100	17236500	0	98	2.03
21	0	0	100	15883900	0	98	1.70
22	0	0	100	10398700	0	99	1.49
23	0	0	100	9914900	0	99	1.28
24	0	0	100	10003700	0	99	1.07
25	0	0	100	6444200	0	99	0.94
26	0	0	100	6824300	0	99	0.80
27	0	0	100	5601900	0	99	0.68
28	0	0	100	4626300	0	99	0.59
29	0	0	100	4002400	0	99	0.50
30	0	0	100	3242600	0	100	0.44
31	0	0	100	3085000	0	100	0.37
32	0	0	100	2645200	0	100	0.32
33	0	0	100	2606200	0	100	0.26
34	0	0	100	1927600	0	100	0.22
35	0	0	100	1852800	0	100	0.19
36	0	0	100	1557200	0	100	0.15
37	0	0	100	1328800	0	100	0.13
38	0	0	100	1094700	0	100	0.10
39	0	0	100	916700	0	100	0.08
40	0	0	100	790900	0	100	0.07
41	0	0	100	620900	0	100	0.06
42	0	0	100	579100	0	100	0.04
43	0	0	100	529300	0	100	0.03
44	0	0	100	372100	0	100	0.02
45	0	0	100	402400	0	100	0.02
46	0	0	100	302400	0	100	0.01
47	0	0	100	271000	0	100	0.00
48	0	0	100	217500	0	100	0.00
49	0	0	100	174300	0	100	0.00
50	0	0	100	151600	0	100	-0.01
TOTAL	3			4829983100			

Calc = 49.49%
Crit = 78.52%
Cannot reject Ho

Co. Donegal CSAEA and Slope (Kolmogorov-Smirnov)

Slope Categories	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0	1	4	4	453139900	9	9	-5.54
1	4	15	19	208424900	4	14	5.53
2	5	19	38	684855100	14	28	10.59
3	2	8	46	720302700	15	43	3.36
4	4	15	62	372660400	8	51	11.03
5	0	0	62	667782700	14	64	-2.79
6	0	0	62	328395400	7	71	-9.59
7	2	8	69	184419100	4	75	-5.72
8	3	12	81	362277900	8	82	-1.68
9	0	0	81	109394900	2	85	-3.94
10	3	12	92	131449700	3	87	4.87
11	2	8	100	123414200	3	90	10.01
12	0	0	100	110315100	2	92	7.73
13	0	0	100	32884400	1	93	7.04
14	0	0	100	63512100	1	94	5.73
15	0	0	100	50312300	1	95	4.69
16	0	0	100	38402700	1	96	3.89
17	0	0	100	29774100	1	97	3.28
18	0	0	100	21808800	0	97	2.83
19	0	0	100	21177500	0	98	2.39
20	0	0	100	17236500	0	98	2.03
21	0	0	100	15883900	0	98	1.70
22	0	0	100	10398700	0	99	1.49
23	0	0	100	9914900	0	99	1.28
24	0	0	100	10003700	0	99	1.07
25	0	0	100	6444200	0	99	0.94
26	0	0	100	6824300	0	99	0.80
27	0	0	100	5601900	0	99	0.68
28	0	0	100	4626300	0	99	0.59
29	0	0	100	4002400	0	99	0.50
30	0	0	100	3242600	0	100	0.44
31	0	0	100	3085000	0	100	0.37
32	0	0	100	2645200	0	100	0.32
33	0	0	100	2606200	0	100	0.26
34	0	0	100	1927600	0	100	0.22
35	0	0	100	1852800	0	100	0.19
36	0	0	100	1557200	0	100	0.15
37	0	0	100	1328800	0	100	0.13
38	0	0	100	1094700	0	100	0.10
39	0	0	100	916700	0	100	0.08
40	0	0	100	790900	0	100	0.07
41	0	0	100	620900	0	100	0.06
42	0	0	100	579100	0	100	0.04
43	0	0	100	529300	0	100	0.03
44	0	0	100	372100	0	100	0.02
45	0	0	100	402400	0	100	0.02
46	0	0	100	302400	0	100	0.01
47	0	0	100	271000	0	100	0.00
48	0	0	100	217500	0	100	0.00
49	0	0	100	174300	0	100	0.00
50	0	0	100	151600	0	100	-0.01
TOTAL	26			4829983100			

Calc = 11.03%

Crit = 26.67%

Cannot reject Ho

Co. Donegal CEB and Slope (Kolmogorov-Smirnov)

Slope Categories	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0	0	0	0	453139900	9	9	-9.38
1	3	33	33	208424900	4	14	19.64
2	3	33	67	684855100	14	28	38.79
3	0	0	67	720302700	15	43	23.88
4	1	11	78	372660400	8	51	27.27
5	0	0	78	667782700	14	64	13.45
6	1	11	89	328395400	7	71	17.76
7	0	0	89	184419100	4	75	13.94
8	1	11	100	362277900	8	82	17.55
9	0	0	100	109394900	2	85	15.29
10	0	0	100	131449700	3	87	12.56
11	0	0	100	123414200	3	90	10.01
12	0	0	100	110315100	2	92	7.73
13	0	0	100	32884400	1	93	7.04
14	0	0	100	63512100	1	94	5.73
15	0	0	100	50312300	1	95	4.69
16	0	0	100	38402700	1	96	3.89
17	0	0	100	29774100	1	97	3.28
18	0	0	100	21808800	0	97	2.83
19	0	0	100	21177500	0	98	2.39
20	0	0	100	17236500	0	98	2.03
21	0	0	100	15883900	0	98	1.70
22	0	0	100	10398700	0	99	1.49
23	0	0	100	9914900	0	99	1.28
24	0	0	100	10003700	0	99	1.07
25	0	0	100	6444200	0	99	0.94
26	0	0	100	6824300	0	99	0.80
27	0	0	100	5601900	0	99	0.68
28	0	0	100	4626300	0	99	0.59
29	0	0	100	4002400	0	99	0.50
30	0	0	100	3242600	0	100	0.44
31	0	0	100	3085000	0	100	0.37
32	0	0	100	2645200	0	100	0.32
33	0	0	100	2606200	0	100	0.26
34	0	0	100	1927600	0	100	0.22
35	0	0	100	1852800	0	100	0.19
36	0	0	100	1557200	0	100	0.15
37	0	0	100	1328800	0	100	0.13
38	0	0	100	1094700	0	100	0.10
39	0	0	100	916700	0	100	0.08
40	0	0	100	790900	0	100	0.07
41	0	0	100	620900	0	100	0.06
42	0	0	100	579100	0	100	0.04
43	0	0	100	529300	0	100	0.03
44	0	0	100	372100	0	100	0.02
45	0	0	100	402400	0	100	0.02
46	0	0	100	302400	0	100	0.01
47	0	0	100	271000	0	100	0.00
48	0	0	100	217500	0	100	0.00
49	0	0	100	174300	0	100	0.00
50	0	0	100	151600	0	100	-0.01
TOTAL	9			4829983100			

Calc = 38.79%
Crit = 45.33%
Cannot reject Ho

Co. Donegal CEA and Slope (Kolmogorov-Smirnov)

Slope Categories	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0	10	8	8	453139900	9	9	-1.19
1	16	13	21	208424900	4	14	7.61
2	13	11	32	684855100	14	28	4.09
3	12	10	42	720302700	15	43	-0.99
4	12	10	52	372660400	8	51	1.13
5	12	10	61	667782700	14	64	-2.86
6	10	8	70	328395400	7	71	-1.46
7	11	9	79	184419100	4	75	3.74
8	5	4	83	362277900	8	82	0.34
9	7	6	89	109394900	2	85	3.81
10	7	6	94	131449700	3	87	6.83
11	2	2	96	123414200	3	90	5.91
12	1	1	97	110315100	2	92	4.45
13	1	1	98	32884400	1	93	4.59
14	1	1	98	63512100	1	94	4.09
15	0	0	98	50312300	1	95	3.05
16	0	0	98	38402700	1	96	2.25
17	1	1	99	29774100	1	97	2.46
18	1	1	100	21808800	0	97	2.83
19	0	0	100	21177500	0	98	2.39
20	0	0	100	17236500	0	98	2.03
21	0	0	100	15883900	0	98	1.70
22	0	0	100	10398700	0	99	1.49
23	0	0	100	9914900	0	99	1.28
24	0	0	100	10003700	0	99	1.07
25	0	0	100	6444200	0	99	0.94
26	0	0	100	6824300	0	99	0.80
27	0	0	100	5601900	0	99	0.68
28	0	0	100	4626300	0	99	0.59
29	0	0	100	4002400	0	99	0.50
30	0	0	100	3242600	0	100	0.44
31	0	0	100	3085000	0	100	0.37
32	0	0	100	2645200	0	100	0.32
33	0	0	100	2606200	0	100	0.26
34	0	0	100	1927600	0	100	0.22
35	0	0	100	1852800	0	100	0.19
36	0	0	100	1557200	0	100	0.15
37	0	0	100	1328800	0	100	0.13
38	0	0	100	1094700	0	100	0.10
39	0	0	100	916700	0	100	0.08
40	0	0	100	790900	0	100	0.07
41	0	0	100	620900	0	100	0.06
42	0	0	100	579100	0	100	0.04
43	0	0	100	529300	0	100	0.03
44	0	0	100	372100	0	100	0.02
45	0	0	100	402400	0	100	0.02
46	0	0	100	302400	0	100	0.01
47	0	0	100	271000	0	100	0.00
48	0	0	100	217500	0	100	0.00
49	0	0	100	174300	0	100	0.00
50	0	0	100	151600	0	100	-0.01
TOTAL	122			4829983100			

Calc =7.61%
Crit =12.31%
Cannot reject Ho

Co. Donegal All Rectilinear sites above 180m2 and Slope (Kolmogorov-Smirnov)

Slope Categories	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0	1	11	11	453139900	9	9	1.73
1	2	22	33	208424900	4	14	19.64
2	0	0	33	684855100	14	28	5.46
3	1	11	44	720302700	15	43	1.66
4	1	11	56	372660400	8	51	5.05
5	2	22	78	667782700	14	64	13.45
6	1	11	89	328395400	7	71	17.76
7	0	0	89	184419100	4	75	13.94
8	0	0	89	362277900	8	82	6.44
9	1	11	100	109394900	2	85	15.29
10	0	0	100	131449700	3	87	12.56
11	0	0	100	123414200	3	90	10.01
12	0	0	100	110315100	2	92	7.73
13	0	0	100	32884400	1	93	7.04
14	0	0	100	63512100	1	94	5.73
15	0	0	100	50312300	1	95	4.69
16	0	0	100	38402700	1	96	3.89
17	0	0	100	29774100	1	97	3.28
18	0	0	100	21808800	0	97	2.83
19	0	0	100	21177500	0	98	2.39
20	0	0	100	17236500	0	98	2.03
21	0	0	100	15883900	0	98	1.70
22	0	0	100	10398700	0	99	1.49
23	0	0	100	9914900	0	99	1.28
24	0	0	100	10003700	0	99	1.07
25	0	0	100	6444200	0	99	0.94
26	0	0	100	6824300	0	99	0.80
27	0	0	100	5601900	0	99	0.68
28	0	0	100	4626300	0	99	0.59
29	0	0	100	4002400	0	99	0.50
30	0	0	100	3242600	0	100	0.44
31	0	0	100	3085000	0	100	0.37
32	0	0	100	2645200	0	100	0.32
33	0	0	100	2606200	0	100	0.26
34	0	0	100	1927600	0	100	0.22
35	0	0	100	1852800	0	100	0.19
36	0	0	100	1557200	0	100	0.15
37	0	0	100	1328800	0	100	0.13
38	0	0	100	1094700	0	100	0.10
39	0	0	100	916700	0	100	0.08
40	0	0	100	790900	0	100	0.07
41	0	0	100	620900	0	100	0.06
42	0	0	100	579100	0	100	0.04
43	0	0	100	529300	0	100	0.03
44	0	0	100	372100	0	100	0.02
45	0	0	100	402400	0	100	0.02
46	0	0	100	302400	0	100	0.01
47	0	0	100	271000	0	100	0.00
48	0	0	100	217500	0	100	0.00
49	0	0	100	174300	0	100	0.00
50	0	0	100	151600	0	100	-0.01
TOTAL	9			4829983100			

Calc = 19.64%
Crit =45.33%
Cannot Reject Ho

Co. Donegal RSA and Slope (Kolmogorov-Smirnov)

Slope Categories	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0	0	0	0	453139900	9	9	-9.38
1	0	0	0	208424900	4	14	-13.70
2	0	0	0	684855100	14	28	-27.88
3	0	0	0	720302700	15	43	-42.79
4	1	20	20	372660400	8	51	-30.51
5	2	40	60	667782700	14	64	-4.33
6	1	20	80	328395400	7	71	8.87
7	0	0	80	184419100	4	75	5.05
8	0	0	80	362277900	8	82	-2.45
9	1	20	100	109394900	2	85	15.29
10	0	0	100	131449700	3	87	12.56
11	0	0	100	123414200	3	90	10.01
12	0	0	100	110315100	2	92	7.73
13	0	0	100	32884400	1	93	7.04
14	0	0	100	63512100	1	94	5.73
15	0	0	100	50312300	1	95	4.69
16	0	0	100	38402700	1	96	3.89
17	0	0	100	29774100	1	97	3.28
18	0	0	100	21808800	0	97	2.83
19	0	0	100	21177500	0	98	2.39
20	0	0	100	17236500	0	98	2.03
21	0	0	100	15883900	0	98	1.70
22	0	0	100	10398700	0	99	1.49
23	0	0	100	9914900	0	99	1.28
24	0	0	100	10003700	0	99	1.07
25	0	0	100	6444200	0	99	0.94
26	0	0	100	6824300	0	99	0.80
27	0	0	100	5601900	0	99	0.68
28	0	0	100	4626300	0	99	0.59
29	0	0	100	4002400	0	99	0.50
30	0	0	100	3242600	0	100	0.44
31	0	0	100	3085000	0	100	0.37
32	0	0	100	2645200	0	100	0.32
33	0	0	100	2606200	0	100	0.26
34	0	0	100	1927600	0	100	0.22
35	0	0	100	1852800	0	100	0.19
36	0	0	100	1557200	0	100	0.15
37	0	0	100	1328800	0	100	0.13
38	0	0	100	1094700	0	100	0.10
39	0	0	100	916700	0	100	0.08
40	0	0	100	790900	0	100	0.07
41	0	0	100	620900	0	100	0.06
42	0	0	100	579100	0	100	0.04
43	0	0	100	529300	0	100	0.03
44	0	0	100	372100	0	100	0.02
45	0	0	100	402400	0	100	0.02
46	0	0	100	302400	0	100	0.01
47	0	0	100	271000	0	100	0.00
48	0	0	100	217500	0	100	0.00
49	0	0	100	174300	0	100	0.00
50	0	0	100	151600	0	100	-0.01
TOTAL	5			4829983100			

Calc = 42.79%
Crit = 60.82%
Cannot Reject Ho

Co. Donegal All Irregular sites above 180m2 and Slope (Kolmogorov-Smirnov)

Slope Categories	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0	2	12	12	453139900	9	9	2.38
1	1	6	18	208424900	4	14	3.95
2	1	6	24	684855100	14	28	-4.35
3	1	6	29	720302700	15	43	-13.38
4	5	29	59	372660400	8	51	8.32
5	0	0	59	667782700	14	64	-5.51
6	1	6	65	328395400	7	71	-6.42
7	2	12	76	184419100	4	75	1.52
8	0	0	76	362277900	8	82	-5.98
9	1	6	82	109394900	2	85	-2.36
10	1	6	88	131449700	3	87	0.80
11	0	0	88	123414200	3	90	-1.76
12	0	0	88	110315100	2	92	-4.04
13	1	6	94	32884400	1	93	1.16
14	0	0	94	63512100	1	94	-0.15
15	0	0	94	50312300	1	95	-1.19
16	1	6	100	38402700	1	96	3.89
17	0	0	100	29774100	1	97	3.28
18	0	0	100	21808800	0	97	2.83
19	0	0	100	21177500	0	98	2.39
20	0	0	100	17236500	0	98	2.03
21	0	0	100	15883900	0	98	1.70
22	0	0	100	10398700	0	99	1.49
23	0	0	100	9914900	0	99	1.28
24	0	0	100	10003700	0	99	1.07
25	0	0	100	6444200	0	99	0.94
26	0	0	100	6824300	0	99	0.80
27	0	0	100	5601900	0	99	0.68
28	0	0	100	4626300	0	99	0.59
29	0	0	100	4002400	0	99	0.50
30	0	0	100	3242600	0	100	0.44
31	0	0	100	3085000	0	100	0.37
32	0	0	100	2645200	0	100	0.32
33	0	0	100	2606200	0	100	0.26
34	0	0	100	1927600	0	100	0.22
35	0	0	100	1852800	0	100	0.19
36	0	0	100	1557200	0	100	0.15
37	0	0	100	1328800	0	100	0.13
38	0	0	100	1094700	0	100	0.10
39	0	0	100	916700	0	100	0.08
40	0	0	100	790900	0	100	0.07
41	0	0	100	620900	0	100	0.06
42	0	0	100	579100	0	100	0.04
43	0	0	100	529300	0	100	0.03
44	0	0	100	372100	0	100	0.02
45	0	0	100	402400	0	100	0.02
46	0	0	100	302400	0	100	0.01
47	0	0	100	271000	0	100	0.00
48	0	0	100	217500	0	100	0.00
49	0	0	100	174300	0	100	0.00
50	0	0	100	151600	0	100	-0.01
TOTAL	17			4829983100			

Calc = 13.38%

Crit = 32.98%

Cannot Reject Ho

Co. Donegal All Irregular drystone sites above 180m2 and Slope (Kolmogorov-Smirnov)

Slope Categories	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0	1	20	20	453139900	9	9	10.62
1	0	0	20	208424900	4	14	6.30
2	0	0	20	684855100	14	28	-7.88
3	0	0	20	720302700	15	43	-22.79
4	2	40	60	372660400	8	51	9.49
5	0	0	60	667782700	14	64	-4.33
6	0	0	60	328395400	7	71	-11.13
7	0	0	60	184419100	4	75	-14.95
8	0	0	60	362277900	8	82	-22.45
9	0	0	60	109394900	2	85	-24.71
10	0	0	60	131449700	3	87	-27.44
11	0	0	60	123414200	3	90	-29.99
12	0	0	60	110315100	2	92	-32.27
13	1	20	80	32884400	1	93	-12.96
14	0	0	80	63512100	1	94	-14.27
15	0	0	80	50312300	1	95	-15.31
16	1	20	100	38402700	1	96	3.89
17	0	0	100	29774100	1	97	3.28
18	0	0	100	21808800	0	97	2.83
19	0	0	100	21177500	0	98	2.39
20	0	0	100	17236500	0	98	2.03
21	0	0	100	15883900	0	98	1.70
22	0	0	100	10398700	0	99	1.49
23	0	0	100	9914900	0	99	1.28
24	0	0	100	10003700	0	99	1.07
25	0	0	100	6444200	0	99	0.94
26	0	0	100	6824300	0	99	0.80
27	0	0	100	5601900	0	99	0.68
28	0	0	100	4626300	0	99	0.59
29	0	0	100	4002400	0	99	0.50
30	0	0	100	3242600	0	100	0.44
31	0	0	100	3085000	0	100	0.37
32	0	0	100	2645200	0	100	0.32
33	0	0	100	2606200	0	100	0.26
34	0	0	100	1927600	0	100	0.22
35	0	0	100	1852800	0	100	0.19
36	0	0	100	1557200	0	100	0.15
37	0	0	100	1328800	0	100	0.13
38	0	0	100	1094700	0	100	0.10
39	0	0	100	916700	0	100	0.08
40	0	0	100	790900	0	100	0.07
41	0	0	100	620900	0	100	0.06
42	0	0	100	579100	0	100	0.04
43	0	0	100	529300	0	100	0.03
44	0	0	100	372100	0	100	0.02
45	0	0	100	402400	0	100	0.02
46	0	0	100	302400	0	100	0.01
47	0	0	100	271000	0	100	0.00
48	0	0	100	217500	0	100	0.00
49	0	0	100	174300	0	100	0.00
50	0	0	100	151600	0	100	-0.01
TOTAL	5			4829983100			

Calc = 32.27%
Crit = 60.82%
Cannot Reject Ho

Co. Donegal PA and Slope (Kolmogorov-Smirnov)

Slope Categories	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0	0	0	0	453139900	9	9	-9.38
1	3	9	9	208424900	4	14	-4.32
2	2	6	16	684855100	14	28	-12.25
3	7	22	38	720302700	15	43	-5.29
4	4	13	50	372660400	8	51	-0.51
5	4	13	63	667782700	14	64	-1.83
6	5	16	78	328395400	7	71	7.00
7	2	6	84	184419100	4	75	9.43
8	0	0	84	362277900	8	82	1.93
9	1	3	88	109394900	2	85	2.79
10	0	0	88	131449700	3	87	0.06
11	0	0	88	123414200	3	90	-2.49
12	0	0	88	110315100	2	92	-4.77
13	2	6	94	32884400	1	93	0.79
14	2	6	100	63512100	1	94	5.73
15	0	0	100	50312300	1	95	4.69
16	0	0	100	38402700	1	96	3.89
17	0	0	100	29774100	1	97	3.28
18	0	0	100	21808800	0	97	2.83
19	0	0	100	21177500	0	98	2.39
20	0	0	100	17236500	0	98	2.03
21	0	0	100	15883900	0	98	1.70
22	0	0	100	10398700	0	99	1.49
23	0	0	100	9914900	0	99	1.28
24	0	0	100	10003700	0	99	1.07
25	0	0	100	6444200	0	99	0.94
26	0	0	100	6824300	0	99	0.80
27	0	0	100	5601900	0	99	0.68
28	0	0	100	4626300	0	99	0.59
29	0	0	100	4002400	0	99	0.50
30	0	0	100	3242600	0	100	0.44
31	0	0	100	3085000	0	100	0.37
32	0	0	100	2645200	0	100	0.32
33	0	0	100	2606200	0	100	0.26
34	0	0	100	1927600	0	100	0.22
35	0	0	100	1852800	0	100	0.19
36	0	0	100	1557200	0	100	0.15
37	0	0	100	1328800	0	100	0.13
38	0	0	100	1094700	0	100	0.10
39	0	0	100	916700	0	100	0.08
40	0	0	100	790900	0	100	0.07
41	0	0	100	620900	0	100	0.06
42	0	0	100	579100	0	100	0.04
43	0	0	100	529300	0	100	0.03
44	0	0	100	372100	0	100	0.02
45	0	0	100	402400	0	100	0.02
46	0	0	100	302400	0	100	0.01
47	0	0	100	271000	0	100	0.00
48	0	0	100	217500	0	100	0.00
49	0	0	100	174300	0	100	0.00
50	0	0	100	151600	0	100	-0.01
TOTAL	32			4829983100			

Calc = 12.25%

Crit = 24.04%

Cannot Reject Ho

Co. Donegal All sites with architectural features and Slope (Kolmogorov-Smirnov)

Slope Categories	Site Distribution	% of Site Distribution	Accumulative Site %	Area Distribution	% of Area Distribution	Accumulative Area %	D
0	1	20	20	453139900	9	9	10.62
1	1	20	40	208424900	4	14	26.30
2	1	20	60	684855100	14	28	32.12
3	0	0	60	720302700	15	43	17.21
4	0	0	60	372660400	8	51	9.49
5	0	0	60	667782700	14	64	-4.33
6	0	0	60	328395400	7	71	-11.13
7	0	0	60	184419100	4	75	-14.95
8	0	0	60	362277900	8	82	-22.45
9	1	20	80	109394900	2	85	-4.71
10	0	0	80	131449700	3	87	-7.44
11	0	0	80	123414200	3	90	-9.99
12	0	0	80	110315100	2	92	-12.27
13	0	0	80	32884400	1	93	-12.96
14	0	0	80	63512100	1	94	-14.27
15	1	20	100	50312300	1	95	4.69
16	0	0	100	38402700	1	96	3.89
17	0	0	100	29774100	1	97	3.28
18	0	0	100	21808800	0	97	2.83
19	0	0	100	21177500	0	98	2.39
20	0	0	100	17236500	0	98	2.03
21	0	0	100	15883900	0	98	1.70
22	0	0	100	10398700	0	99	1.49
23	0	0	100	9914900	0	99	1.28
24	0	0	100	10003700	0	99	1.07
25	0	0	100	6444200	0	99	0.94
26	0	0	100	6824300	0	99	0.80
27	0	0	100	5601900	0	99	0.68
28	0	0	100	4626300	0	99	0.59
29	0	0	100	4002400	0	99	0.50
30	0	0	100	3242600	0	100	0.44
31	0	0	100	3085000	0	100	0.37
32	0	0	100	2645200	0	100	0.32
33	0	0	100	2606200	0	100	0.26
34	0	0	100	1927600	0	100	0.22
35	0	0	100	1852800	0	100	0.19
36	0	0	100	1557200	0	100	0.15
37	0	0	100	1328800	0	100	0.13
38	0	0	100	1094700	0	100	0.10
39	0	0	100	916700	0	100	0.08
40	0	0	100	790900	0	100	0.07
41	0	0	100	620900	0	100	0.06
42	0	0	100	579100	0	100	0.04
43	0	0	100	529300	0	100	0.03
44	0	0	100	372100	0	100	0.02
45	0	0	100	402400	0	100	0.02
46	0	0	100	302400	0	100	0.01
47	0	0	100	271000	0	100	0.00
48	0	0	100	217500	0	100	0.00
49	0	0	100	174300	0	100	0.00
50	0	0	100	151600	0	100	-0.01
TOTAL	5			4829983100			

Calc = 32.12%

Crit = 60.82%

Cannot Reject Ho

Co. Donegal CSB and Aspect (Chi-Square)

Category	Oi	Area Distribution	% of Area Distribution	Ei	% of Site Distribution	Oi - Ei	()2	/
Flat/N	6	1004555700	21	6.2391	20	0	0	0.009161
NE/E	4	922384400	19	5.7287	13	-2	3	0.52167
SE/E	7	1260252900	26	7.8272	23	-1	1	0.087412
SW/W/NW	13	1643116000	34	10.205	43	3	8	0.765487
Total	30	4830309000	100	19.795	100			0.618243

df = 3
Calc = .62
Crit = 11.34 at 0.05
Cannot reject Ho

Co. Donegal CSA and Aspect (Chi-Square)

Category	Oi	Area Distribution	% of Area Distribution	Ei	% of Site Distribution	Oi - Ei	()2	/
Flat	5	453139900	9	9	5	-3.91212	15.30468	1.717
N	16	551415800	11	11	17	5.155041	26.57445	2.450
NE	11	485640500	10	10	12	1.448676	2.098661	0.220
E	6	436743900	9	9	6	-2.58965	6.706294	0.781
SE	9	707729700	15	14	9	-4.91926	24.19911	1.739
S	6	552523200	11	11	6	-4.86674	23.68514	2.180
SW	11	501637300	10	10	12	1.134059	1.28609	0.130
W	14	447921300	9	9	15	5.190517	26.94147	3.058
NW	17	693557400	14	14	18	3.359475	11.28607	0.827
Total	95	4830309000	100	95	100			11.385

df = 8
Calc = 11.88
Crit = 15.507 at 0.5
Cannot reject

Co. Donegal CSAEB and Aspect (Chi-Square)
Not enough samples

Co. Donegal CSAEA and Aspect (Chi-Square)
Not enough samples

Co. Donegal CEB and Aspect (Chi-Square)
Not enough samples

Co. Donegal CEA and Aspect (Chi-Square)

Category	Oi	Area Distribution	% of Area Distribution	Ei	% of Site Distribution	Oi - Ei	()2	/
Flat	1	453139900	9	11	1	-10.445	109.0988	9.532412
N	35	551415800	11	14	29	21.07279	444.0625	31.88453
NE	8	485640500	10	12	7	-4.26591	18.198	1.483624
E	9	436743900	9	11	7	-2.03092	4.124639	0.373916
SE	14	707729700	15	18	11	-3.87526	15.01763	0.840135
S	9	552523200	11	14	7	-4.95518	24.55381	1.759476
SW	15	501637300	10	13	12	2.330055	5.429155	0.428507
W	7	447921300	9	11	6	-4.31323	18.60396	1.644442
NW	24	693557400	14	18	20	6.482694	42.02532	2.399074
Total	122	4830309000	100	122	100			40.8137

df = 8
Calc = 40.81
Crit = 15.507 at 0.05
Reject Ho

Co. Donegal All Rectilinear sites above 180m2 and Aspect (Chi-Square)
Not enough samples

Co. Donegal RSA and Aspect (Chi-Square)
Not enough samples

Co. Donegal All Irregular sites above 180m2 and Aspect (Chi-Square)
Not enough samples

Co. Donegal All Irregular drystone sites above 180m2 and Aspect (Chi-Square)
Not enough samples

Co. Donegal All Irregular earth constructed sites and Aspect (Chi-Square)
Not enough samples

Co. Donegal PA and Aspect (Chi-Square)
Not enough samples

Co. Donegal All sites with architectural features and Aspect (Chi-Square)
Not enough samples

Viewshed Analysis Results for Sites in Argyll

Argyll CSB Summary data for Hypotheses 1 to 3 (m = 120, n = 19)

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km2)					
Mean	70.24	105.07	132.10	20	0.05
Minimum	0.05	2.20	0.42	9	0.45
Maximum	394.91	614.06	670.73	20	0.05
Area of visible sea (km2)					
Mean	55.80	90.76	114.18	20	0.05
Minimum	-	-	-	-	-
Maximum	365.73	595.05	642.94	20	0.05
Area of visible land (km2)					
Mean	13.43	18.13	17.92	18	0.15
Minimum	0.02	0.54	0.03	2	0.10
Maximum	50.16	94.54	147.31	20	0.05
Ratio of sea area to land area					
Mean	7.84	103.24	139.86	20	0.05

Argyll CSB Data for Hypotheses 4 (m = 120, n = 19)

Number of arch sites w/ visibility of a location (a)	1	2	3	4	5	6	7	8	9	10	11	12	Weighted average
Area visible from a actual sites/km2	4989.75	1899.86	894.39	407.80	124.18	105.71	95.20	50.74	16.35	0.22	0.0007	-	1.82
Minimum area visible from a random sites/km2	3127.19	979.71	361.53	103.22	19.35	2.24	0.09	0.01	-	-	-	-	1.39
Maximum area visible from a random sites/km2	4971.14	2033.29	961.73	492.59	165.23	65.83	29.22	11.52	0.66	0.21	0.08	0.004	1.87
Number of random groups with values of a	19	19	19	19	19	19	19	19	16	11	3	2	
Rank	20	19	19	18	17	20	20	20	20	20	18	-	19
Significance	0.05	0.10	0.10	0.15	0.20	0.05	0.05	0.05	0.05	0.05	0.15	-	0.10

Argyll CSA Summary data for Hypotheses 1 to 3 (m = 59, n = 19)

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km2)					
Mean	57.10	88.49	108.65	20	0.05
Minimum	0.10	2.15	0.97	17	0.20
Maximum	314.87	537.19	525.32	19	0.10
Area of visible sea (km2)					
Mean	39.61	69.88	86.19	20	0.05
Minimum	-	-	-	-	-
Maximum	298.92	529.78	494.58	19	0.10
Area of visible land (km2)					
Mean	11.65	21.59	22.45	20	0.05
Minimum	0.04	1.50	0.26	9	0.45
Maximum	41.62	104.91	66.81	12	0.45
Ratio of sea area to land area					
Mean	3.39	105.57	19.25	13	0.40

Argyll CSA Summary data for Hypotheses 4 (m = 59, n = 19)

Number of arch sites w/ visibility of a location (a)	1	2	3	4	5	6	7	8	Weighted average
Area visible from a actual sites/km2	2775.88	683.62	277.31	96.45	30.34	31.80	0.01	0.003	1.46
Minimum area visible from a random sites/km2	1891.05	121.77	23.48	0.12	-	-	-	-	1.05
Maximum area visible from a random sites/km2	3358.97	195.80	195.80	140.26	7.21	0.97	0.35	-	1.38
Number of random groups with values of a	19	19	19	19	17	7	2	0	
Rank	11	20	20	19	20	20	18	20	20
Significance	0.50	0.05	0.05	0.10	0.05	0.05	0.15	0.05	0.05

Argyll CSAEB Summary data for Hypotheses 1 to 3 (m = 4, n = 19)

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km2)					
Mean	29.90	193.82	147.26	19	0.10
Minimum	0.35	55.26	7.20	16	0.25
Maximum	76.85	434.65	443.61	20	0.05
Area of visible sea (km2)					
Mean	13.32	185.30	124.13	19	0.10
Minimum	0.00	3.77	1.12	18	0
Maximum	49.15	428.33	396.27	19	0.10
Area of visible land (km2)					
Mean	8.53	40.12	23.14	18	0.15
Minimum	0.35	19.69	5.45	15	0.30
Maximum	19.67	67.32	47.34	19	0.10
Ratio of sea area to land area					
Mean	0.49	34.28	4.97	11	0.50

Argyll CSAEB Summary data for Hypotheses 4

Viewshed of CSAEB sites do not overlap.

Argyll CSAEA Summary data for Hypotheses 1 to 3 (m = 5, n = 19)

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km2)					
Mean	20.69	182.40	90.55	12	0.45
Minimum	0.85	20.08	1.40	2	0.10
Maximum	48.91	554.97	378.24	17	0.20
Area of visible sea (km2)					
Mean	1.50	166.12	77.60	12	0.45
Minimum	-	7.39	-	-	-
Maximum	7.50	531.34	369.59	17	0.20
Area of visible land (km2)					
Mean	4.39	27.89	12.95	7	0.35
Minimum	0.25	18.57	1.40	2	0.10
Maximum	6.35	99.05	20.05	3	0.15
Ratio of sea area to land area					
Mean	0.31	30.50	8.73	11	0.50

Argyll CSAEA Summary data for Hypotheses 4

Viewshed of CSAEA sites do not overlap.

Argyll all curvilinear earth constructed sites Summary data for Hypotheses 1 to 3 (m = 6, n = 19)

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km2)					
Mean	22.96	131.31	164.77	20	0.05
Minimum	1.12	18.51	4.04	12	0.45
Maximum	45.67	463.61	495.86	20	0.05
Area of visible sea (km2)					
Mean	9.49	109.46	142.38	20	0.05
Minimum	0.00	0.00	0.09	20	0.05
Maximum	35.02	459.07	475.54	20	0.05
Area of visible land (km2)					
Mean	4.77	21.85	22.39	19	0.10
Minimum	0.03	5.13	2.18	13	0.40
Maximum	13.71	69.61	49.13	16	0.25
Ratio of sea area to land area					
Mean	0.67	993.19	5.62	4	0.20

Argyll all curvilinear earth constructed sites Summary data for Hypotheses 4 (m = 6, n = 19)

Number of arch sites w/ visibility of a location (a)	1	2	3	Weighted average
Area visible from a actual sites/km2	1403.45	4.71	-	1.00
Minimum area visible from a random sites/km2	209.12	-	-	1.00
Maximum area visible from a random sites/km2	947.26	96.91	0.0004	1.16
Number of random groups with values of a	19	16	1	
Rank	20	15	-	13
Significance	0.05	0.30	-	0.40

Argyll RSB Summary data for Hypotheses 1 to 3 (m = 17, n = 19)

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km2)					
Mean	73.36	202.37	156.41	18	0.15
Minimum	0.05	6.73	2.99	18	0.15
Maximum	228.67	576.10	384.68	10	0.50
Area of visible sea (km2)					
Mean	58.05	188.90	143.13	18	0.15
Minimum	-	-	-	-	-
Maximum	225.81	541.06	382.11	11	0.50
Area of visible land (km2)					
Mean	9.68	21.08	13.29	9	0.45
Minimum	0.02	0.93	0.03	2	0.10
Maximum	23.82	88.33	58.25	17	0.20
Ratio of sea area to land area					
Mean	12.51	596.20	926.97	20	0.05

Argyll RSB sites Summary data for Hypotheses 4 (m = 17, n = 19)

Number of arch sites w/ visibility of a location (a)	1	2	3	4	Weighted average
Area visible from a actual sites/km2	1864.79	375.19	14.62	-	1.18
Minimum area visible from a random sites/km2	794.76	61.55	-	-	1.04
Maximum area visible from a random sites/km2	2369.43	599.14	112.71	17.27	1.36
Number of random groups with values of a	19	19	18	7	
Rank	17	17	14	10	11
Significance	0.20	0.20	0.35	0.50	0.50

Argyll RSA Summary data for Hypotheses 1 to 3 (m = 31, n = 19)

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km2)					
Mean	43.73	99.91	166.46	20	0.05
Minimum	0.30	3.25	7.34	20	0.05
Maximum	243.33	462.07	491.40	20	0.05
Area of visible sea (km2)					
Mean	29.79	85.96	149.31	20	0.05
Minimum	-	-	0.46	20	0
Maximum	219.34	444.09	459.74	20	0.05
Area of visible land (km2)					
Mean	11.19	21.85	17.15	10	0.50
Minimum	0.05	2.72	0.14	2	0.10
Maximum	37.65	112.31	56.27	8	0.40
Ratio of sea area to land area					
Mean	2.67	76.85	101.17	20	0.05

Argyll RSA sites Summary data for Hypotheses 4 (m = 31, n = 19)

Number of arch sites w/ visibility of a location (a)	1	2	3	4	5	6	7	8	Weighted average
Area visible from a actual sites/km2	3370.66	741.55	97.01	0.11	-	-	-	-	1.22
Minimum area visible from a random sites/km2	1179.59	63.14	0.70	-	-	-	-	-	1.05
Maximum area visible from a random sites/km2	2285.21	545.72	111.68	10.85	0.09	0.01	0.0014	0.0011	1.32
Number of random groups with values of a	19	19	19	16	6	1	1	1	
Rank	20	20	19	9	-	-	-	-	16
Significance	0.05	0.05	0.10	0.45	-	-	-	-	0.25

Argyll ICSB Summary data for Hypotheses 1 to 3 (m = 23, n = 19)

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km2)					
Mean	36.54	105.78	89.81	19	0.10
Minimum	0.10	7.83	1.79	13	0.40
Maximum	96.87	479.76	422.12	18	0.15
Area of visible sea (km2)					
Mean	22.01	86.12	74.15	19	0.10
Minimum	-	-	-	-	-
Maximum	88.01	461.45	418.68	18	0.15
Area of visible land (km2)					
Mean	11.13	19.66	14.66	8	0.40
Minimum	0.10	3.01	0.38	10	0.50
Maximum	33.09	67.32	37.62	3	0.15
Ratio of sea area to land area					
Mean	2.47	71.63	21.80	15	0.30

Argyll ICSB sites Summary data for Hypotheses 4 (m = 23, n = 19)

Number of arch sites w/ visibility of a location (a)	1	2	3	4	5	6	Weighted average
Area visible from a actual sites/km2	1669.82	87.30	25.70	1.93	0.08	0.01	1.08
Minimum area visible from a random sites/km2	778.78	2.99	-	-	-	-	1.00
Maximum area visible from a random sites/km2	2128.37	131.06	13.41	1.02	0.0003	-	1.14
Number of random groups with values of a	19	19	18	10	1	0	
Rank	17	17	20	20	20	20	17
Significance	0.20	0.20	0.05	0.05	0.05	0.05	0.20

Argyll ICSA Summary data for Hypotheses 1 to 3 (m = 43, n = 19)

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km2)					
Mean	54.39	113.56	145.62	20	0.05
Minimum	0.18	3.95	0.90	12	0.45
Maximum	268.71	584.44	472.62	17	0.20
Area of visible sea (km2)					
Mean	39.40	97.57	123.89	20	0.05
Minimum	-	-	-	-	-
Maximum	262.19	567.79	461.11	17	0.20
Area of visible land (km2)					
Mean	11.79	19.34	21.75	20	0.05
Minimum	0.05	1.16	0.19	6	0.30
Maximum	32.85	100.76	102.37	20	0.05
Ratio of sea area to land area					
Mean	6.19	65.18	59.21	19	0.10

Argyll ICSA sites Summary data for Hypotheses 4 (m = 43, n = 19)

Number of arch sites w/ visibility of a location (a)	1	2	3	4	5	6	Weighted average
Area visible from a actual sites/km2	3551.48	892.80	99.17	0.31	0.0045	-	1.24
Minimum area visible from a random sites/km2	1636.54	123.72	3.74	0.01	-	-	1.04
Maximum area visible from a random sites/km2	3957.25	892.80	68.36	6.70	1.79	0.33	1.32
Number of random groups with values of a	19	19	19	19	15	6	
Rank	19	20	20	9	9	-	19
Significance	0.10	0.05	0.05	0.45	0.45	-	0.10

Argyll IRSB Summary data for Hypotheses 1 to 3 (m = 4, n = 19)

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km2)					
Mean	27.92	270.12	232.82	19	0.10
Minimum	0.57	69.26	112.37	20	0.05
Maximum	76.93	458.17	300.09	11	0.50
Area of visible sea (km2)					
Mean	17.40	259.90	210.60	19	0.10
Minimum	-	57.01	34.17	17	0.20
Maximum	57.14	440.84	300.03	12	0.45
Area of visible land (km2)					
Mean	6.07	22.50	22.22	19	0.10
Minimum	0.02	12.52	0.06	2	0.10
Maximum	12.25	45.00	78.20	20	0.05
Ratio of sea area to land area					
Mean	2.30	2485.50	1339.02	19	0.10

Argyll IRSB sites Summary data for Hypotheses 4 (m = 4, n = 19)

Number of arch sites w/ visibility of a location (a)	1	2	3	Weighted average
Area visible from a actual sites/km2	804.29	62.24	-	1.07
Minimum area visible from a random sites/km2	111.37	-	-	1.00
Maximum area visible from a random sites/km2	744.39	178.05	8.82	1.47
Number of random groups with values of a	19	18	2	
Rank	20	13	-	12
Significance	0.05	0.40	-	0.45

Argyll IRSA Summary data for Hypotheses 1 to 3 (m = 32, n = 19)

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km2)					
Mean	56.44	135.91	173.31	20	0.05
Minimum	0.05	4.76	5.03	20	0.05
Maximum	291.08	569.89	456.81	16	0.25
Area of visible sea (km2)					
Mean	42.38	121.70	151.68	20	0.05
Minimum	-	-	2.12	20	0.05
Maximum	272.47	564.91	448.22	17	
Area of visible land (km2)					
Mean	10.67	17.93	21.63	20	0.05
Minimum	0.03	1.93	0.03	2	
Maximum	32.17	112.31	80.15	15	0.30
Ratio of sea area to land area					
Mean	7.06	197.94	405.08	20	0.05

Argyll IRSA sites Summary data for Hypotheses 4 (m = 32, n = 19)

Number of arch sites w/ visibility of a location (a)	1	2	3	4	5	6	7	Weighted average
Area visible from a actual sites/km2	2652.88	575.36	199.45	79.55	31.47	61.42	1.19	1.46
Minimum area visible from a random sites/km2	1395.02	59.33	0.13	-	-	-	-	1.03
Maximum area visible from a random sites/km2	2701.61	782.76	254.44	26.96	0.02	-	-	1.43
Number of random groups with values of a	19	19	19	13	3	0	0	
Rank	19	19	19	20	20	20	20	20
Significance	0.10	0.10	0.10	0.05	0.05	0.05	0.05	0.05

Argyll IISB Summary data for Hypotheses 1 to 3 (m = 3, n = 19)

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km2)					
Mean	40.76	7.54	199.29	16	0.25
Minimum	0.93	113.43	20.39	9	0.45
Maximum	85.36	405.26	343.67	18	0.15
Area of visible sea (km2)					
Mean	27.34	244.80	197.54	17	0.20
Minimum	-	115.15	18.83	11	0.50
Maximum	77.87	389.90	343.16	18	0.15
Area of visible land (km2)					
Mean	2.29	25.74	1.75	1	0.05
Minimum	0.04	21.79	0.51	6	0.30
Maximum	3.27	46.75	3.20	1	0.05
Ratio of sea area to land area					
Mean	1.61	961.95	253.30	19	0.10

Argyll IISB sites Summary data for Hypotheses 4

Viewshed of IISB sites do not overlap.

Argyll IISA Summary data for Hypotheses 1 to 3 (m = 18, n = 19)

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km2)					
Mean	67.09	156.14	226.80	20	0.05
Minimum	0.28	6.73	32.02	20	0.05
Maximum	268.53	554.97	662.62	20	0.05
Area of visible sea (km2)					
Mean	56.27	139.94	210.77	20	0.05
Minimum	-	-	23.75	20	0.05
Maximum	265.17	531.34	659.47	20	0.05
Area of visible land (km2)					
Mean	8.48	21.69	16.04	14	0.35
Minimum	0.06	1.91	0.02	1	0.05
Maximum	30.00	112.31	61.66	14	0.35
Ratio of sea area to land area					
Mean	8.70	76.06	210.35	20	0.05

Argyll IISA sites Summary data for Hypotheses 4 (m = 18, n = 19)

Number of arch sites w/ visibility of a location (a)	1	2	3	4	5	Weighted average
Area visible from a actual sites/km2	2839.98	408.53	54.55	16.38	0.13	1.17
Minimum area visible from a random sites/km2	1082.13	2.54	-	-	-	1.01
Maximum area visible from a random sites/km2	2142.56	319.16	155.54	0.14	0.0004	1.06
Number of random groups with values of a	19	19	12	2	1	
Rank	20	20	19	20	20	20
Significance	0.05	0.05	0.10	0.05	0.05	0.05

Argyll PB Summary data for Hypotheses 1 to 3 (m = 5, n = 19)

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km2)					
Mean	20.44	163.80	222.58	20	0.05
Minimum	0.79	23.08	58.52	20	0.05
Maximum	29.24	569.89	461.65	18	0.15
Area of visible sea (km2)					
Mean	5.27	151.03	208.60	20	0.05
Minimum	0.00	2.52	45.47	20	0.05
Maximum	10.95	564.91	456.46	18	0.15
Area of visible land (km2)					
Mean	8.21	28.53	13.99	7	0.35
Minimum	0.08	9.60	4.08	16	0.25
Maximum	13.65	73.47	36.18	10	0.50
Ratio of sea area to land area					
Mean	0.82	47.06	36.68	14	0.35

Argyll PB sites Summary data for Hypotheses 4

Viewshed of PB sites do not overlap.

Argyll PA Summary data for Hypotheses 1 to 3 (m = 57, n = 19)

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km2)					
Mean	64.18	117.60	203.02	20	0.05
Minimum	0.19	1.42	1.36	18	0.15
Maximum	271.80	614.06	573.35	18	0.15
Area of visible sea (km2)					
Mean	49.72	99.58	189.03	20	0.05
Minimum	-	-	-	-	-
Maximum	259.34	595.05	530.41	18	0.15
Area of visible land (km2)					
Mean	12.94	19.34	13.98	4	0.20
Minimum	0.05	0.75	0.01	1	0.05
Maximum	42.12	104.91	82.01	15	0.30
Ratio of sea area to land area					
Mean	13.20	44.49	405.34	20	0.05

Argyll PA sites Summary data for Hypotheses 4 (m = 57, n = 19)

Number of arch sites w/ visibility of a location (a)	1	2	3	4	5	6	7	8	9	10	11	Weighted average
Area visible from a actual sites/km2	3422.71	1609.55	565.55	315.87	131.97	45.96	-	-	-	-	-	1.73
Minimum area visible from a random sites/km2	1904.30	442.93	105.38	13.60	0.65	0.01	-	-	-	-	-	1.22
Maximum area visible from a random sites/km2	3637.37	1075.13	321.71	141.73	52.64	7.22	2.47	0.89	0.07	0.01	0.00002	1.52
Number of random groups with values of a	19	19	19	19	19	19	17	13	12	6	1	
Rank	18	20	20	20	20	20	-	-	-	-	-	20
Significance	0.15	0.05	0.05	0.05	0.05	0.05	-	-	-	-	-	0.05

Argyll AFCB Summary data for Hypotheses 1 to 3 (m = 22, n = 19)

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km2)					
Mean	51.09	115.59	196.77	20	0.05
Minimum	0.270	6.25	5.380	18	0.15
Maximum	204.08	550.37	796.27	20	0.05
Area of visible sea (km2)					
Mean	37.02	95.64	178.28	20	0.05
Minimum	-	-	-	-	-
Maximum	198.88	525.49	761.89	20	0.05
Area of visible land (km2)					
Mean	297.23	348.93	18.49	13	0.40
Minimum	0.03	2.71	0.18	4	0.20
Maximum	31.62	98.15	73.66	15	0.30
Ratio of sea area to land area					
Mean	3.68	275.70	144.40	19	0.10

Argyll AFCB sites Summary data for Hypotheses 4 (m = 22, n = 19)

Number of arch sites w/ visibility of a location (a)	1	2	3	4	5	Weighted average
Area visible from a actual sites/km2	2892.08	509.18	133.62	0.01	-	1.22
Minimum area visible from a random sites/km2	993.18	34.44	0.26	-	-	1.03
Maximum area visible from a random sites/km2	1876.45	429.43	94.58	40.88	1.23	1.34
Number of random groups with values of a	19	19	19	18	2	
Rank	20	20	20	2	-	16
Significance	0.05	0.05	0.05	0.10	-	0.25

Argyll AFCA Summary data for Hypotheses 1 to 3 (m = 6, n = 19)

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km2)					
Mean	13.36	136.63	81.23	14	0.35
Minimum	0.30	9.06	36.12	20	0.05
Maximum	34.39	554.97	230.89	7	0.35
Area of visible sea (km2)					
Mean	0.32	114.82	54.39	11	0.50
Minimum	-	-	5.64	20	0.05
Maximum	1.18	544.99	189.58	5	0.25
Area of visible land (km2)					
Mean	6.17	23.53	26.84	20	0.05
Minimum	0.30	5.24	2.45	12	0.45
Maximum	13.49	64.09	45.13	14	0.35
Ratio of sea area to land area					
Mean	0.04	68.30	3.90	5	0.25

Argyll AFCA sites Summary data for Hypotheses 4 (m = 6, n = 19)

Number of arch sites w/ visibility of a location (a)	1	2	3	Weighted average
Area visible from a actual sites/km2	458.27	13.54	0.19	1.03
Minimum area visible from a random sites/km2	92.87	-	-	1.00
Maximum area visible from a random sites/km2	818.78	12.30	0.01	1.08
Number of random groups with values of a	19	15	2	
Rank	14	20	20	18
Significance	0.35	0.05	0.05	0.15

Argyll AFIR Summary data for Hypotheses 1 to 3 (m = 6, n = 19)

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km2)					
Mean	33.36	119.76	110.36	18	0.15
Minimum	0.48	22.99	3.14	6	0.30
Maximum	66.75	482.62	357.24	15	0.30
Area of visible sea (km2)					
Mean	14.16	108.42	101.42	19	0.10
Minimum	-	-	0.42	20	0.05
Maximum	50.69	474.54	351.00	15	0.30
Area of visible land (km2)					
Mean	6.74	31.87	8.94	4	0.20
Minimum	0.48	11.65	0.01	1	0.05
Maximum	14.10	92.54	20.42	4	0.20
Ratio of sea area to land area					
Mean	0.78	48.42	1704.76	20	0.05

Argyll AFIR sites Summary data for Hypotheses 4 (m = 6, n = 19)

Number of arch sites w/ visibility of a location (a)	1	2	3	Weighted average
Area visible from a actual sites/km2	672.88	18.44	0.26	1.03
Minimum area visible from a random sites/km2	197.59	-	-	1.00
Maximum area visible from a random sites/km2	876.64	48.57	0.71	1.10
Number of random groups with values of a	19	18	1	
Rank	17	16	19	15
Significance	0.20	0.25	0.10	0.30

Viewshed Analysis Results for Sites in Northern Ireland

Northern Ireland CSA Summary data for Hypotheses 1 to 3 (m = 6, n = 19)

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km2)					
Mean	29.08	151.35	52.87	5	0.25
Minimum	1.56	43.25	14.60	14	0.35
Maximum	60.69	451.41	187.11	10	0.50
Area of visible sea (km2)					
Mean	-	99.66	31.62	9	0.45
Minimum	-	-	-	-	-
Maximum	-	371.85	150.54	12	0.45
Area of visible land (km2)					
Mean	22.20	41.67	21.25	1	0.05
Minimum	1.36	32.57	0.15	1	0.05
Maximum	31.35	141.21	36.57	3	0.15
Ratio of sea area to land area					
Mean	-	10.01	44.45	20	0.05

Northern Ireland CSA sites Summary data for Hypotheses 4 (m = 6, n = 19)

Number of arch sites w/ visibility of a location (a)	1	2	3	Weighted average
Area visible from a actual sites/km2	296.86	9.83	-	1.03
Minimum area visible from a random sites/km2	154.48	-	-	1.00
Maximum area visible from a random sites/km2	905.95	184.29	0.26	1.46
Number of random groups with values of a	19	18	9	
Rank	6	9	6	13
Significance	0.30	0.45	0.30	0.40

Northern Ireland CSAEA Summary data for Hypotheses 1 to 3 (m = 28, n = 19)

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km2)					
Mean	55.62	113.79	61.41	2	0.10
Minimum	0.09	17.21	2.52	2	0.10
Maximum	233.79	413.94	366.41	18	0.15
Area of visible sea (km2)					
Mean	13.71	68.54	24.36	2	0.10
Minimum	-	-	-	-	-
Maximum	168.46	371.85	338.59	16	0.25
Area of visible land (km2)					
Mean	31.43	53.69	37.05	3	0.15
Minimum	0.09	7.84	2.52	7	0.35
Maximum	84.17	223.04	102.51	2	0.10
Ratio of sea area to land area					
Mean	0.42	13.88	2.36	11	0.50

Northern Ireland CSAEA sites Summary data for Hypotheses 4 (m = 28, n = 19)

Number of arch sites w/ visibility of a location (a)	1	2	3	4	5	6	7	8	9	Weighted average
Area visible from a actual sites/km2	781.45	318.78	62.63	23.38	0.37	0.05	0.03	-	-	1.43
Minimum area visible from a random sites/km2	706.52	79.56	0.12	-	-	-	-	-	-	1.1
Maximum area visible from a random sites/km2	9543.84	1420.04	265.15	110.70	84.53	40.56	19.43	2.75	0.12	1.84
Number of random groups with values of a	19	19	19	18	18	17	8	6	1	
Rank	3	10	4	7	4	11	15	-	-	12
Significance	0.15	0.50	0.20	0.35	0.20	0.50	0.30	-	-	0.45

Northern Ireland CEA Summary data for Hypotheses 1 to 3 (m = 92, n = 19)

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km2)					
Mean	69.23	96.17	95.24	18	0.15
Minimum	0.09	5.60	1.35	3	0.15
Maximum	312.66	489.94	460.28	18	0.15
Area of visible sea (km2)					
Mean	31.89	52.32	46.31	13	0.40
Minimum	0.00	0.00	0.00	N/A	N/A
Maximum	298.88	489.33	414.01	18	0.15
Area of visible land (km2)					
Mean	34.55	47.36	48.93	20	0.05
Minimum	0.09	4.01	1.35	12	0.45
Maximum	122.28	223.04	135.45	8	0.40
Ratio of sea area to land area					
Mean	2.17	10.87	2.72	6	0.30

Northern Ireland CEA sites Summary data for Hypotheses 4 (m = 92, n = 19)

Number of arch sites w/ visibility of a location (a)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Area visible from a actual sites/km2	1137.50	775.26	486.14	267.35	118.29	63.49	50.97	39.30	26.21	21.62	27.92	25.92	11.96	31.39	1.26	0.32
Minimum area visible from a random sites/km2	1414.14	651.02	332.71	147.78	73.53	44.12	13.61	3.59	1.25	0.52	0.04	0.01	0.0047	0.0002	-	-
Maximum area visible from a random sites/km2	2273.92	1048.71	607.33	383.75	231.45	136.47	50.97	74.25	39.14	63.71	47.95	24.67	7.5	4.59	0.69	0.06
Number of random groups with values of a	19.00	19.00	19.00	19.00	19.00	19	19	19	19	19	19	19	19	19	15	11
Rank	1	7	16	14	6	8	13	16	18	18	19	20	20	20	20	20
Significance	0.05	0.35	0.25	0.35	0.30	0.40	0.40	0.25	0.15	0.15	0.10	0.05	0.05	0.05	0.05	0.05

Number of arch sites w/ visibility of a location (a)	17	18	19	20	21	22	23	24	Weighted average
Area visible from a actual sites/km2	0.22	0.11	0.11	0.08	0.05	0.04	0.0039	0.0018	2.77
Minimum area visible from a random sites/km2	-	-	-	-	-	-	-	-	1.83
Maximum area visible from a random sites/km2	0.02	0.01	0.01	0.0015	-	-	-	-	2.42
Number of random groups with values of a	7	4	4	2	0	0	0	0	
Rank	20	20	20	20	20	20	20	20	20
Significance	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05

Northern Ireland all Rectilinear sites above 180m² Summary data for Hypotheses 1 to 3 (m = 5, n = 19)

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km2)					
Mean	24.69	164.67	104.56	14	0.35
Minimum	14.35	53.46	5.26	4	0.20
Maximum	35.10	248.59	328.51	19	0.10
Area of visible sea (km2)					
Mean	-	101.86	65.08	16	0.25
Minimum	-	-	-	-	-
Maximum	-	247.44	321.18	19	0.10
Area of visible land (km2)					
Mean	17.28	72.19	39.48	11	0.50
Minimum	3.65	29.26	5.26	5	0.25
Maximum	33.81	128.22	116.71	16	0.25
Ratio of sea area to land area					
Mean	-	16.47	8.78	19	0.10

Northern Ireland all Rectilinear sites above 180m² Summary data for Hypotheses 4 (m = 5, n = 19)

Number of arch sites w/ visibility of a location (a)	1	2	3	Weighted average
Area visible from a actual sites/km2	517.28	2.45	0.00	1.12
Minimum area visible from a random sites/km2	99.74	0.00	0.00	1.00
Maximum area visible from a random sites/km2	595.15	178.98	17.33	1.40
Number of random groups with values of a	19	17	5	
Rank	16	9	9	8
Significance	0.25	0.45	0.45	0.40

Northern Ireland all Irregular sites Summary data for Hypotheses 1 to 3 (m = 6, n = 19)

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km2)					
Mean	32.61	166.81	207.40	20	0.05
Minimum	1.60	26.69	33.06	20	0.05
Maximum	74.66	419.81	364.51	19	0.10
Area of visible sea (km2)					
Mean	3.18	111.01	145.94	20	0.05
Minimum	-	-	-	-	-
Maximum	22.23	367.62	362.96	19	0.05
Area of visible land (km2)					
Mean	29.44	63.45	61.46	19	0.01
Minimum	0.99	26.69	1.55	2	0.01
Maximum	69.54	128.22	96.99	10	0.50
Ratio of sea area to land area					
Mean	0.05	38.37	34.62	19	0.01

Northern Ireland all Irregular sites Summary data for Hypotheses 4 (m = 6, n = 19)

Number of arch sites w/ visibility of a location (a)	1	2	3	4	5	Weighted average
Area visible from a actual sites/km2	1014.07	140.63	50.95	0.00	0.00	1.20
Minimum area visible from a random sites/km2	180.91	0.77	0.00	0.00	0	1.00
Maximum area visible from a random sites/km2	836.30	184.27	51.12	1.35	0.0001	1.38
Number of random groups with values of a	19	19	16	4	1	
Rank	20	18	19	N/A	N/A	12
Significance	0.05	0.15	0.1	N/A	N/A	0.45

Northern Ireland all Irregular-Rectilinear sites Summary data for Hypotheses 1 to 3 (m = 3, n = 19)

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km2)					
Mean	44.09	150.47	140.33	17	0.20
Minimum	5.44	47.08	33.06	16	0.25
Maximum	63.65	419.81	332.32	19	0.10
Area of visible sea (km2)					
Mean	-	122.54	84.23	19	0.10
Minimum	-	1.26	-	-	-
Maximum	-	367.62	252.69	19	0.10
Area of visible land (km2)					
Mean	24.70	75.25	56.10	13	0.40
Minimum	4.88	47.08	33.06	17	0.20
Maximum	52.19	128.22	79.63	8	0.40
Ratio of sea area to land area					
Mean	-	2.35	1.06	18	0.15

Northern Ireland all Irregular-Rectilinear sites Summary data for Hypotheses 4 (m = 3, n = 19)

Viewshed of all Irregular-Rectilinear sites do not overlap.

Northern Ireland PA Summary data for Hypotheses 1 to 3 (m = 12, n = 19)

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km2)					
Mean	46.23	130.03	234.00	20	0.05
Minimum	3.12	22.53	10.41	13	0.40
Maximum	172.15	275.94	425.33	20	0.05
Area of visible sea (km2)					
Mean	18.51	93.80	213.23	20	0.05
Minimum	-	-	-	-	-
Maximum	162.48	256.31	417.39	20	0.05
Area of visible land (km2)					
Mean	22.64	51.25	21.43	1	0.05
Minimum	10.16	1.68	0.15	1	0.05
Maximum	41.98	121.87	92.88	14	0.35
Ratio of sea area to land area					
Mean	0.74	24.19	230.79	20	0.05

Northern Ireland PA Summary data for Hypotheses 4 (m = 12, n = 19)

Number of arch sites w/ visibility of a location (a)	1	2	3	4	5	6	Weighted average
Area visible from a actual sites/km2	985.12	678.46	145.98	5.85	-	-	1.44
Minimum area visible from a random sites/km2	372.52	9.19	-	-	-	-	1.01
Maximum area visible from a random sites/km2	1371.10	228.88	103.49	8.54	2.19	0.01	1.56
Number of random groups with values of a	19	19	18	12	5	3	
Rank	15	20	20	19	-	-	19
Significance	0.30	0.05	0.05	0.10	-	-	0.10

Viewshed Analysis Results for Sites in Co. Donegal

Co. Donegal CSB Summary data for Hypotheses 1 to 3 (m = 30, n = 19)

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km2)					
Mean	36.35	91.18	603.30	13	0.40
Minimum	0.79	10.10	3.90	12	0.45
Maximum	139.95	454.67	239.19	3	0.15
Area of visible sea (km2)					
Mean	15.01	55.54	29.22	13	0.40
Minimum	-	-	-	-	-
Maximum	118.12	151.49	207.55	4	0.20
Area of visible land (km2)					
Mean	18.67	35.77	31.08	17	0.20
Minimum	0.79	7.07	3.90	16	0.25
Maximum	51.66	152.98	131.19	18	0.15
Ratio of sea area to land area					
Mean	0.43	17.87	2.67	12	0.45

Co. Donegal CSB Summary data for Hypotheses 4 (m = 30, n = 19)

Number of arch sites w/ visibility of a location (a)	1	2	3	4	5	6	7	8	Weighted average
Area visible from a actual sites/km2	1134.81	267.37	40.97	0.65	-	-	-	-	1.24
Minimum area visible from a random sites/km2	858.77	58.79	2.00	0.01	-	-	-	-	1.06
Maximum area visible from a random sites/km2	2160.93	377.73	40.02	9.41	2.01	0.06	0.0023	0.0002	1.2
Number of random groups with values of a	19	19	19	19	18	9	5	1	
Rank	5	18	20	9	-	-	-	-	20
Significance	0.25	0.15	0.05	0.45	-	-	-	-	0.05

Co. Donegal CSA Summary data for Hypotheses 1 to 3 (m = 95, n = 19)

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km2)					
Mean	50.76	72.41	88.09	20	0.05
Minimum	0.38	3.60	5.81	20	0.05
Maximum	280.36	880.31	350.44	8	0.40
Area of visible sea (km2)					
Mean	21.32	43.56	58.37	20	0.05
Minimum	-	-	-	-	-
Maximum	169.79	868.57	320.52	11	0.50
Area of visible land (km2)					
Mean	22.92	33.22	29.72	15	0.30
Minimum	0.11	2.61	1.13	11	0.50
Maximum	82.17	578.11	247.58	18	0.15
Ratio of sea area to land area					
Mean	1.03	38.52	7.71	16	0.25

Co. Donegal CSA Summary data for Hypotheses 4 (m = 95, n = 19)

Number of arch sites w/ visibility of a location (a)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Weighted average
Area visible from a actual sites/km2	2490.13	896.59	381.93	186.30	120.98	93.27	77.72	18.38	0.34	0.07	0.05	0.02	0.01	-	-	1.88
Minimum area visible from a random sites/km2	1893.74	631.42	160.34	36.37	8.65	1.59	0.32	0.05	0.0025	0.0001	-	-	-	-	-	1.32
Maximum area visible from a random sites/km2	3020.85	1168.18	381.93	157.48	57.84	16.03	3.08	1.08	0.45	0.22	0.07	0.02	0.0024	0.0011	0.0004	1.64
Number of random groups with values of a	19	19	19	19	19	19	19	19	19	19	15	7	3	2	1	
Rank	10	8	20	20	20	20	20	20	19	19	18	19	20	-	-	20
Significance	0.50	0.40	0.05	0.05	0.05	0.05	0.05	0.05	0.10	0.10	0.15	0.10	0.05	-	-	0.05

Co. Donegal CSAEB Summary data for Hypotheses 1 to 3 (m = 3, n = 19)

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km2)					
Mean	11.16	148.10	22.21	5	0.25
Minimum	4.45	39.26	7.77	4	0.20
Maximum	17.79	372.58	33.46	6	0.30
Area of visible sea (km2)					
Mean	-	64.38	0.93	9	0.45
Minimum	-	-	-	-	-
Maximum	-	193.15	2.76	9	0.45
Area of visible land (km2)					
Mean	6.27	18.42	21.28	5	0.25
Minimum	4.25	39.03	7.77	4	0.20
Maximum	17.76	322.67	33.44	7	0.35
Ratio of sea area to land area					
Mean	-	1.14	0.04	8	0.40

Co. Donegal CSAEB Summary data for Hypotheses 4 (m = 3, n = 19)

Viewshed of CSAEB sites do not overlap.

Co. Donegal CSAEA Summary data for Hypotheses 1 to 3 (m = 26, n = 19)

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km2)					
Mean	36.25	81.82	88.49	20	0.05
Minimum	0.79	10.24	8.91	19	0.10
Maximum	130.98	474.51	310.84	10	0.50
Area of visible sea (km2)					
Mean	12.17	19.06	53.54	20	0.05
Minimum	-	-	-	-	-
Maximum	123.99	454.99	277.87	11	0.50
Area of visible land (km2)					
Mean	23.57	33.90	34.95	20	0.05
Minimum	0.70	10.24	8.91	19	0.10
Maximum	56.93	122.92	115.74	18	0.15
Ratio of sea area to land area					
Mean	0.31	14.31	2.08	12	0.45

Co. Donegal CSAEA Summary data for Hypotheses 4 (m = 26, n = 19)

Number of arch sites w/ visibility of a location (a)	1	2	3	4	5	6	7	Weighted average
Area visible from a actual sites/km2	853.82	377.77	157.24	44.04	5.52	-	-	1.59
Minimum area visible from a random sites/km2	715.38	69.88	1.55	0.01	-	-	-	1.04
Maximum area visible from a random sites/km2	1883.78	257.74	105.23	5.74	1.27	0.29	0.0004	1.29
Number of random groups with values of a	19	19	19	19	14	2	1	
Rank	4	20	20	20	20	-	-	20
Significance	0.20	0.05	0.05	0.05	0.05	-	-	0.05

Co. Donegal CEB Summary data for Hypotheses 1 to 3 (m = 9, n = 19)

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km2)					
Mean	25.07	85.53	19.85	1	0.05
Minimum	2.95	15.97	4.60	3	0.15
Maximum	68.86	412.27	44.14	1	0.05
Area of visible sea (km2)					
Mean	5.32	63.03	4.70	1	0.05
Minimum	-	-	-	-	-
Maximum	31.79	408.63	17.56	1	0.05
Area of visible land (km2)					
Mean	18.17	39.23	15.15	1	0.05
Minimum	2.95	13.96	2.98	2	0.10
Maximum	22.73	37.63	41.78	7	0.35
Ratio of sea area to land area					
Mean	0.16	13.37	0.47	6	0.30

Co. Donegal CEB Summary data for Hypotheses 4 (m = 9, n = 19)

Number of arch sites w/ visibility of a location (a)	1	2	3	4	5	Weighted average
Area visible from a actual sites/km2	128.90	20.77	2.49	-	-	1.17
Minimum area visible from a random sites/km2	211.32	1.56	0.00	-	-	1.00
Maximum area visible from a random sites/km2	724.84	547.87	1.73	0.21	0.0038	1.13
Number of random groups with values of a	19	19	15	4	2	
Rank	1	13	20	-	-	20
Significance	0.05	0.4	0.05	-	-	0.05

Co. Donegal CEA Summary data for Hypotheses 1 to 3 (m = 122, n = 19)

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km2)					
Mean	42.00	70.68	82.60	20	0.05
Minimum	0.38	2.10	0.91	6	0.30
Maximum	292.99	887.09	460.92	17	0.20
Area of visible sea (km2)					
Mean	14.82	45.68	55.18	20	0.05
Minimum	-	-	-	-	-
Maximum	221.54	871.07	399.64	10	0.50
Area of visible land (km2)					
Mean	0.82	0.38	27.41	13	0.40
Minimum	0.11	1.78	0.55	5	0.25
Maximum	97.37	578.11	103.22	5	0.25
Ratio of sea area to land area					
Mean	0.88	32.60	6.90	18	0.15

Co. Donegal CEA Summary data for Hypotheses 4 (m = 122, n = 19)

Number of arch sites w/ visibility of a location (a)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Area visible from a actual sites/km2	1654.89	543.48	341.40	268.51	60.62	67.82	43.87	43.97	51.06	41.46	24.52	20.81	16.06	21.27	22.68	16.47
Minimum area visible from a random sites/km2	1778.93	611.82	187.24	90.35	48.39	24.60	9.51	4.18	1.43	0.55	0.06	0.02	0.0027	0.0001	0.0001	-
Maximum area visible from a random sites/km2	2936.66	114.04	602.53	180.28	125.96	88.64	63.29	34.61	32.96	15.79	10.11	4.59	2.94	1.24	0.88	0.74
Number of random groups with values of a	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	18
Rank	1	1	14	20	5	19	18	20	20	20	20	20	20	20	20	20
Significance	0.05	0.05	0.35	0.05	0.25	0.05	0.15	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05

Number of arch sites w/ visibility of a location (a)	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	Weighted average
Area visible from a actual sites/km2	14.77	14.39	12.26	14.29	16.84	14.55	8.67	4.14	1.93	0.87	0.18	0.02	0.01	0.0039	0.0018	0.0005	3.23
Minimum area visible from a random sites/km2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.56
Maximum area visible from a random sites/km2	0.35	0.31	0.25	0.07	0.03	0.02	0.01	0.01	0.01	0.0011	0.0009	0.0034	0.0013	-	-	-	2.05
Number of random groups with values of a	18	17	16	14	8	7	6	5	3	3	2	1	1	0	0	0	
Rank	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
Significance	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05

Co. Donegal all Rectilinear sites Summary data for Hypotheses 1 to 3 (m = 7, n = 19)

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km2)					
Mean	22.77	134.74	100.31	18	0.15
Minimum	0.38	19.13	5.07	6	0.30
Maximum	38.67	385.63	323.06	18	0.15
Area of visible sea (km2)					
Mean	2.98	102.54	87.24	19	0.10
Minimum	-	-	-	-	-
Maximum	10.61	362.73	314.33	19	0.10
Area of visible land (km2)					
Mean	17.63	50.27	13.07	1	0.05
Minimum	0.38	12.21	3.32	6	0.30
Maximum	26.76	116.98	37.68	5	0.25
Ratio of sea area to land area					
Mean	0.14	11.97	9.98	19	0.10

Co. Donegal all Rectilinear sites Summary data for Hypotheses 4 (m = 7, n = 19)

Number of arch sites w/ visibility of a location (a)	1	2	3	Weighted average
Area visible from a actual sites/km2	643.82	82.14	-	1.04
Minimum area visible from a random sites/km2	139.53	0.02	-	1.00
Maximum area visible from a random sites/km2	942.43	20.21	0.34	1.08
Number of random groups with values of a	19	19	7	
Rank	18	20	-	18
Significance	0.15	0.05	-	0.15

Co. Donegal all Rectilinear drystone sites Summary data for Hypotheses 1 to 3 (m = 5, n = 19)

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km2)					
Mean	24.89	139.08	126.96	19	0.10
Minimum	4.06	31.76	5.07	3	0.15
Maximum	38.67	385.63	323.06	18	0.15
Area of visible sea (km2)					
Mean	4.04	97.97	112.88	20	0.05
Minimum	-	-	-	-	-
Maximum	10.61	362.73	314.33	19	0.10
Area of visible land (km2)					
Mean	16.31	48.72	14.08	1	0.05
Minimum	2.82	30.91	5.07	5	0.25
Maximum	26.76	116.98	37.68	5	0.25
Ratio of sea area to land area					
Mean	0.20	15.51	11.74	19	0.10

Co. Donegal all Rectilinear drystone sites Summary data for Hypotheses 4 (m = 5, n = 19)

Number of arch sites w/ visibility of a location (a)	1	2	3	Weighted average
Area visible from a actual sites/km2	643.82	82.14	0.00	1.04
Minimum area visible from a random sites/km2	139.53	0.02	0.00	1.00
Maximum area visible from a random sites/km2	942.43	20.21	0.34	1.08
Number of random groups with values of a	19	19	7	
Rank	18	20	N/A	18
Significance	0.15	0.05	N/A	0.15

Co. Donegal all Irregular sites Summary data for Hypotheses 1 to 3 (m = 17, n = 19)

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km2)					
Mean	41.30	103.52	93.48	19	0.10
Minimum	0.79	14.02	12.89	18	0.15
Maximum	105.26	474.51	277.10	12	0.45
Area of visible sea (km2)					
Mean	8.83	65.91	54.38	18	0.15
Minimum	0.00	0.00	0.00	N/A	N/A
Maximum	42.35	454.99	213.40	14	0.35
Area of visible land (km2)					
Mean	21.30	42.37	39.09	19	0.10
Minimum	0.79	12.28	12.89	20	0.05
Maximum	46.49	117.54	80.66	8	0.40
Ratio of sea area to land area					
Mean	0.32	15.57	1.68	11	0.50

Co. Donegal all Irregular sites Summary data for Hypotheses 4 (m = 17, n = 19)

Number of arch sites w/ visibility of a location (a)	1	2	3	4	5	6	7	Weighted average
Area visible from a actual sites/km2	623.24	333.64	95.61	1.14	0.0003	-	-	1.50
Minimum area visible from a random sites/km2	550.35	25.41	0.12	-	-	-	-	1.02
Maximum area visible from a random sites/km2	1298.27	265.85	34.73	4.26	0.11	0.01	0.01	1.31
Number of random groups with values of a	19	19	19	15	6	2	1	
Rank	4	20	20	17	15	-	-	20
Significance	0.2	0.05	0.05	0.2	0.3	-	-	0.05

Co. Donegal all irregular drystone sites measuring above 180m² Summary data for Hypotheses 1 to 3 (m = 5, n = 19)

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km2)					
Mean	40.04	189.16	83.94	9	0.45
Minimum	0.79	56.31	12.89	10	0.50
Maximum	81.99	474.51	149.79	7	0.35
Area of visible sea (km2)					
Mean	4.15	154.10	36.04	7	0.35
Minimum	-	-	-	-	-
Maximum	20.74	454.99	69.13	4	0.20
Area of visible land (km2)					
Mean	11.67	50.07	47.90	17	0.20
Minimum	0.79	29.79	12.89	17	0.20
Maximum	28.06	117.54	80.66	13	0.40
Ratio of sea area to land area					
Mean	0.04	48.77	0.63	5	0.25

Co. Donegal all irregular drystone sites measuring above 180m² Summary data for Hypotheses 4 (m = 5, n = 19)

Number of arch sites w/ visibility of a location (a)	1	2	3	4	5	6	7	Weighted average
Area visible from a actual sites/km2	623.24	333.64	95.61	1.14	0.0003	0.00	0.00	1.50
Minimum area visible from a random sites/km2	550.35	25.41	0.12	0.00	0.00	0.00	0.00	1.02
Maximum area visible from a random sites/km2	1298.27	265.85	34.73	4.26	0.11	0.01	0.01	1.31
Number of random groups with values of a	19	19	19	15	6	2	1	
Rank	4	20	20	17	15	N/A	N/A	20
Significance	0.2	0.05	0.05	0.2	0.3	N/A	N/A	0.05

Co. Donegal all irregular earth constructed sites measuring above 180m^2 Summary data for Hypotheses 1 to 3 (m = 4, n = 19)

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km2)					
Mean	13.79	78.93	144.75	20	0.05
Minimum	1.53	38.37	22.69	17	0.20
Maximum	17.48	189.27	277.10	20	0.05
Area of visible sea (km2)					
Mean	-	54.23	109.82	20	0.05
Minimum	-	0.52	-	-	-
Maximum	-	170.11	213.40	20	0.05
Area of visible land (km2)					
Mean	13.79	49.90	34.93	18	0.15
Minimum	1.53	33.24	21.26	19	0.10
Maximum	17.48	93.48	74.10	19	0.10
Ratio of sea area to land area					
Mean	-	3.04	3.41	20	0.05

Co. Donegal all irregular earth constructed sites measuring above 180m^2 Summary data for Hypotheses 4 (m = 4, n = 19)

Number of arch sites w/ visibility of a location (a)	1	2	3	4	5	6	7	Weighted average
Area visible from a actual sites/km2	623.24	333.64	95.61	1.14	0.0003	0.00	0.00	1.50
Minimum area visible from a random sites/km2	550.35	25.41	0.12	0.00	0.00	0.00	0.00	1.02
Maximum area visible from a random sites/km2	1298.27	265.85	34.73	4.26	0.11	0.01	0.01	1.31
Number of random groups with values of a	19	19	19	15	6	2	1	
Rank	4	20	20	17	15	N/A	N/A	20
Significance	0.2	0.05	0.05	0.2	0.3	N/A	N/A	0.05

Co. Donegal PA Summary data for Hypotheses 1 to 3 (m = 32, n = 19)

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km2)					
Mean	50.15	120.07	209.79	20	0.05
Minimum	0.96	8.35	0.72	1	0.05
Maximum	229.58	880.31	483.65	19	0.10
Area of visible sea (km2)					
Mean	25.88	93.66	194.05	20	0.05
Minimum	-	-	-	-	-
Maximum	175.45	868.57	478.78	19	0.10
Area of visible land (km2)					
Mean	20.03	33.80	15.74	1	0.05
Minimum	0.86	8.35	0.32	1	0.05
Maximum	63.45	127.68	71.42	2	0.10
Ratio of sea area to land area					
Mean	0.98	17.78	78.58	20	0.05

Co. Donegal PA Summary data for Hypotheses 4 (m = 32, n = 19)

Number of arch sites w/ visibility of a location (a)	1	2	3	4	5	6	7	Weighted average
Area visible from a actual sites/km2	2331.80	806.69	359.61	71.28	265.24	-	-	1.73
Minimum area visible from a random sites/km2	1188.80	87.69	5.92	0.08	0.0004	-	-	1.07
Maximum area visible from a random sites/km2	2516.80	398.10	129.74	6.75	1.97	0.13	0.0010	1.33
Number of random groups with values of a	19	19	19	19	19	12	2	
Rank	19	20	20	20	20	-	-	20
Significance	0.10	0.05	0.05	0.05	0.05	-	-	0.05

Co. Donegal all site with architectural features measuring above 180m² Summary data for Hypotheses 1 to 3 (m = 5, n = 19)

	Minimum for Reference set	Maximum for Reference set	Values for archaeological sites	Rank of archaeological sites	Significance
Area of the viewshed (km2)					
Mean	24.73	189.08	130.25	18	0.15
Minimum	2.76	25.62	7.91	6	0.30
Maximum	71.46	887.09	355.08	16	0.25
Area of visible sea (km2)					
Mean	0.65	175.81	63.76	15	0.30
Minimum	-	6.50	-	-	-
Maximum	3.19	871.07	214.88	14	0.35
Area of visible land (km2)					
Mean	11.04	50.43	66.49	20	0.05
Minimum	0.86	25.47	7.91	10	0.50
Maximum	20.48	89.78	251.14	20	0.05
Ratio of sea area to land area					
Mean	0.02	35.98	1.33	9	0.45

Co. Donegal all site with architectural features measuring above 180m² Summary data for Hypotheses 4 (m = 5, n = 19)

Viewshed of archaeological sites do not overlap.