

**An Analysis of Early Iron Age Socio-Economic Organization in the Rathcroghan
Hinterland of Connacht, Ireland**

by

Maighread Southard-Wray

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This thesis was presented

by

Maighread Elaine Southard-Wray

It was defended on

March 28, 2024

and approved by

Dr. Elizabeth Arkush, Professor, Department of Anthropology, University of Pittsburgh

Dr. Marc Bermann, Associate Professor, Department of Anthropology, University of Pittsburgh

Dr. Derek Pitman, Associate Professor and Deputy Head, Department of Archaeology &
Anthropology, University of Bournemouth

Thesis Advisor: Dr. Bryan Hanks, Associate Professor, Department of Anthropology, University
of Pittsburgh

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The Irish Iron Age (c. 700 BCE – AD 400) is a period of late prehistory which continues to remain shrouded in darkness. The enigma of this period is largely due to the ephemerality of the material record of settlement and daily lifeways, a scarcity that is highlighted when compared to the sedentary, agricultural Bronze Age. It has been suggested that this ephemerality of the Iron Age represents a shift in subsistence economy to a multi-resource pastoralist economy that incorporated small-scale localized agriculture, hunter-gatherer foraging, and mixed-species herd management. In the absence of known domestic sites, the Irish Iron Age has become known by the large-scale sites of ceremony, economic, and political organization, known as ‘royal sites’, a name which derives from medieval interpretations. These royal sites are tied to local landscapes and depend on this connection for the maintenance of their legitimacy. By interpreting the royal sites as fixed points of organization (anchors) within multi-sited pastoral landscapes, the nature of socio-economic organization may be revealed.

This thesis models paths of movement in the Rathcroghan hinterland through the use of GIS analysis to assess potential routes of mobility throughout the landscape, in relation to waterways, peatland environments, and dry land. I use a multi-scalar approach to assess movement and mobility at a local scale (radius=25km) and a regional scale (radius=50km). These models of potential pathways of movement are compared to archaeological datapoints accessed through the National Monuments Service of Ireland to reveal the social factors of pastoral mobility. Through

the analysis conducted, Rathcroghan is considered in the context of its broader social context of the pastoral Iron Age. The results of this analysis indicate that in dry land environments pastoralist communities may have been utilizing energy-efficient routes of movement. However, in bogland contexts and at river fords, the social value of landscape features becomes clear as local knowledge would have overridden efficiency of movement.

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Preface

I would like to thank Dr. Bryan Hanks for his support in the development of this BPhil thesis. The focus of this research was significantly aided by the expertise in archaeological pastoralism and the Eurasian Iron Age that Dr. Bryan Hanks provided. I thank him for providing me with the theoretical and archaeological foundation which shaped this thesis.

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Finally, this thesis relies on the data compiled and made available by the National Monuments Service of Ireland. I thank the National Monuments Service for their continued maintenance of the Historic Environment viewer and for the public access which this database provides.

Go raibh mile maith agat.

1.0 Territorial Horizons and Patterns of Mobility

1.1 Introduction

Seamus Heaney's famed poem *Bogland* paints an image of Ireland as an open landscape where one's eyesight fades before the horizon does. A place without fences to divide and a landscape dotted with boglands. This image of the countryside resonates with our contemporary understanding of Ireland in prehistory, a time when boglands were crucial to both patterns of subsistence and social identity formation. Indeed, the role bogs played in the daily practices of the inhabitants of Ireland, since the earliest of times, has been so crucial to the development of subsistence, industry, and social order that to overlook them in any analysis of the Irish past would be a grave disservice.

The long-standing relationship between people and bogs has resulted in mutual adaptation, visible in the archaeological record by way of the economic and ritual exploitation of bog resources and cultural responses to bogland changes. Without a doubt, the high percentage of artifacts and features found in wetland contexts can be partly attributed to preservation issues, as anerobic peat environments generally preserve artifacts at a higher rate than other environmental contexts, but the scale to which wetlands were utilized in prehistory indicates that preservation is not the only factor at play. Instead, the trackways, features, burials, and artifacts that are associated with Iron Age bog usage indicate that these unique environments were important economically as well as for ceremony and ritual. Archaeological investigations must consider peatland environments as crucial to changing patterns of social, economic, and political organization.

This thesis research, utilizing available open-source data and GIS analysis, investigates potential routes of pastoralist movement within the hinterland (radius=50km) of the ancient Rathcroghan mound, which is situated in County Roscommon, northwestern Ireland. This important site is part of a wider archaeological complex of sites and is one of four designated “royal sites” of Ireland, which are widely referred to in early Irish medieval manuscripts. The GIS analysis of pathways allows for the examination of the potential use of Rathcroghan as an anchor for pastoralist communities who may have practiced a higher degree of mobility and livestock specialization in the Late Bronze Age to Early Iron Age transition (c. 700 – 400 BCE). In addition, the role of bogland environments in the context of pastoralist movement are explored. The GIS-generated least cost paths are compared to known dryland roadways and wetland trackways, known as toghers. The aim is to assess potential routes of movement and to examine potential strategies by mobile pastoralist communities that emerged in the Rathcroghan hinterland during the Late Bronze Age (1000 – 700 BCE), which was a time of substantial change based on available archaeological and environmental data.

The role of landscape features in the ordering of social networks of movement is a crucial component to understanding the socio-economic organization of the Early Iron Age. The cultural navigation and interpretation of dry land features, such as hills and slopes, is an important part of mobility. Equally important, though less discussed, is the role of wetland environments, such as rivers and bogs, in the cultural organization of movement. Historically, in Irish bogland contexts, local economic extraction has been demonstrated by rough grazing practices (describing the utilization of bog environments, mountain areas, and lowland areas which are characterized by scrub and brush, after O’Donovan et al. 2021: 225, citing O’Mara 2008), seasonal harvest of plant resources, and peat cutting (Farrell & Doyle 2001; O’Sullivan 2007). It is also possible to

recognize a local ceremonial understanding of liminality, seen in myth as well as archaeology (Waddell 2014), and regional political organization visible through the construction of high labor toghers, such as the Corlea 1 trackway (Raftery 1987) and Edercloon trackway complex (Moore 2021). Archaeologically, supra-regional ritual deposition has been identified through the recovery of artifact deposits and what has been identified as the disposal of “kingly sacrifices” in bog contexts (Mulhall 2019). Thus, bogs may have been viewed as landscape destinations for a variety of social and economic purposes rather than simply as barriers to pastoral movement. Similarly, the waterways of western Ireland, particularly the River Shannon and River Suck, not only represented potential barriers to movement, resulting in the need to use specific fording locations, but also played significant roles in the ordering of the landscape through time. For example, the numerous towns that are situated along both the River Shannon and the River Suck have their origins in locations used historically to safely ford these major waterways. While many of these towns may have been established during the Medieval Period, some may have also been used as ford sites in prehistoric practice as well.

1.2 Centers, Mobility, and Boglands in the Irish Iron Age

The pastoralist interpretation of the Irish Iron Age has grown and developed significantly from its origins. The hiatus of settlement for the early Iron Age has long been recognized archaeologically and led to the discussion of the Iron Age as a period of mobility and pastoralism. These early models (e.g. Piggott 1958) resulted in the definition of the Scottish and Irish Iron Ages as a period of the “footloose Celtic cowboy ranging over rough pasture as a semi-nomadic pastoralist” (Harding 2017: 27). This romanticized conception of Iron Age social organization as

untethered and unknown long prevailed, stunting the development of critical analyses and theoretical frameworks for a semi-mobile pastoral society. However, in the later 20th century, projects investigating the ephemerality and social organization of the Iron Age critically strengthened the pastoralist lens of interpretation (Weir 1995; Raftery 1983; Raftery 1984). At the same time, archaeological research schemes initiated at the royal sites (Johnston and Wailes 2007; Waterman 1997; Newman 1998), and the intensity of excavation at these monuments, resulted in the separation of royal sites from the corpus of Iron Age archaeology (Armit 2007; Newman 1998).



Fig. 1 Distribution of Iron Age sites and features through time. From left to right: Early (c. 400 BC-AD 100), Middle (c. AD 100-500), and Late (c. AD 500-700). (From Dowling 2014: 151.)

While a highly mobile cultural tradition during the early Irish Iron Age is the accepted explanation for the substantial decline of domestic features in the archaeological record (discussed in detail in Chapter 2), the resulting effects of this mobility on the social structures of Iron Age Irish cultures is largely a matter of speculation. The Iron Age is a period defined archaeologically by the presence and construction of monumental architecture, seen in the communal utilization of the ‘royal’ social centers which continued to experience significant construction and regular

depositional events throughout the Iron Age. These anchoring centers stand in stark contrast to the lack of other settlement sites.

Excavations at the royal sites of Knockaulin, County Kildare, and Navan Fort, County Armagh, have located large deposits of domestic faunal remains, comprised mainly of cattle, sheep, and pig remains, with butchery patterns indicating seasonality of slaughtering. This evidence suggests that such depositional events are the result of feasting activities where dispersed populations would gather, perhaps on a seasonal basis. At Knockaulin, excavations conducted by Bernard Wailes, Susan Johnston, and Pamela Crabtree between 1968-1975, produced a significant Iron Age faunal assemblage NISP of 18,755 (Crabtree et al. 2009: 2). The majority of the Iron Age faunal remains recovered in these excavations are cattle (NISP of 1075) with pigs as an important secondary species (NISP of 711) (Crabtree et al. 2009). Apart from three bones of red deer, the entire assemblage is composed of domesticated species, illustrating the value that these herd species held in Iron Age society (Crabtree et al. 2009: 3). In addition, assemblages at Navan Fort, while still made up primarily of domesticates, are dominated by pig remains (NISP 2624) (Madgewick et al. 2019: 1) slaughtered for feasting events. Both Knockaulin and Navan Fort demonstrate the focus on feasting, indicating that gatherings at royal sites may have been utilized as a method of reinforcing socio-political organization. The Hill of Tara, located in County Meath, differs from both Navan Fort and Knockaulin in terms of evidence for feasting practices. Despite hosting a monument known as the Banqueting Hall, a name which describes later Medieval use and reinterpretation (Newman et al. 2007), evidence for seasonal feasting in the Tara complex is somewhat limited. Rather, the Hill of Tara is understood to have been a place of burial and associated political power, demonstrated not only by the many tombs but also by mythological and Early Medieval sources which speak to the inauguration of kings in the complex (Newman et al.

2007; O’Sullivan & Kinsella 2013; Dowling 2015). The multi-period nature of Tara’s burial grounds demonstrates the important role that funerary practice held in the control of territory during later prehistory.

While royal sites are social and ceremonial centers rather than places for the day-to-day practice of life (Armit 2007; Becker 2019), they remain the primary source of archaeological information for the Iron Age. This creates a complicated situation where the understanding of socioeconomic and political organization of Irish Iron Age has been informed by an “archaeology of the non-routine; of ceremonial centres, routeways and boundaries, and rich metalwork offered up in bogs, rivers and pools” (Armit 2007: 133). These sites of ceremonial and political gathering reveal much about the large-scale community organizations and events of the later prehistoric period; however, an understanding of the day-to-day social structure of Iron Age communities remains elusive. By examining the potential patterns and pathways of mobility of pastoralist communities within the hinterland of Rathcroghan, including movement within the wetland environments of eastern Connacht, the importance of large-scale sites as anchors of landscape organization for mobile pastoral communities of the Irish Iron Age may be explored.

Economic resource extraction from peatlands is visible through the history of grazing on blanket bog locations as well as the seasonal harvest and exploitation of plant resources found within specific bog contexts (Farrell & Doyle 2003). The earliest records for the utilization of bogs for rough grazing dates to the 18th century AD. However, due to the limitation of quality dryland pasture available in the Connacht region, it is probable that this practice extends into the prehistoric period. Historic records indicate that the herds that were rough pastured within boglands were traditionally cattle, although sheep now dominate the herds that are pastured in these zones (Farrell & Doyle 2003). While the historic usage of peatland environments as rough grazing appears to be

a decision driven by the need for pastureland, the prehistoric utilization of these environments may also have served as a means of protecting valuable herds from targeted raids due to the difficulty of traversing bogs and the local knowledge required to do so with livestock.

While the economic aspect of peatlands cannot be denied, ritual bog usage is far more investigated. The ritual depositional practices of the late prehistoric period have captured international interest. This is largely reflected in the haunting images of preserved human remains recovered from Irish bog contexts and the exhibition of these bodies in the National Museum of Ireland and in some cases worldwide. While bog bodies are not a strictly Irish phenomenon, the significant wetland coverage in Ireland [roughly ~14-17% of the landmass today (Connolly et al. 2007; Connolly & Holden 2013; Hammond 1979)], has yielded a number of Iron Age bodies. The pattern observed in recovered Irish bog bodies indicates that these individuals were of significant social status. This is reflected in the state in which they were sacrificed and placed within the bogs, with carefully manicured hair, peculiar final meals, and the ways in which they were killed. This has led various scholars to argue that these are the bodies of kings or other high-status individuals who were sacrificed in times of strife or social unrest (Giles 2020; Aldhouse-Green 2016).

In this vein, the National Museum of Ireland (NMI) Archaeology's permanent exhibition "Kingship and Sacrifice" investigates the bog bodies of Irish context from the perspective that the ritual killing of these individuals and deposition of their bodies into bogland contexts is tied to sovereignty, rituals of kingship, and territoriality (NMI Kingship and Sacrifice <https://www.museum.ie/en-IE/Museums/Archaeology/Exhibitions/Kingship-and-Sacrifice>). The Bog Bodies Research project of the National Museum of Ireland (NMI), established in 2003, has sought to understand the social meaning of human sacrifice and bog deposition through the multi-method, detailed analysis of these human remains and their associated contexts (Mulhall 2019).

The data collected from the sampling of tissue have revealed much about the social structure of kingship, power, and the understanding of the environment during the Iron Age (Mulhall 2019; <https://www.museum.ie/en-IE/Museums/Archaeology/Exhibitions/Kingship-and-Sacrifice>).

Previous research focused on bog utilization in later prehistory suggests that these peatland environments were multi-purpose, and the analyses conducted through the NMI's project have supported this interpretation. The Iron Age data from a range of peatland contexts paint an image of a society that understood the economic and ritual spheres as intertwined social aspects rather than separate. Each was dependent on the other for the success of the community. Such a symbiosis creates the need to reevaluate previous interpretations not only of bogs but also of our understanding of the symbolic and economic worlds of the Iron Age (Becker 2019; Brück 1999; Harding 2009).

1.3 Thesis Research Questions

The research agenda of this thesis seeks to explore potential routes of movement within the Rathcroghan hinterland through the use of GIS modeling, treating the royal site itself as a landscape anchor (Hammer 2014) through which pastoralist communities of the early Iron Age ordered their seasonal rhythms of movement. Research for this thesis was therefore structured according to the following questions:

1. Based on available geospatial data, how would movement within the Rathcroghan hinterland have been affected by regional rivers and the use of fording locations? How would movement have been affected by lakes, slopes, bogs, and other impediments?

2. How might movement have been affected by wet conditions versus dry conditions, in seasonal or multi-annual fluctuations?
3. Would movement inward or outward from farther areas (e.g., for periodic ceremonial gatherings) result in different routes from local movement inward and outward from Rathcroghan to the nearby hinterland? How long might these journeys have taken?
4. Do these GIS modeled pathways correspond to known historical roadways and toghers in the region of study?

These questions are designed to build on previous archaeological investigation of the Early Iron Age, both in Connacht specifically and in the broader Irish context. The goal of this approach is to examine potential seasonal (dry climate and wet climate) models of mobility within the Rathcroghan hinterland, both in dry and wetland areas. Routes are also analyzed using two scales, with a local scale being radius=25km and a regional scale of radius=50km, to understand potential short and long routes of movement. The GIS modeled routes, where possible, have been compared to known historic paths, accessed as point shapefiles from the National Monuments Service' Historic Environment viewer, throughout the province. A comparison of modelled movement and actual routeways provides the opportunity to critically assess the reliability of GIS models in the analysis and understanding of late prehistoric movement in Ireland. Potentially, this approach can have wider applicability to other regions and archaeological contexts in Ireland.

2.0 New Approaches to the Late Bronze to Early Iron Age Transition (c. 700 – 400 BCE)

2.1 Theoretical Trends for a Pastoral Irish Iron Age

The proposed pastoralism of the Early Irish Iron Age emerges out of investigations that have identified an ephemerality of archaeological evidence suggesting distinct shifts in settlement patterning. This transition to livestock herding and seasonal mobility is based on recovered domestic faunal remains, construction of major landscape anchors (e.g. “royal sites”), and use of enclosures and earthworks as possible livestock herding and management features (Becker 2019). These lines of evidence, coupled with evidence from paleoclimatic reconstruction indicating the regrowth of woodlands (Weir 1995), have stimulated this mobile pastoralist model (Armit 2007; Becker 2019; Becker 2009; Raftery 1994). This pastoralist model of the Irish Iron Age has been combined with an interpretation of heterarchical social organization (Dolan 2014) to create a framework through which an understanding of Iron Age life can be achieved (Becker 2019). This perspective brings with it a potential for comparison with archaeological studies of pastoralism in different regions of the world. Working towards this broader comparative framework is specifically what Honeychurch and Makarawicz have suggested is crucial for future studies on the archaeology of pastoral nomadism (2016).

Further complicating the Bronze-Iron Age transition period is the issue of funerary traditions. The funerary tradition of the Irish Bronze Age is largely characterized by the practice of cremations (O’Brien 2020: 7) which were often deposited into cist burials in ceramic containers. Bronze Age burial tradition also involved the construction of barrow tombs, or the continued use of barrow structures from the Neolithic. Mound of the Hostages in the Hill of Tara complex is an

example of such reuse of tombs into the Bronze Age. This indigenous tradition of cremation continued into the Iron Age, though with one important change. While Bronze Age cremated burials can be identified through the presence of ceramic vessels, the Iron Age is devoid of a ceramic tradition (Mallory 2009), making the identification of Iron Age burials dependent on absolute dating techniques rather than identifiable through artifact typologies (O'Brien 2020: 7; Lamb and Schönfelder 2022). Cremation burials seem to have continued as the dominant funerary tradition throughout the Early Iron Age (c 700 – 400 BCE); no evidence has been uncovered for inhumations during this period, though a degree of this may be the result of preservation biases (Lamb and Schönfelder 2022: 230). The exception to this pattern of cremation is the burial of remains in bogland environments. Inhumation burials reemerge in the archaeological record of Ireland during the 2nd century BCE, primarily in the regions around Dublin (Lamb and Schönfelder 2022: 241; Mallory 2015: 196-99).

Table 1 Chronology of Bronze Age - Iron Age Transition

Conventional Period	Approximate Date Range	Settlement Patterns	Subsistence Patterns	Funerary Evidence
Bronze Age	2400-1000 BCE	Sedentary farmsteads/communities	Agriculture	Crouched inhumation, cremation, bog bodies (e.g. Cashel Man)
Late Bronze Age	1000-700 BCE	Nucleated, sedentary farmsteads	Agriculture, incorporation of small-scale pastoralism	Ceramic vessel cremations & some crouched inhumation
Early Iron Age	700-400 BCE	Disbanding of homesteads; Ephemeral evidence of dwellings suggesting mobility	Multi-resource pastoralism, localized agriculture, foraging	Cremations. No evidence for ceramic vessel burials
Middle / La Tene Iron Age	400 BCE-CE 100	Ephemerality of dwelling evidence	Multi-resource pastoralism, localized agriculture, foraging	Cremation, Bog Bodies (e.g. Oldcroghan Man), scattered crouched inhumation
Late / Roman Iron Age	CE 100-430	Emergence of sedentary communities	Pastoralism, increasing incorporation of agriculture	Cremations & Crouched inhumation
Early Medieval Period	CE 430-1170	Sedentary communities	Agriculture	Crouched and extended inhumation (continued use of pre-Christian ancestral burial sites until c. 8th century CE (O'Brien 2020:196-7))

Table 1 demonstrates the chronological changes in settlement patterning, subsistence practice and burial tradition from the Bronze Age (c. 2400 – 1000 BCE) through the Early Medieval Period (CE 430-1170). The employment of multiple archaeological science methodologies, including archaeological geophysics (Waddell et al. 2009; Fenwick et al. 2020), absolute dating techniques (Becker et al. 2011), paleoclimate reconstruction (Armit et al. 2014; Plunkett et al. 2013), and palynological investigation (Weir 1995; Plunkett 2008), indicate that the change in material patterning associated with the Bronze Age-Iron Age transition is the result of changing cultural practices rather than preservation. It may be that the subsistence economies of the Irish Bronze and Iron Ages should be thought of as a spectrum along lines of sedentism-mobility and agriculture-pastoralism (Cribb 1991). Through this spectrum-focused lens, pastoralist practices in the Early Iron Age need not have resulted from a hard break with indigenous traditions,

but rather demonstrate an environmental and social period which necessitated a shift along this continuum. A shift away from intensive agricultural reliance is supported by the notable increase in equestrian-related artifacts (Maguire 2021) and wooden trackways dating (Raftery 1987; Brindley & Lanting 1998; O’Sullivan 2007) to the Iron Age. These, coupled with regrowth of trees and enclosure of previously cultivated areas (Weir 1995; Gearey et al. 2020) and large faunal assemblages found at royal sites (Crabtree 1990; Crabtree et al. 2009; Johnston & Wailes 2007; Madgewick et al. 2019) suggests a culture of high mobility practicing a form of seasonal pastoralism. While excavations continue to produce Iron Age sites and artifacts, these largely follow the established non-routine pattern and continue to provide evidence which suggests significant decentralization and changing patterns of landscape occupation (Dolan 2014; Becker 2010; Armit 2007; Raftery 1994).

In Ireland, the investigation of pastoralism has been approached through an explicit landscape perspective (Armit 2007; Becker 2019; Raftery 1994). This approach is not new in Ireland; landscape studies have been vital to archaeological research for many years as investigation and management schemes of the 1980s moved away from a focus on single sites to holistic landscapes (Darvill 2008: 68; Reeves-Smyth & Hammond 1983). The post-processual framework that first emerged in the 1980s brought with it new and important theoretical perspectives for exploring archaeological evidence and highlighted such issues as agency, materiality, phenomenology, landscape, and social identity, to name only a few of the key developments (Johnson 1999). In particular, landscape-focused studies became a vital area of theorization and stimulated new ways of conceptualizing archaeological sites and their potential significance through time (Bradley 2000; Ashmore & Knapp 1999; Barrett 1999). These approaches became a significant part of research trends in Ireland as well, due in part to the

apparent social and symbolic significance associated with certain archaeological sites and their places within the broader landscape. The Irish “royal sites” are an excellent example of this, as the construction of these monuments correlates to their prominent topographical positions and the perceived power and authority they may have represented regionally through time.

Ashmore and Knapp (1999) have described the challenging division that has been generated by some scholars who sought to make distinctions between sacred, ceremonial landscapes and landscapes of economy and subsistence. The conceptualization of landscape as both a sacred space and economic resource remains an important consideration, and the bog landscapes of the Irish Iron Age represent an excellent example of this. For example, ritual bog deposits occurred in proximity to the extraction of wild resources in these locations, and available evidence indicates that the pastoralism practiced during the Early Iron Age in Ireland may have been multi-resource, indicated by the small-scale, localized agriculture that also continued to be practiced. Further, documentary evidence of the Medieval Period indicates that wild flora, particularly trees, played a significant role in late prehistoric Ireland (Newman et al. 2006). However, an accurate definition of Irish multi-resource pastoralism is difficult given the lack of systematic investigation to date. The available evidence, nevertheless, suggests that this may have been a specialized subsistence economy that incorporated small-scale, localized agriculture, hunter-gathering foraging, and mixed species herding into a multi-resource pastoralist pattern of subsistence.

The ephemeral nature of mobility in the archaeological record requires a different conceptual and methodological approach than is generally applied to sedentary contexts. The multi-scalar and multi-sited nature of ‘pastoral landscapes’ (Hammer 2014; Honeychurch & Makarawicz 2016) provides such a framework for thinking critically about the nature of mobility

and connection to landscape resources that human and animal communities depend upon for pastoralist subsistence patterns. Pastoral landscapes, created through the ordering of features and resources within specific landscape zones, inherently operate at varying scales and can address some of the gaps in the material record that may arise from higher degrees of mobility, which are often seasonally conditioned. These local and regional landscapes demonstrate the networks and intersection of social, economic, and political sectors of lifeways among multi-site communities (Hammer 2014; Honeychurch & Makarawicz 2016). Hammer's (2014) investigation of pastoralism in southern Türkiye illustrates the degree of modification which is inherent in the construction and maintenance of pastoral landscapes. Through this modification, sites of resource extraction or construction, such as water sources (cisterns in this specific case study), become "landscape anchors" (272) which order the economic movement of pastoralist communities by serving as fixed points of reference. Hammer's call for the utilization of middle scale analysis in the investigation of mobile pastoralism connects importantly with the concept of multi-scalar investigations. Middle scale, as defined by Hammer, "concern[s] the dwelling spaces of mobile pastoral households and the local landscape organization most directly relating to these households' daily movement patterns and seasonal land-use within a particular environment during a single season" (Hammer 2014: 285). While this definition may appear to be quite specific to the author's case study, the application of this middle scale more broadly may serve as a steppingstone between local (defined by the extent of a single day's movement) and regional (defined here by a journey requiring two days of movement) scales of pastoral landscapes in other regional contexts. The Irish 'royal sites' are known, both archaeologically and historically, to have served as landscape anchors on a regional scale, with influence acting not only within their province but also

reaching across the island. However, the role that these ‘royal’ sites played as landscape anchors at local and middle scales is less clear.

2.2 The Royal Sites of Ireland

As introduced in Chapter 1, the Irish royal sites are a monument class specific to Ireland that includes several large-scale, supra-regional settlement sites, demonstrated in Figure 2. Scholarship has largely defined these sites through medieval interpretations, which viewed them as sites of sacral kingship. While the number of sites included in this category are debated, a few stand out as really defining this category of monument. These sites are Rathcroghan, County Roscommon; Knockaulin, County Kildare; Navan Fort, County Armagh; and Hill of Tara, County Meath.



Fig. 2 Map of major Royal Sites of Ireland

Each of these sites exhibits a significant degree of multi-period construction and interpretation, creating a palimpsest of sacred landscape space (comparison displayed in Figure 3). These major royal sites witnessed significant construction phases and cultural utilization during the early Iron Age (c. 700 – 400 BCE), a period that otherwise is defined by ephemerality of evidence for both funerary practice and lifeways. The Iron Age deposits recovered from these sites have not been investigated to the same extent. Knockaulin has seen significant excavations, led by Bernard Wailes and Susan Johnston, which have yielded much information regarding the role of the site as a gathering place (Johnston & Wailes 2007; Johnston et al. 2016; 2009; 2014). There have been excavations at Navan Fort that also confirm the widespread influence that this ceremonial center exerted on networks of trade and mobility (Gleeson et al. 2023; Mallory & Lynn 2002; O’Driscoll et al. 2020), demonstrated by an African barbary ‘ape’ skull. These macaques are native to northeastern Africa, and the presence of a skull in this Irish context indicates the strength of networks of exchange in which Navan Fort was a significant player (Lynn 2003). Rathcroghan, however, has seen far less excavation. Archaeological investigations here have relied heavily on non-invasive techniques, such as archaeological geophysics. The variable scale of archaeological excavation, and different methodological approaches, to the investigation of these sites, has hindered interpretations of them as a coherent class of monument. Despite this, however, archaeological understandings of late prehistoric Ireland indicate that this was likely not a period of highly centralized organization as reflected in the Medieval texts. Rather, royal sites appear to have served both local and regional communities as gathering places through which the heterogeneous social organization of the Iron Age was negotiated (Armit 2007; Becker 2019; Dolan 2014).

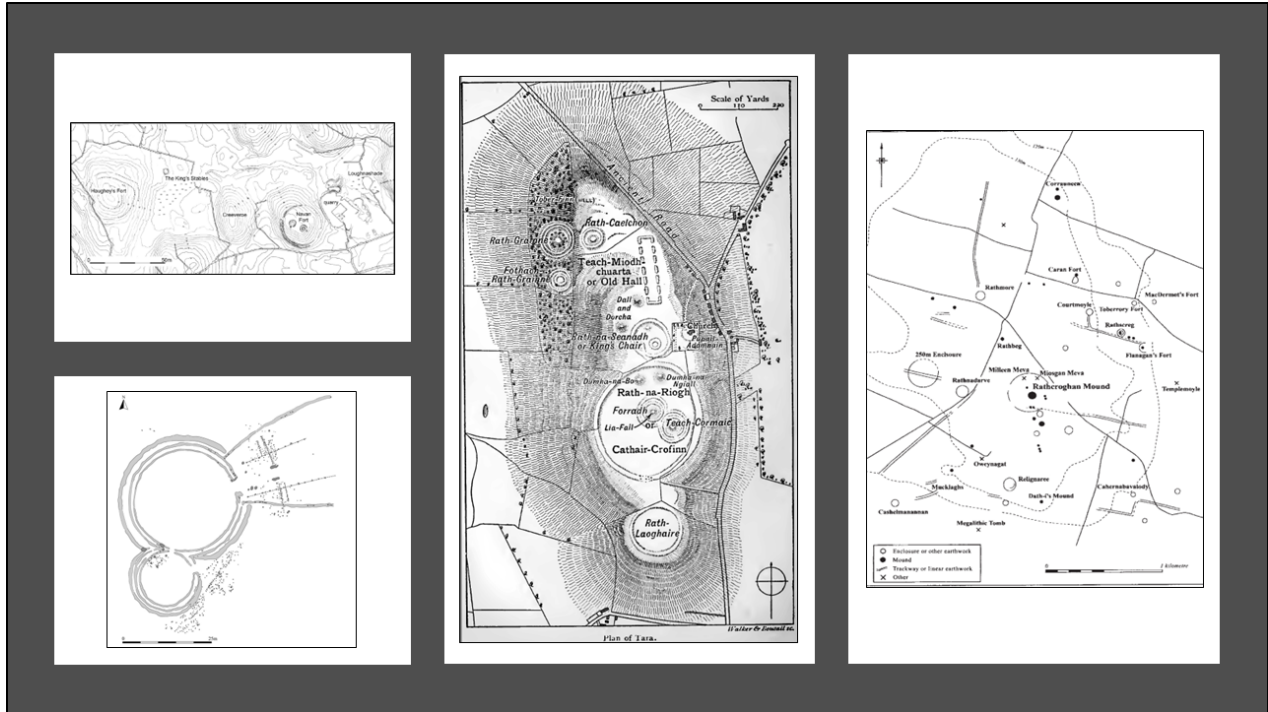


Fig. 3 Comparative maps of Royal sites. Clockwise from bottom left: Knockaulin, Navan Fort, Hill of Tara, and Rathcroghan. (After Becker 2019: 277; Madgewick et al. 2019: 2; Wakeman 1903: 166; Waddell, et al. 2009: 4).

Questions have arisen in recent years as to the degree to which royal sites can be identified separately from other monument classes. While the four major sites certainly exhibit similarities in form, these features are not limited to this class of monuments, and in fact several sites throughout Ireland, including Raffin fort in County Meath, have been put forward as part of a class of secondary royal sites (Newman 1998). These might have served local communities through the organization of landscape and socio-economic movement on a smaller scale than the primary sites discussed above. While the organization of royal sites into a separate class has certainly resulted in their consideration and investigation in isolation from other sites, there is a widespread opinion that medieval interpretations of these sites are not completely accurate. Yet, the categorization of “royal sites” persists as a general means of reference. Within this thesis, the term is used with a

similar purpose, to indicate those sites that may have been of particular social, economic, and symbolic importance among Irish Iron Age societies.

Recent archaeological research focused on Irish royal sites have uncovered evidence of various features that suggest non-ritual activities at these sites. This evidence includes large, funnel-shaped entrance avenues that are present to some degree at each of the major royal sites (Becker 2019) (A comparative image of these funnel-shaped avenues of approach is seen in Figure 4). While these avenues of approach may also have had a significant ceremonial aspect, in the context of use by increasingly mobile pastoralist communities, a more practice-oriented interpretation can be considered. Given the heavy emphasis on feasting at royal sites, these funnel-shaped avenues of approach may be evidence for herding, corralling, and butchering of livestock (Becker 2019). More importantly, there is no reason to suggest that such use did not also have an important ceremonial component to it. Archaeological evidence has indicated that gatherings at royal sites may have taken place seasonally, and it is possible that their use in livestock management not only served as an important economic activity but also as a ceremonial practice for feasting and sacrifice of wealth.

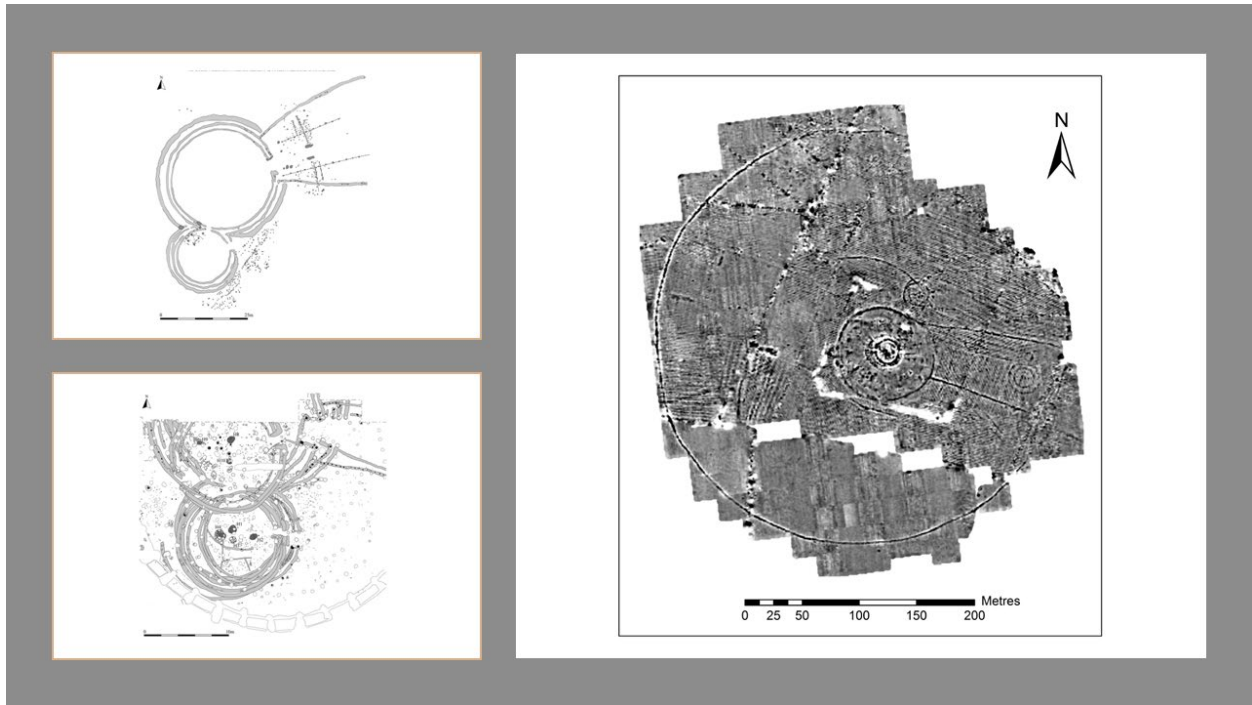


Fig. 4 Avenues of Approach. From bottom left Navan Fort (Becker 2019: 278); Knockaulin (Becker 2019: 277); and Rathcroghan (Fenwick 2018: 39)

2.3 Early Iron Age Irish Context

The prehistoric sites of Ireland represent a vast array of lifeways and cultural contexts through time that paint a picture of a region in which socio-political organization and subsistence patterning were deeply intertwined with the regional environment and landscape. A significant portion of these prehistoric sites are multi-period, creating a palimpsest of cultural activity that relates to generations of social reappropriation and use. In many cases, these diachronic sites continued to retain social significance well into the historic period, easily identifiable in medieval and post-medieval archaeological evidence of phases of occupation and historic references. The Early Iron Age (c. 700 – 400 BCE) is a particularly challenging period of Irish prehistory. This is

due in no small part to the discontinuity of the archaeological record observed during this period. Previous periods, especially the Bronze Age, are primarily characterized by more permanent settlements. These settlements were, by and large, composed of nucleated farmsteads diffusely positioned across the landscape (O’Driscoll 2023). Excavations of these homesteads throughout Ireland have indicated that a high degree of homogeneity existed in material culture patterning (ibid). The majority of data associated with Bronze Age settlement patterning has been obtained through contract infrastructural projects, particularly those associated with the National Roads Association (NRA) (O’Driscoll 2023; Becker et al. 2017) (Figure 5).

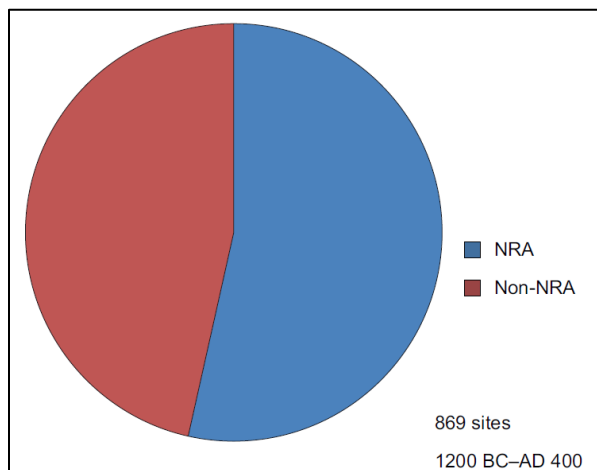


Fig. 5 Proportion of Late Prehistoric Sites located during NRA projects. (From Becker et al. 2017: 88.)

Ginn and Plunkett (2020) divide Bronze Age settlement into five phases, shown in Table 2, documenting the fluctuation of expansion and intensity of settlement evidence in the archaeological record.

Table 2 Chronology of Bronze Age Settlement (Ginn & Plunkett 2020: 42.)

		Years BC																										
		2000	1950	1900	1850	1800	1750	1700	1650	1600	1550	1500	1450	1400	1350	1300	1250	1200	1150	1100	1050	1000	950	900	850	800	750	700
Phases of "contraction" are denoted in pale colours and "expansion" in bold		Conventional Timeline																										
		EBA2				MBA1				MBA2				MBA3				LBA1		LBA2								
		Ballyvally				Derry-niggin		Killy-maddy		Bishopsland				Roscommon				Dowris										
		Metalwork Assemblage IV, V						Acton Park		Orna-ment Horizon / Taunton		Penard (c. 1275-1140 BC)				Wilburton (c. 1140-1020 BC)				Blackmoore Hoard / Ewart Park		Llyn Fawr						
		Period 3				Period 4				Period 5				Period 6				Period 7		Early Iron Age								
		Phase 1 (2700-1900 BC)		Lull A (1900-1700 BC)		Phase 2 (1750-1375 BC)						Lull B (1375-1100 BC)				Phase 3 (1225-775 BC)						Lull C (775-700 BC)		Phase 4 (700-300 BC)				
		Phase 1 (2200-1700 BC)				Phase 2 (1700-1300 BC)						Phase 3 (1300-1100 BC)				Phase 4 (1100-800/750 BC)						Phase 5 (800/750 BC onwards)						
European Trends ⁴				European Contraction						European Expansion				European Contraction				European Expansion		European Contraction								

Phase 1 (2200 – 1700 BCE) describes the emergence of domestic settlement associated with the Bronze Age. This initial phase is followed by a significant expansion during the later third millennium BCE (ibid: 48). Phase 2 (1700 – 1300 BCE) was a period of rapid expansion of Bronze Age settlement in Ireland. This period is also characterized by the development of large houses, greater than 80m², associated with other smaller scale dwellings (ibid). In contrast to these robust phases, Phase 3 (1300-1100 BCE) represents a collapse of settlement activity across known sites in Ireland (ibid: 49). This apparent decrease in Bronze Age occupation activity is supported by a

variety of evidence beyond the decline of dwelling structures, such as the reduction of funerary mounds and burnt features as well as palynological evidence of woodland regeneration (ibid: 50). This lull is followed by a significant renewal of activity in Phase 4 and the declines noted for Phase 5 relating to the Late Bronze to Iron Age transition. These settlement phases, as suggested by Ginn and Plunkett (2020), clearly illustrate the consistency of tradition of sedentary settlement and during the Irish Bronze Age while still allowing variation through time to be visible.

From settlements of the Bronze Age, abundant data has been gleaned on lifeways and daily practices. This wealth of information has allowed for the creation of a robust chronology up to the Bronze-Iron Age transition period; however, this is not so for the Early Iron Age. In contrast to the Bronze Age and the Medieval Period, the archaeological record of the Early Iron Age is very sparse. The minimal evidence for regional settlement patterning during the Early Iron Age has challenged a clearer understanding of the occupation, subsistence, and general lifeways of people during this time. Due to this issue, archaeological investigations have focused more intently on the prominent monumental constructions, such as the royal sites, as the primary basis for interpreting the Early Iron Age in Ireland. This shift in the material record has been linked to a model of socio-political organization and subsistence related to multi-resource pastoralism that occurred during the Bronze-Iron Age transition. While such a structural reorganization would explain the ephemerality of the Early Iron Age record, this proposed pastoral turn is largely supported by the absence of settlement evidence rather than a clear association with occupations reflecting mobile pastoralism. However, the continued construction phases and reinterpretation of landscape anchors, seen in the royal sites, as well as the proposed herding-focused utilization of large enclosures (Becker 2019), may provide an important foundation for pursuing a model of mobile pastoralism for the Early Iron Age. Additionally, indirect evidence, including palynological data

associated with woodland regeneration (Weir 1995), zooarchaeological remains of domesticates (Crabtree 1990; Crabtree et al. 2009), and paleoclimatic data indicating an environmental shift which no longer favored arable agriculture (Gearey et al. 2020; Raftery 1994), have been abundantly cited for the Early Iron Age. However, while this social reorganization favoring pastoralism may fit best with the archaeological record as it is presently understood, the continuation of arable agriculture into the Iron Age, albeit on a much smaller scale than the Bronze Age, cannot be overlooked (Gearey et al. 2020).

Significant to the historic investigation of the Irish Iron Age has been the question of Celtic migration and identity. Modern Irish identities have become so tangled in the notion of ‘celticness’ that they are practically synonymous. Archaeological evidence supports the continued use and adaptation of the wide-spread La Tène-style art motifs associated with Celtic peoples in Ireland long, after their disappearance on the continent (Armit 2007). This close association between Ireland and Celtic peoples has resulted in the entrenching of historic models of cultural interaction into archaeological investigation in ways that have hindered the development of Iron Age archaeology (Collis 1996; Morse 1996; Hutchinson 2001). Models of Celtic migration to Ireland have argued that the Iron Age witnessed a mass invasion of Celtic peoples which replaced the indigenous Irish population and their language. However, examination of the Iron Age record demonstrates no evidence for a mass migration of people (Armit 2007). Thus, proposals that suggest that the Celtic languages and motifs of the European continent made their way to Ireland through exchange rather than invasion are likely more aligned to the archaeological record as it is currently understood.

Koch (2007) considers three paradigms for the adoption of language: mass migration, bilingualism, and co-evolution. The first paradigm in application to Ireland is ruled out by the

archaeological record. However, given the uncertainty surrounding the adoption of a proto-Irish language, either paradigm may apply to some degree. Bilingualism requires a significant amount of time and numerous generations before one language can fully replace the other, demonstrated by the continued bilingualism in Ireland today. Koch's final model, co-evolution, suggests that the language, in this case Irish, evolved from the contact and mixing of two previously separate languages. The spread of Celtic peoples and languages throughout Europe need not have necessarily occurred in the same way across the continent (Koch 2007). Regardless of the method of interaction between Ireland and Celtic peoples, the modern association has shaped the development and interpretation of archaeology, hindering the consideration of the influence which non-Celtic material cultures may have had. Addressing this hinderance, Armit (2007) argues convincingly for the need to investigate Roman material in Ireland during the Iron Age. While Roman occupation of Ireland did not occur, the influence of Roman material culture on populations of the Late Irish Iron Age may indicate changing identity formation and a move away from more 'traditional' lifeways as the dawn of the Medieval Period approached (Armit 2007:136-7).

The research presented in this thesis connects with these important issues and seeks to understand how changing patterns of pastoralist mobility may have contributed to new socio-economic and political structures in the region of Connacht during the Early Iron Age of Ireland (c. 700 BCE – 400 BCE). The relative paucity of archaeological evidence dating to the Early Iron Age may suggest populations that were seasonally mobile, with subsistence practices relying on the herding of livestock within defined territorial zones. Evidential support for such a pattern can be found in assemblages of domestic faunal remains from feasting sites (Crabtree 1990; Crabtree et al. 2009; Madgewick 2019; Johnston & Wailes 2007), paleoclimate reconstruction (Armit et al. 2014; Geary et al. 2020; Raftery 1994), deposition of equestrian artifacts (Maguire 2021), and the

lack of dwelling structures indicating sedentary occupation (Raftery 1994; Becker 2009; Armit 2007). The mobility of this period is a stark contrast to the clearer patterns of full-time sedentary occupation during the Bronze Age and is likely the result of several factors including significant social and environmental change.

The Bronze Age collapse is a known phenomenon seen throughout Europe to varying degrees, and the results of the associated social reorganization led to vastly different Iron Age developments throughout the European continent. Paleoenvironmental and archaeological investigations indicate that a similar social reorganization may have occurred in Ireland (Raftery 1994; Becker 2008; Becker 2019; Dolan 2014; Dowling 2014), with data from wetlands and palynological investigations indicating that this reorganization was tied, at least partly, to significant changes in the environment (Gearey et al. 2020; Weir 1995; Armit et al. 2014). As outlined above, these shifts may have been tied to an increasing dependence on mobility and livestock herding and may have significantly impacted the ways in which Early Iron Age populations utilized regional resources. However, in the investigation of a mobile Early Iron Age practice of pastoralism, it is important that the stereotype of “Celtic cowboys” (Harding 2017: 27) moving across the landscape managing herds of livestock without ties to physical places be avoided as a pitfall. The thesis examines these issues through a specific focus on the region of Connacht in western Ireland, where available archaeological, paleoenvironmental, and zooarchaeological data provide an important context for evaluating these developments.

2.4 The Province of Connacht

Connacht, an archaeologically significant region in western Ireland, is home to Rathcroghan, the royal site of western Ireland. Connacht is made up of Counties Galway, Roscommon, Mayo, Leitrim, and Sligo. Until the modern era, it also included County Clare and County Longford (demonstrated below in Figure 6).



Fig. 6 "The Province of Connaught". 1610. Showing the inclusion of Counties Clare and Longford. Cambridge University Library

Connacht is one of five early socio-political provinces of Ireland, the others being Ulster, Leinster, Munster, and Meath. Meath was absorbed into the province of Leinster during the

Norman period following the assassination of king Tigernán Ua Ruairc (Ó hOireabhárd 2018), creating the four provinces known in Ireland today. Historic references to Connacht as a political unit are largely found in volumes of bardic verse poetry, such as the 13th century collection *Aithdioghluim Dána*, which was translated into English in 1939. Prior to the famine of the 1840s, the province boasted a population of nearly 1.5 million people (Knight 1848). However, as one of the hardest hit regions of Ireland during the Hunger, Connacht lost a significant proportion of its population and based on the results of the 2022 census the population remains at just over 500,000 (Central Statistics Office, Census of Population 2022). Under the British colonial regime, traditional lifeways and language were pushed to the west, and Connacht was viewed as a backwater. Oliver Cromwell, when asked about the fate of Catholics in Ireland, is said to have replied that such individuals could go “to hell or to Connacht” (Cunningham 2011), demonstrating the forced relocation and subjugation of people and communities. Connacht continues to have the highest number of native Irish (Gaeilge) speakers and is home to the most prominent Gaeltachts found in Ireland (Central Statistics Office, Census of Population 2022).

Connacht is generally considered to be the ‘wildest’ province of Ireland, boasting a modern ecotourism industry focused around natural areas such as the Wild Atlantic Way and Connemara National Park, to which thousands of visitors flock each year. Ecologically, Connacht is represented by poor quality pastureland. This is reflected in the abundance of wetland, mainly peatbogs, and the rugged Atlantic coastline for which the province is known. Figure 7, below, illustrates the distribution of peatland environments throughout Ireland. The significant wetland coverage across the province has not only allowed a peat extraction industry to thrive in Connacht but has also resulted in the preservation of a variety of organic artifacts, including wooden vessels, leather, and human remains. Bord na Móna, a semi-state corporation, owns a number of peatlands

in Connacht. The corporation is responsible for modern economic development of peatlands and partners closely with environmental agencies including the parks and wildlife service to protect and rehabilitate depleted peatland environments. Bord na Móna continues peat cutting projects throughout Connacht, now done largely through machine extraction. A fraction of peatlands in Ireland are currently set aside for conservation purposes, however, only 7% of boglands remain intact in the modern era (Crushell et al. 2008), resulting in concerns about the long-term survival of peatland and wetland environments (Farrell & Doyle 2003; O'Sullivan 2007). The collapse of these peatland environments would result in a restructuring of ecosystems on a scale that would permanently change the landscape of Ireland (Farrell & Doyle 2003).

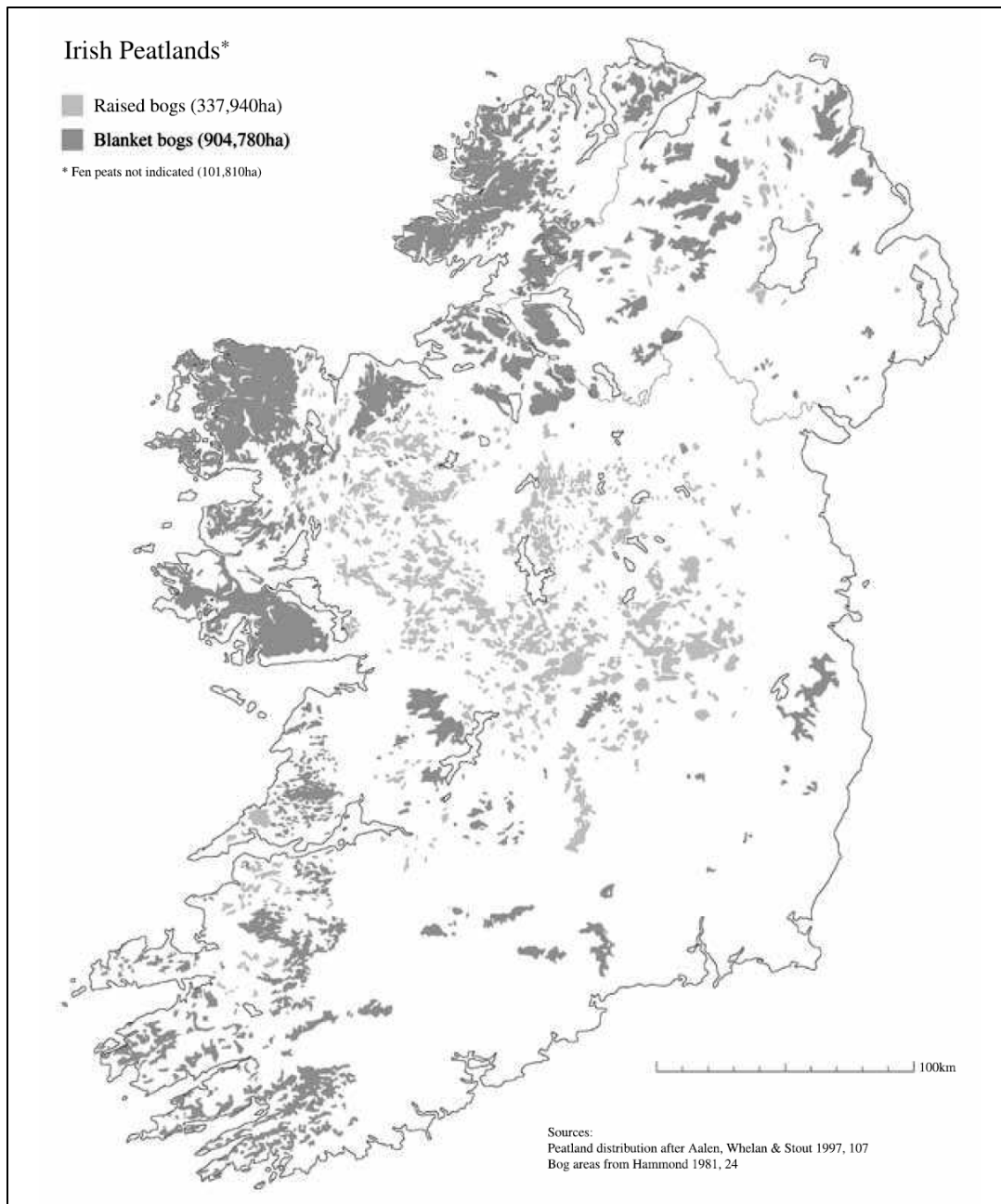


Fig. 7 Distribution of Peatland in Ireland. (From O'Sullivan 2007: 151.)

Connacht remains a destination for those seeking to experience ‘traditional’ lifeways and culture in locations such as the Aran Islands. These traditions can, in some cases, be traced to early medieval practices, creating a lineage of cultural heritage that can still be accessed today. Despite the seemingly unforgiving environment, human settlement in Connacht stretches back to the

Mesolithic Period, evidenced by sites like the Carrowkeel cemetery, although significant population of the region began to occur during the Neolithic era. The chronological changes laid out by Table 1 in chapter 1 demonstrate the shift in lifeways during the Early Iron Age (c. 700 – 400 BCE) which encompassed subsistence patterning, settlement traditions, and funerary evidence. These developments, as previously discussed, are interpreted as a shift to a form of pastoralism. As set out in Chapter 1, this thesis seeks to understand potential patterns of mobility used by multi-resource pastoralists within the Rathcroghan hinterland and to assess these patterns in the context of an anchoring of movement around this royal site.

3.0 Understanding the Irish Iron Age: Rathcroghan in Context

3.1 The Nature of the Irish Iron Age

As outlined in Chapter 2, the significant decrease in archaeological evidence associated with the Early Iron Age (c 700 BCE—400BCE) has long created an interpretive problem for scholars. Early on, some scholars, such as Eogan (1964), suggested that rather than an Early Iron Age phase, Ireland instead witnessed an extended Bronze Age. This proposal states that the ‘collapse’ of the post-Dowris phase is not indicative of an Iron Age transition but is instead a subdevelopment within Dowris chronology (Eogan 1964: 324). Eogan’s chronology suggests that the Iron Age did not, in fact, begin in Ireland until the introduction and incorporation of La Tène motifs into the art and artifact traditions of Ireland (c. 400 BCE—AD 1) (Eogan 1964; Gearey et al. 2020). Eogan’s Dowris C phase is supported by the uneven distribution of iron production sites in Ireland and slow introduction of the new material (Dolan 2016: 31). However, the earliest iron working features that have been positively identified and radiocarbon dated suggest that the knowledge of iron working technology was present in Ireland perhaps as early as the Bronze-Iron Age transition and certainly during the Early Iron Age (Garstki 2019: 448). Iron production steadily increased throughout the Early Iron Age, and the Developed / La Tène period iron workers are thought to have held an important social role and elevated status (Dolan 2016).

Further, scholarship is increasingly supporting the explanation that the disappearance of settlements and associated domestic features from the archaeological record is indicative of a change in social organization specifically tied to subsistence practices and socio-economic organization. This proposal emphasizes the continued, and in many cases increased, usage and

construction of monumental sites throughout Ireland, many of which have revealed evidence for large-scale feasting events. The construction of ringed enclosures and feasting has been connected to an increasing reliance on livestock and seasonal mobility. A recent pilot study conducted at Navan Fort examined the strontium isotope ratios of Iron Age domestic faunal remains deposited in feasting events (Madgewick et al. 2019). The results of the study were mixed as the sample size was not equally distributed across species and the lack of a refined and regional strontium baseline map of Ireland hindered more detailed conclusions of spatial mobility in the analysis. However, the analysis indicated that a percentage of sheep-goat, cow, and pig present in Iron Age feasting deposits may have originated from a variety of non-local communities and contexts (ibid: 6). These authors suggest that this is evidence of the far-reaching power of Navan Fort as a draw (anchor) for non-local populations gathering seasonally for ritual and political feasting (ibid: 8). These populations, they posit, brought their livestock with them for the purpose of slaughter. It is possible, however, that non-local livestock made their way to Navan Fort by some other means than accompanied by the herders who reared them. For example, one important factor to consider more carefully is livestock raiding, which appears to have made up a significant percentage of interpersonal violence during the Iron Age (O’Driscoll 2017; Newman 1998; Dowling 2014). The mythology associated with this period (interpreted through the lens of medieval manuscripts) boasts an entire genre of raiding tales, the most famous of which is the *Táin Bó Cúailnge*. It is surprising, then, that the authors of the 2019 paper did not consider more carefully the possibility that non-local livestock identified at Navan were procured through raiding and theft. Another possible explanation would be trade in livestock, which may have occurred during times of wider community gatherings at the royal sites. Regardless, the appearance of non-local animals in faunal deposits at royal sites does indicate that livestock played a significant role in the subsistence

economy of Iron Age Ireland, supporting the proposed socio-political and economic shift that occurred at this time.

The construction and utilization of centers of power during the Early Iron Age is a contrast to the lack of domestic evidence seen in the archaeological record, indicating a more dispersed social organization. Thus, the movement of small kin groups through the landscape may have been organized and managed through the royal sites. Further support, albeit indirect, for the potential pastoral Iron Age is the significant uptick in the presence of equine-related artifacts found in Ireland during the Iron Age (Maguire 2021). Often found in ‘hoards’ of two or more items, these artifacts are largely horse tack items, intricately made and finely decorated (ibid). This apparent new focus of material wealth on equine-related tack items may represent a change in cultural understanding of horses and thus could act as a proxy for the importance of mobility during the Late Iron Age (Maguire 2021). The high degree of La Tène-style decoration, and use of prized metallurgical materials (such as bronze) in crafting horse tack, may also suggest that as part of a shift to a more specialized pastoralist economy was an adoption of forms of mobile and easily exchangeable wealth (e.g., horses and tack items). It should also be noted that the royal sites may have provided important locations for the creation of associated craft markets (Dolan 2014: 44; Johnston 2007; Maguire 2021: 72-3). While the caches described by Maguire (2021: 63) are largely the result of later Iron Age deposition, this does not preclude the possibility for Early Iron Age movement on a similar scale. While the movement of kin groups and communities is as a rule ephemeral, the major royal sites of political and social significance continue to witness construction and further utilization during this time.

As noted in Chapter 1, the most widely recognized class of these sites is known by the misnomer ‘royal’ sites. These monumental, multi-period sites are considered a monument class

unto themselves and include Rathcroghan, Hill of Tara, Knockaulin, and Navan. Other sites, such as the Hill of Uisneach and Rock of Cashel are sometimes also included or are considered secondary royal sites. The concept of secondary royal sites was proposed as a solution to the appearance of 'royal' features at smaller-scale sites (Newman 1998). This subcategory represented settlements with similar socio-political functions to the supra-regional royal sites that operated on a smaller and more localized scale (ibid). All of these sites are quite spectacular to visit, both through approaching them and once at the location. By making use of the natural terrain in the creation of earthworks, these sites, it may be argued, create monuments out of the landscape itself, thereby increasing their power and possibly naturalizing their control over mobile communities. Visibility is significant at each of the royal sites, with wide viewsheds that include important landscape features, such as mountain ranges, rivers, and often other contemporary sites. The visibility of these monuments within the landscape creates known points and may have acted as landscape anchors for mobile populations within the region. The royal sites are not only visually impressive; they also boast large artifact and feature assemblages that allow for the development of relative chronologies and elucidate the socio-political role of monumentalization in the Early Iron Age. These chronologies are by no means complete, nor do they allow for a full spectrum of understanding for the Iron Age, but through examination of these sites, the role of ceremonial and ritual activity, combined with possible socio-political authority, can begin to be understood. The heavy investigative focus on these monumental sites, however, has left the early Irish Iron Age defined sites of ceremony rather than daily life (Armit 2007). This shift in socio-political organization may partly be the result of a significant decrease in population numbers associated with the 2.8 ka BP cold event that some scholars credit with contributing to widespread change in settlement and subsistence patterning (Gearey et al. 2020).

3.2 The Role of Climate in Iron Age Reorganization

The 2.8 ka BP cold event was an environmental shift that caused a significant downturn in temperatures across Eurasia. Archaeological research in China has indicated that these environmental and climatic changes may have fueled an associated change in material culture and agricultural exploitation (Jia et al. 2022), giving a correlation between environmental shifts and cultural change credence. In Western Europe, particularly Britain and Ireland, there has been less thorough investigation of what role, if any, the 2.8 ka BP cold event may have had on environment and culture. Barry Raftery's picture of the Late Bronze Age to Early Iron Age transition as a period of environmental and climate deterioration, "with waterlogged and ruined crops, with rivers bursting their banks and weeks of leaden skies and unceasing rain Ireland's Late Bronze Age farmers may have felt themselves on the brink of Armageddon" (Raftery 1994: 37), has resulted in the acceptance of the 2.8 ka BP event as a significant part of socio-economic reorganization. Palaeohydrological investigations appear to support this assertion, indicating that the period of Bronze-Iron Age transition witnessed an environmental tendency for colder and wetter climates, resulting in bog bursts (the term used to describe landslides where peat deposits become detached and move freely on the water table) which may have affected agricultural success (Gearey et al. 2020).

However, some doubt about the influence of climate change remains. Despite the palaeohydrological data indicating a shift in climate, correlating this change with archaeological evidence has posed challenges (Fitzpatrick 2014). Further, the role of the 2.8 ka BP cold event as a factor of social change in Britain has not been systematically investigated. Armit et al. (2014) have examined these possible correlations between the Irish Bronze Age collapse and the 2.8 ka BP cold event through comparative analyses of climate conditions and archaeological evidence.

This analysis demonstrated that the population dispersal associated with the Bronze Age-Iron Age transition began to occur at least a century before the 2.8 ka BP climate event effected Ireland (ibid). This research implies that the “darkness” of the Early Iron Age was a complex multi-causal phenomenon that contributed both to environmental change and social instability in Ireland and that several social factors must be considered to avoid environmental determinism.

The archaeology of this transition period in Ireland indicates a population which may have been navigating new environments through a variety of means (Raftery 1994; Gearey et al. 2020). These navigations include not only physical movement, as seen in the exploitation of boglands as loci of social and economic importance, but also social navigations, seen in the reinterpretations and construction of monuments. In recent years, scholarship has begun to focus on the subsistence spectrum shift to multi-resource pastoralism seen in the Early Iron Age. This shift saw a transition away from the sedentary agropastoralism that was represented during the height of the Bronze Age Dowris Phase toward a herding-focused pastoral economy. Evidence drawn on in support of this subsistence change comes from a variety of environmental and archaeological investigations.

Paleopalynological data from the Early Iron Age indicate woodland regeneration and the enclosure of previously exploited agricultural fields, evidence of the lessening of intensive agricultural subsistence (Molloy 2005; Weir 1995). Additionally, the Early Iron Age is represented archaeologically by a general lack of domestic dwelling sites and features (Armit 2007; Raftery 1994; Becker 2008; 2019). Such an absence supports a shift to pastoral subsistence, by its very nature a mobile form of social organization and indicative of population dispersal or a drop in population numbers. As discussed above, further support for a seasonally mobile, specialized herding society is seen in the significant increase in equestrian artifacts during the Iron Age (Maguire 2014).

3.3 Mobility in Connacht during the Early Iron Age

These new data and analyses have led to a more focused interest in the role of mobility in the Early Iron Age, especially as concerns Connacht. Unlike other regions in Ireland, Connacht is made up of notoriously poor arable land, meaning that the shift in socio-economic organization of the Early Iron Age may be more highly visible here than in other provinces as herders sought grazing land for their livestock and moved away from intensive settlement of arable land. Furthermore, the presence of Rathcroghan in Connacht, considered to be the ‘political center of prehistoric Ireland’ (Curley & McCarthy 2023), suggests that an understanding of the pastoral subsistence transition may be importantly associated with these royal sites. Additionally, the Connacht region boasts a high degree of bog coverage that may have posed significant barriers to the movement of livestock. The blanket bogs of Ireland, however, have been used as rough grazing land for livestock throughout the historic period, with continued use during the modern era (Huang 2002). It is likely, therefore, given the limitations of quality rangeland in western Ireland, that this method of bog exploitation has its roots in the pasturing practice of late prehistoric peoples. The potential utilization of blanket bogs as rough pasture complicates the Iron Age relationship with these wetland zones, demanding interpretive understandings that account for both economic exploitation and ritual utilization.

While dwelling evidence for the Iron Age remains limited, clues as to the nature of social organization in western Ireland can be found in the major sites that dot the landscape. The western stone forts, such as Dun Angus, *Dún Aonghasa* in Irish, display high degrees of fortification that would be expected during periods of increased regional conflict. Investigations led by the government-sponsored Discovery Programme have identified a significant Iron Age component to the construction and utilization of Dun Angus. While a degree of refortification took place here

during the Medieval Period, the earliest stone walls constructed in the defense of internal features date to the Iron Age (Cotter 2013: 11). The defensibility of the site and associated construction of additional protective barriers suggests that the Iron Age in Connacht was a period that witnessed significant conflict, perhaps mainly defined by raiding. Indeed, sources written during the Medieval Period indicate that late prehistory and the early Christian era were defined by small-scale, fast-paced raiding parties, which attacked with the principal intention of capturing cattle. This type of inter-group violence appears to have been so commonplace that it has come to define an entire genre of early Irish Literature, *Táin Bó*, literally translating as ‘cattle raid.’ The Aran islands, of which Inishmore, the home of Dun Angus, is the largest, are situated in Galway Bay approximately 10-50 km from the mainland. This relative isolation would likely hinder raiding parties from the mainland, suggesting that perhaps raids occurred at a highly localized scale.

While the stone forts of the western coast indicate the potential for intercommunity conflict, this is by no means the only defining characteristic of the Irish Iron Age. Indeed, excavations of the royal sites have demonstrated that these locations do not exhibit fortifications. Rather, the archaeological assemblages here are defined by large features and enclosures that appear to have ordered the gathering of communities and, perhaps, their animals for seasonally associated ritual activities. These large-scale gatherings may have acted as an important socio-economic leveling mechanism in which social relationships could be negotiated alongside economic matters.

This multi-period complex sits atop the Rathcroghan uplands, a karstic plateau which rests 60-150m above sea level and boasts some of the best grazing lands west of the River Shannon (Waddell et al. 2009). Rathcroghan mound, the center of the complex, has an incredibly wide viewshed and would have risen above the heavy forests of the surrounding lowlands during the prehistoric period (Curley & McCarthy 2023). Unlike other famed monuments of the prehistoric era, the Rathcroghan complex remains largely, over 90%, in private hands, split across several landowners who continue to farm and graze livestock on the plateau and in relation to the archaeological history. Archaeological investigation and preservation at Rathcroghan are managed by a community nonprofit in tandem with landowners, creating a community-focused archaeological outcome that serves not only heritage protection, but also farmers. The large-scale complex is made up of a variety of monuments, including barrows, mounds, parallel earthworks, and famously, a limestone cave, known in English as Oweynagat. These monuments create an archaeological landscape of significant multi-period usage and meaning, a feature of prehistoric monuments throughout Ireland, which represents diachronic appropriation of previous monuments.

Rathcroghan mound, *Ráth Crúachan* in Irish, is the focal point of this prehistoric complex. Broad, flat-topped, and circular in form, this mound rises some 5.5m from the ground and boasts an average basal diameter of 89m (Waddell et al. 2009). Traces of a smaller mound at the summit are still visible on the surface and have been confirmed through geophysical investigations. The usage of Rathcroghan mound has been the subject of discussion for generations. Although the name suggests that the site is a *ráth*, the Irish terminology for a fortified earthwork site (teanglann.ie), no defensive features have been uncovered during investigations of the mound (Waddell et al. 2009). This suggests that rather than a defensive purpose, the mound served a social

and economic function. This may have acted as a means of ordering the landscape and socio-political life of the populations inhabiting western Ireland. Despite the lack of visible fortifications, the site was nevertheless capable of controlling the surrounding landscape and populations occupying its hinterland. The construction of Rathcroghan explicitly mirrors the natural form of the landscape, creating a monument that is intimately tied to and dependent on the constructed landscape of Connacht. Thus, while the communities of western Ireland may have constructed Rathcroghan mound, the landscape itself contributes to the power and importance of the site.

The earliest components of the Rathcroghan complex have been dated to the Neolithic Period based on radiocarbon analysis of charred hazel from the nearby Tusk fort (Curley 2024, pers comm. citing Brady, Forthcoming; Curley & McCarthy 2023: 11). While these early dates are crucial to the chronology of the site, the complex seems to have been thrust into significant social importance in later prehistory, particularly during the Bronze and Iron Ages. The majority of archaeological features date to these later periods. Among these later components are Raignaree, Dathí's Mound, and the Mucklaghs, as well as the principal construction of Rathcroghan mound. The construction of large-scale earthworks during the Iron Age, such as Rathcroghan mound, represents a huge undertaking of community labor and engineering, suggesting the importance of political control at the site.

In folklore, Rathcroghan mound is known as “Mebh’s Palace”, the dwelling and ruling site of the infamous Queen Mebh of Connacht. These legends indicate Rathcroghan was a site of political control and social power during the later prehistoric period. This is a popular interpretation supported by the monumentality of the site and its later role as the site of coronation for the kings of Connacht. Scholars must be careful, however, not to overmine such information from mythology. While Mebh is a significant figure throughout the mythology of the Ulster cycle,

featuring prominently in mythic cycles that tell of her ruthlessness and cunning, there is no archaeological evidence of a historic queen of the Iron Age or early Medieval period named Mebh. Recent interpretations of this body of legends suggest that Mebh should not be interpreted as a historic figure, as has been routinely done, but rather that she represents an embodiment of the landscape and sovereignty of Connacht (Waddell et al. 2009). Medieval conceptions of Mebh as a ruler of Connacht are reflections of understandings of power and authority contemporary to the period when these documents were penned. The interpretation of Mebh as an embodiment of Connacht and the power present in the province is supported by documentary evidence of the kings of early medieval Connacht ritually “marrying” Mebh during their coronation ceremonies at Rathcroghan (Waddell 2014). While the folkloric understanding of the site conceptualized in mythology may not be grounded in archaeology, it does support the archaeological record’s indication of Rathcroghan as a site of significant political and social power and control, both in Connacht and in the wider context of prehistoric Ireland.

The social significance of the Rathcroghan complex within the wider community and landscape certainly saw its heyday during the later prehistoric period, but the role of the monument complex in the social context of County Roscommon can be seen to outlast the prehistoric period. Medieval evidence at the site suggests a significant reuse and reinterpretation of prehistoric monuments by early Christian communities. The reinterpretation of pre-Christian monuments by medieval communities is not uncommon throughout Ireland as Christian leaders sought to situate socially significant monuments within a Christian context. Rathcroghan was certainly no exception to this process, and indeed the reinterpreted and repurposed monuments continue to have social significance among local populations today. It was during the early medieval reinterpretation that the two Ogham inscriptions in the entrance to Oweynagat were carved. These inscriptions, of

which only one has been translated, are the physical manifestation of medieval understandings of prehistoric monuments. The souterrain entrance to Oweynagat has long been understood to be itself a construction of the medieval population due to the dry-stone construction (Waddell 2014). However, a recent uranium-thorium dating scheme utilizing calcite samples has indicated that the oldest portion of the souterrain dates to approximately the 1st century BCE, making it an Iron Age construction. (Curley 2024, personal communication, publication forthcoming). While the cave has not been excavated, its importance in regional mythology suggests that it served a significant social role during the turn from the Iron Age to the Medieval Period. In mythological cycles, Oweynagat is an entrance to the underworld, from which the goddess *An Morrigan* rides to bring about winter. The interpretation of caves as a liminal space is accepted by scholars in a variety of contexts, and it seems that Oweynagat served a similar purpose in the Rathcroghan hinterland. The Iron Age construction of the entrance chamber has been interpreted as a means of facilitating, or limiting, access to the cave.

Without a doubt, the continuing social significance of the Rathcroghan complex, and especially Rathcroghan mound itself, into the modern era is partly the result of the differing impact of the colonial project on the west of Ireland. The tactics of British colonialism, including the penalization of Roman Catholics through prevention of participation in government, education, and land ownership, were trialed and refined in Ireland before their application elsewhere as the British empire expanded (Rahman et al. 2017). Dublin served as the political capital for the management of colonial Ireland, and due to this, eastern Ireland was particularly subjected to British oversight. While western Ireland certainly felt the effects of English rule heavily, political control from the crown was less secure here than in the Dublin area of the east coast. Indeed, western Ireland, and Connacht in particular, continues to boast the highest percentages of daily

speakers of Gaeilge (2011 census). The food scarcity and insecurity of the 1845 famine, called in Irish *An Gorta Mór*, severely impacted the predominantly Irish-speaking west of Ireland. With few options for survival, communities apparently turned to the ancient past. Records from the period indicate that ‘ritual’ bleeding of animals took place atop Rathcroghan mound, where the blood was then collected, mixed with meal, and consumed (Wilde 1852: 56).

Scholarly interest in the history of sites such as Rathcroghan, and particularly in Rathcroghan mound, can be tied to the early years of the antiquarian movement. The 1684 writing of clergyman John Keogh remains the earliest written reference to the archaeological complex (Waddell 1986). While this is a vague and short reference, antiquarian interest in Rathcroghan was not limited to Keogh alone. Indeed, a number of written descriptions indicate that the complex was understood as a location of importance in the pre-Christian era far before any archaeological investigations took place. This antiquarian interest coincides with the romantic movement in art and literature that saw, among other things, a fascination with the ruins of previous cultures and an interest in the ‘wild’ natural world. The influence of this movement can be seen in the 1779 painting of Rath Crúachan mound by Gabriel Beranger (Figure 9) and in the poems of Samuel Ferguson, who explored Oweynagat in 1864.



Fig. 9 Beringer, Gabriel. 1779. "Rath Cruaghan or Croghan, County of Roscommon." Royal Irish Academy.

Beginning in the 1980s, archaeological investigations at Rathcroghan have been led by Dr. John Waddell at the University of Galway. The investigative plan has been principally facilitated using geophysical methodology rather than large-scale excavation seen at Knockaulin and Navan Fort. These schemes of geophysical fieldwork have resulted in a clearer understanding of the development of construction phases as it specifically relates to the Rathcroghan mound. However, excavation is needed to assess the nature of these phases and determine chronology. The lack of excavation within the Rathcroghan complex is due in part to the nature of private ownership of the complex. Because much of the archaeological complex continues to serve as private grazing land, the disruption of grazing areas which would result from excavation has hindered the opportunity

for the ground truthing of the geophysical results. Further, the local community has expressed a desire to preserve the archaeological record associated with Rathcroghan as archaeological methodologies continue to improve and gain nuance. Despite the lack of excavation at Rathcroghan, the importance of the complex within the broader Connacht landscape, and indeed within a wider Irish context, has been revealed through programs of near-surface archaeological survey.

3.5 Toghers of Western Ireland

Toghers are an Irish monument class used to describe late prehistoric roadways. The term is the anglicized form of the Irish word *tóchar* which loosely translates to ‘causeway’ (Lucas 1985). These constructed trackways are found in peatland contexts and have, in some cases, been interpreted as evidence of movement into and through wetlands (O’Sullivan 2007). “Togher” also occurs as a place name throughout Ireland, often found in the west, for example, Togher, Co. Galway. This likely indicates the archaeological proximity of these towns to causeways in prehistory. The construction of toghers varies throughout the country. Rather than a consistent method and pattern of construction and usage, toghers appear to have been constructed and utilized for a variety of purposes to serve the needs of the local community.

The most widely known example of an Iron Age togher is the Corlea trackway complex in County Longford, just outside the village of Keenagh. The distribution of the Corlea trackway complex is shown in Figure 10. This trackway series was uncovered in a bog owned by Bord Na Móna in the 1980s during peat harvesting projects. Excavation and analysis by Barry Raftery in 1984 determined that the principal trackway dates to the Late Iron Age (c 148 BCE) and would

have extended nearly a kilometer, connecting to areas of dry land.

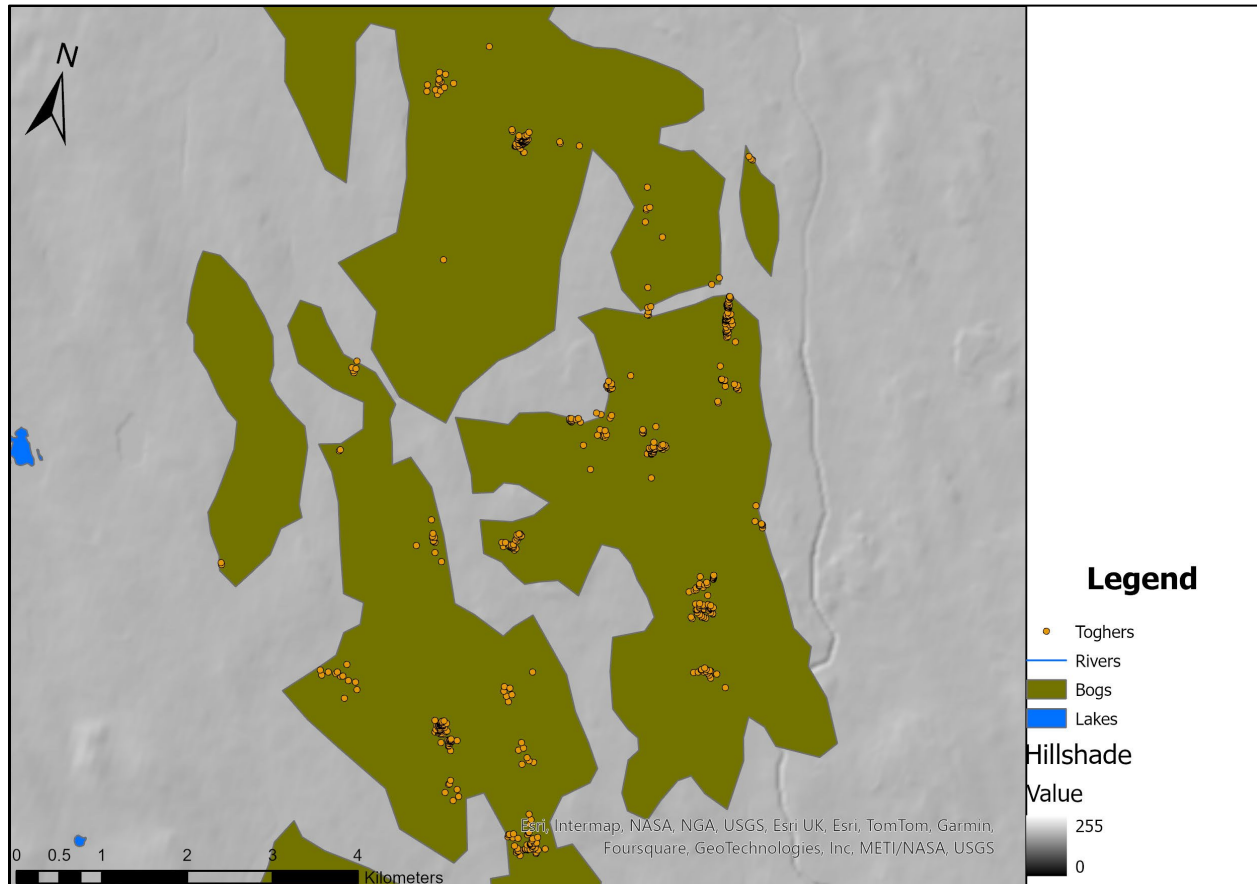


Fig. 10 Corlea and Derryoghill togher complexes, Co. Longford

The prime feature of this trackway complex, Corlea 1, is notable for a variety of reasons. While togher construction is varied, Corlea 1 is particularly unique. This trackway is built using a split-timber construction, known as corduroy. In this method, the split-log planks are laid atop a brush layer and tacked into place. In the case of Corlea 1, the timber is solely oak, another unique factor. Oak is believed to have been a socially significant tree in prehistoric Ireland (Waddell 2018), meaning that the oak construction of Corlea 1 represents a huge investment of not only labor, but social resources as well. Corlea 1 underwent stabilization and preservation measures

after its excavation and is housed in a museum located in the exact place that the togher was lifted from. Figure 11 depicts Corlea 1 as it is seen today.



Fig. 11 Corlea 1 Trackway in its present reconstructed setting. Photo by the author, 2023

Further complicating the archaeological understanding of the Corlea 1 togher is the short period during which it was usable. Corlea 1 sat above the bog's surface for a limited amount of time, perhaps no more than a decade before it was allowed to sink into the peat (Pryor 2003: 386). Further excavations of the Corlea and Derryoghil bogs have uncovered a number of additional trackways, also from the Iron Age, creating a complex and interrelated story of access to these bogs. Investigations of the Edercloon wetland, also of County Longford, in association with the construction of the N4 Dromod-Roosky Bypass, have indicated that the Early Iron Age was a

period of intensive togher construction (Moore 2021: 60). The Edercloon toghers were uncovered in short segments during archaeological testing in 2006. These togher segments appear to have been rebuilt and repaired throughout their use, resulting in deposits of up to 1m in depth (*ibid*: 60). The depth and complexity of the Edercloon toghers demonstrate the importance of peatland travel in later prehistory. Togher complexes may not simply have served as a means of crossing unstable and dangerous boglands, but also as a series of access points into the bog for the purpose of ritual or economic activity (O’Sullivan 2007: 175; Raftery 1987). The desire to get into the bog, reflected in these trackway constructions is a significant clue to understanding the socio-economic role of boglands in the context of organization in Iron Age society, and a reconsideration of the relationship between economic and social aspects of Iron Age life may be needed.

An important point to consider is the role of preservation in the archaeological interpretation of toghers. As a rule, preservation of organic materials is significantly better in wetland contexts than elsewhere, meaning that the potential for similar organic construction in dryland contexts is present. However, the wetland contexts of these roadways indicates that this is not the result of preservation bias issues, but rather the result of intentional targeting of peatland environments by prehistoric communities.

4.0 Analysis of Archaeological and Geographical Spatial Data

4.1 Data Sources

This chapter presents the methodology and results of a GIS analysis of archaeological data in the hinterland of Rathcroghan, one of four major royal sites in Ireland. The aim of this analysis was to create seasonal models of least cost paths of movement which may have been utilized by diffuse communities practicing multi-resource pastoralism. Through the modeling of least cost paths into Rathcroghan, and the comparative analysis of these with cultural features of movement, such as fords, roadways, and toghers, mobility within the Iron Age landscape may be explored.

The National Monuments Service of Ireland, a branch of the Department of Housing, Local Government, and Heritage, maintains an online GIS database which holds data for all known archaeological sites in Ireland (Historic Environment Viewer). This database, known as the Historic Environment Viewer, is the result of decades of changing archaeological methodologies and data collection from both research investigations and Cultural Resource Management projects. The data made publicly available through the Historic Environment Viewer makes up the foundation for the archaeological and geospatial analysis discussed in this chapter. Two datasets are available, the Sites and Monuments Record (SMR) and the National Inventory of Architectural Heritage (NIAH). Due to the prehistoric nature of this analysis, the NIAH was not queried. A bulk download of the SMR was the simplest way to obtain archaeological data. This was then cut to remove all data outside the general Connacht region, this was later cut again to include only those points within the radius=50km hinterland zone of Rathcroghan. This initial download also included site data which had no relevance to this analysis, as it was either from a significantly

earlier or later period, these were queried and removed from the dataset. Due to the variety in data collection methods, there is a degree of variability of information available for each data point, however while this variability was an issue in the sorting of data, it posed no issue to the analysis itself. It is worth noting that many of the points accessed for archaeological roadways do not have associated dates. In some cases, a general chronological period was present with associated data points, found in a field titled 'web_notes', but often this was not present. Based on the available information, these points were removed to avoid the usage of roadways which clearly date to the early modern or modern eras.

The environmental data required for this analysis was obtained from a variety of sources. A 25m digital elevation model, the EU-DEM, was accessed and downloaded through the European Union's Copernicus Land Monitoring Service. As of January 2024, however, Copernicus Land Monitoring Service no longer maintains the EU-DEM, and it is instead available through the European Environment Agency's Datahub. Only a section of this DEM was accessed, eu_dem_v11_E30N30, and this was further clipped to the radius=50km hinterland using Esri's ArcGIS Pro Clip Raster tool. Environmental data, including peatlands, fens, mires, natural grasslands, and ancient/long established woodland, were accessed through Ireland's National Parks and Wildlife Service's article 17 'Habitats' data sets (<https://www.npws.ie/maps-and-data/habitat-and-species-data/article-17>). I augmented these features, especially peatlands, by tracing Google Earth imagery to incorporate wetlands which are not under the protection of the Parks and Wildlife service. Lake and River vector data were accessed and downloaded from the Environmental Protection Agency of Ireland's GeoPortal (<https://gis.epa.ie/>). River data was cut to only include the River Shannon and the River Suck, the two largest river bodies in the hinterland zone of this analysis.

These data reflect modern environmental conditions, and therefore they do not necessarily reflect Iron Age landscapes. Water management programs have resulted in changes to the historic course of rivers, though these changes may be small in scale. However, peatland environments have seen large-scale changes in the industrial age as the result not only of industrial harvest, but also the reclamation of land for agricultural purposes. Concerns over the extinction of these environmental niches has led to the development of management policies such as the National Peatlands Strategy (implemented in 2015). Thus, peatland in Connacht covered significantly more ground throughout prehistory and into the historic period than in the modern, industrial era. This change would result in an increased effect on movement and mobility than what can be modeled in this analysis.

Seasonality, especially increases in rainfall, plays a significant role in the shaping of the landscape of Ireland. During these periods, the increase of water in peatland environments can create instability, leading to landslide events, known as bog bursts, where peat layers become detached and move. These events can have detrimental environmental impacts, and the damage associated with bog bursts can significantly damage infrastructure. These impacts would have been no less detrimental during the Iron Age, and it is possible that the potential risk of loss of livestock wealth, coupled with the logistical difficulty of managing herd animals in an unstable peat environment, led Iron Age people to avoid bogs. Rivers, too, are impacted by seasonal fluctuations in rainfall. Flooding of the Shannon has become a significant problem in the modern era. The low-lying lands which flank the river are quickly inundated in the aftermath of storms, and the threat to infrastructure continues to be a problem (O'Brien 2023). These flooding incidents have become increasingly more severe in recent years as once-in-a-generation weather events become more common. However, the seasonal ebb and flow of the river and the large flooding events which

might come with anomalous weather would certainly have been part of the cycle of the landscape in prehistory. The wet / dry analysis here may help illuminate some of this variation, but it is possible that during extreme flooding events the river became entirely impassable. That is not modeled in this analysis.

4.2 Methodology

The goal of the GIS analysis is to understand the organization of social and political structures of the Iron Age through the movement of pastoralist communities within the Rathcroghan hinterland through a multi-scalar lens. Two scales were utilized in this investigation: “local” (radius=25km), chosen for the average distance that a community group can travel in a single day (Tobler 1993); and a regional (radius=50km). The smaller local scale represents the community of people who might have dwelled year-round in the locality of Rathcroghan and their movement in relation to this landscape anchor. The regional scale encompasses the communities which did not permanently dwell in the Rathcroghan locality but instead moved into and out of the hinterland seasonally, perhaps as part of an annual cycle of ritual activities. Considering the significance of Rathcroghan and the nature of mobility which pastoral Iron Age populations appear to have practiced, the utilization of a multi-scalar framework is a logical method of analysis, which allows for the contrasting of local community movement and the seasonal draw of further dispersed populations for ritual activity.

The analysis for this project utilized Esri’s ArcGIS Pro 3.2.2. Initially, the analysis of archaeological and spatial data began with general exploration. Visual patterns were noted and explored in the context of local environmental factors. Chief among these observations was the

interplay of togher locations and dryland road and trackways. The clustering and general isolation of toghers within the peatlands of the eastern sector of the hinterland zone creates a contrast with the north-south patterning of dryland roads and trackways (see Figure 12). This pattern may partly be the result of limited peatland excavations which are largely conducted only when industrial projects uncover archaeological material.

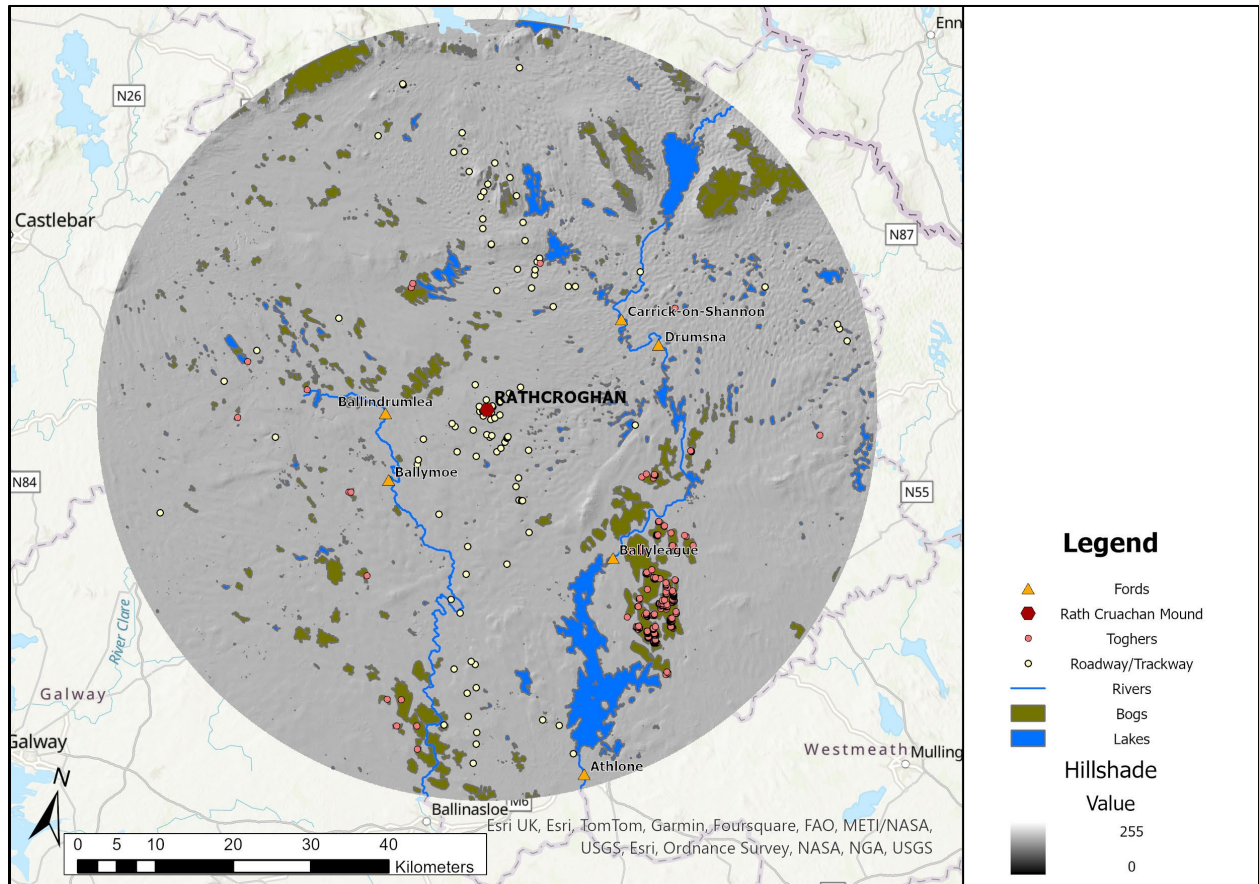


Fig. 12 Distribution of boglands, roadways, and toghers within the Rathcroghan Hinterland. This figure demonstrates the north-south patterning of dryland roadways which are generally hemmed in by the Rivers Shannon and Suck.

The next stage of analysis involved the creation of least cost paths from local and middle scale areas to Rathcroghan. As the movement of kin groups from the middle scale to Rathcroghan is hypothesized to have been based around periodic and potentially seasonal ritual activity, cost

path analyses were created for both wet conditions and dry conditions. Given the nature of Ireland's climate, wet and dry conditions are intended to represent years or extended periods of drought or increased rainfall rather than individual seasons within a single annual cycle. Landscape features, such as rivers and bogs, were incorporated into cost surfaces using different parameters which reflected the higher cost of movement during wet years than during drought.

Fundamental to the assessment of mobility was the assigning of cost values to landscape features. For dry land, I relied on Tobler's hiking function (1993), which states that a human can hike over flat terrain at a rate of 5 km/hr and gives a range of increased costs for movement over sloping land. River crossings and bogs would be more costly to traverse than dry land. Soule and Goldman (1972), using experimental methods, determined that movement in swamp environments is 1.8 times more difficult than dry land. Howey (2007) suggests that the movement cost in wetlands is slightly higher, presenting a coefficient of 2.3 times costs for dry land. For this analysis, I assigned peatland environments a value of 2 times more costly during periods of drought and 3 times more costly during periods of heavy rainfall, when peat sits below the water table.

While rivers could have been considered uncrossable except at fording locations, I chose not to take this approach for a few reasons. Firstly, the relatively shallow profile of both the River Shannon and the River Suck would realistically not pose a complete barrier to crossing except, perhaps, under anomalous conditions. Secondly, seasonal cattle drives across the Shannon are not uncommon in the modern era (Condren 2023), suggesting that this method of livestock movement may have been used to cross the river in the past, perhaps as far back as late prehistory. Rivers had been downloaded as line features and needed to be assigned a width for this analysis. I used the Buffer tool to create a 50m buffer around the river feature (resulting in a total river width of 100 m). While the width of rivers is not static, the use of Google Earth Pro imagery confirmed that

this width is generally representative of the River Shannon. An additional buffer of radius 100m was used to represent wet conditions (for a total river width of 200 m). To assign cost values to the two major rivers of the project area, the Shannon and the Suck, I initially used the average swim velocity of 2km/hr, which would yield a coefficient of 2.5 times the cost of flat dry land (at 5 km/hr). However, both of these rivers are relatively shallow, and this analysis is investigating the movement of pastoral communities and herds of livestock. For these reasons, I chose to raise the cost of movement across the Shannon and Suck to be 3 times the cost of dry land in periods of drought. The seasonal flooding of the river Shannon has grown more pronounced in the modern era, but the low-lying regions which flank the river undoubtedly experienced flooding during prehistory. After reviewing footage of the nature of modern flooding events, I chose to create an additional, wider river zone for wet years, and keep the cost value 3. These cost values were input in a new field created in the feature class of bogs and rivers.

I incorporated river crossings (fords) into the analysis, based on current towns which sit along the River Shannon and River Suck and have historically managed crossings of these river bodies. Six sites were selected: Ballymoe, Ballindrumlea, Carrick-on-Shannon, Drumsna, and Athlone. The spatial location and relationship of these is seen in Figure 13.

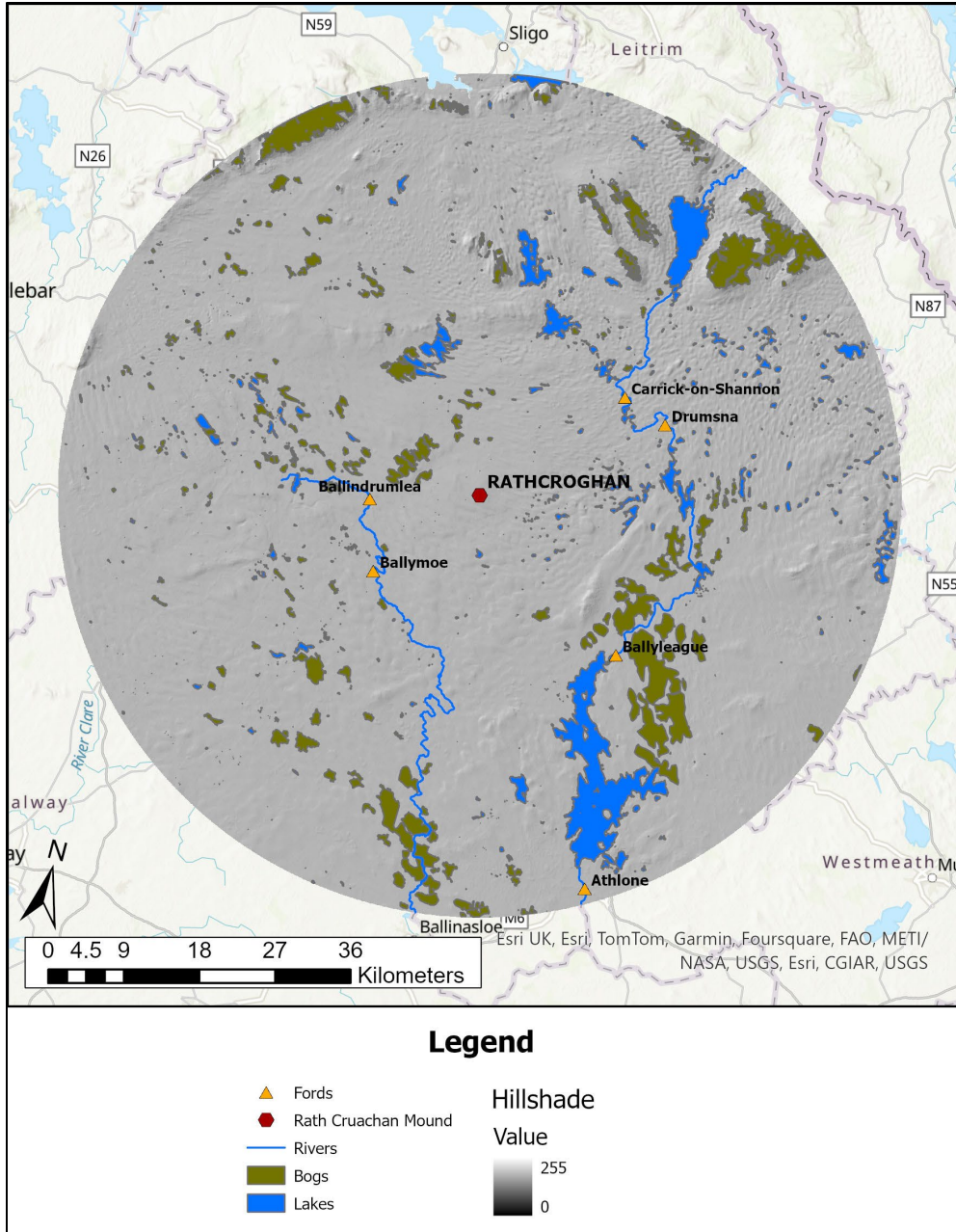


Fig. 13 Fording locations utilized in analysis

To create ford sites, I created a new feature class which crossed the river perpendicularly at the sites of fording. Buffers of $r=25m$ were made around ford lines (creating a 50m-wide ford), and the 50m and 100m river buffer was clipped at the intersection points.

These vector river and peatland layers were then converted to rasters using the Feature to Raster tool. Cell size for the conversion to rasters was set at 20 to prevent the software from

generating paths that cross rivers diagonally between cells. The two rasters were reclassified to create a cost surface and multiplied using Raster Calculator to create cost surfaces which utilized cost values for both rivers and bogs. Using these procedures, one cost surface was created for dry conditions, and one for wet conditions.

These cost surfaces were then input into the Distance Accumulation tool in ArcGIS Pro. Distance Accumulation calculates the cumulative cost of travel from each cell to or from a selected location (“source”) along the most efficient (least costly) route. For this analysis, Rathcroghan mound was selected as the source, and movement was set ‘to source’ to ensure that cost was calculated in the right direction. Lake polygons were input as impenetrable “barriers” to movement, and the clipped EU-DEM was selected as the surface raster to model movement over sloping terrain. For each seasonal condition, wet and dry, the cost surface raster corresponding to that seasonal condition was included in the tool, which multiplied cell costs at rivers and bogs by the appropriate coefficient. A back link raster was generated to ensure that cost distance paths could be drawn. The EU-DEM was put in as the vertical raster, and the vertical factor was set to Table to refer to a table of travel times for different slopes based on the Tobler Hiking function. Given the high resolution of this raster, the processing extent was limited to the regional hinterland zone. From these distance accumulation rasters, least cost paths could be modeled to Rathcroghan from hypothetical origin points, discussed below.

Due to the ephemeral evidence for Iron Age sites of habitation, particularly for the early Iron Age period, few locations of habitation are known within the Rathcroghan hinterland landscape. This analysis was conducted under the assumption that local pastoral kin-groups were living and herding in the vicinity of Rathcroghan diffusely across the landscape, so the creation of random points served as proxies for community units. To create random points within the

Rathcroghan hinterland, the tool Create Random Points was utilized. This tool generates a set number of points based on provided parameters. Two scales of points were created, mirroring each scale of the hinterland. The minimum distance between these points was set to 5km. After the removal of points which were placed in lakes, the local scale proxy included 53 points, and the regional scale included 66 points. These diffuse, random points served as the origin points for the cost path analysis which seeks to characterize potential routes of movement into Rathcroghan.

The final technical step in this analysis, the creation of cost distance paths, was carried out using the Optimal Path as Line tool. This spatial analysis tool calculates the least costly route of movement between a source and a destination and draws this path as a line feature. Four path outputs were created with this tool, one at each scale for each seasonal condition.

4.3 Results

Both wet and dry cost surfaces result in modeled paths that carefully avoid peatland environments, either through navigating around them or through taking the quickest path of exit. While this aligns with the goals of a cost distance analysis, it differs from archaeological evidence for movement in bogland contexts. The fragments of recovered wetland toghers which date to the Irish Iron Age represent the construction and maintenance of infrastructure into and through peatlands. While the extent of their utilization is somewhat unclear due to the happenstance nature of discovery, there is no doubt that Iron Age populations were moving in bogland contexts. Further, as previously discussed, peat is highly changeable. The avoidance of bogs may be a tactic utilized

depending on the environmental conditions or on a case-by-case basis based on the presence of toghers.

4.3.1 Dry Period Paths

Regional paths modeled through this GIS analysis for dry periods manage cost through the navigation around peat bog environments. Some convergence of paths was observed in this model, shown in Figure 14. These ‘highways’ of movement created by the convergence of modeled paths emerge with increasing proximity to the royal site, perhaps partly as a result of the increase in elevation of the Rathcroghan plateau.

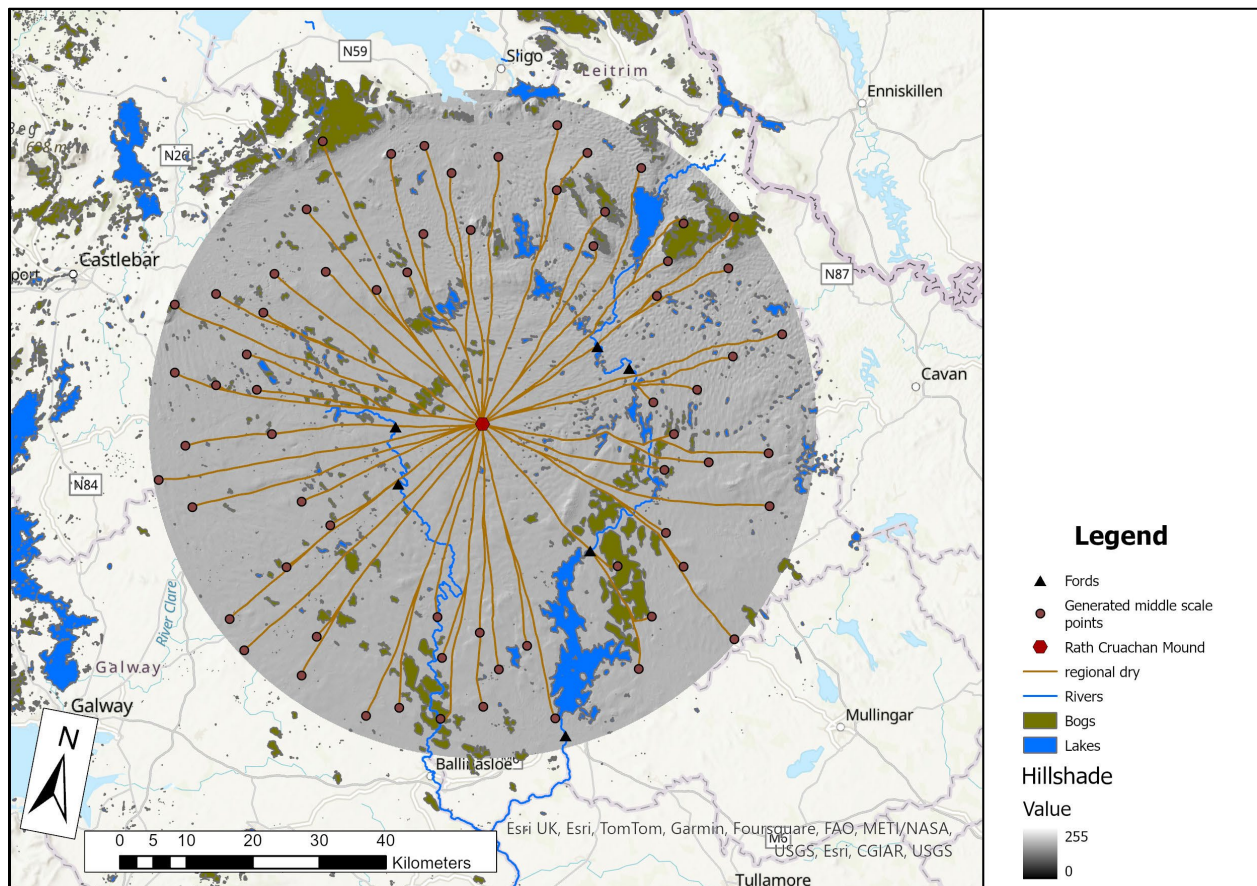


Fig. 14 Dry period regional scale paths within radius=50km hinterland

These convergent routeways demonstrate some alignment with known points for historic roadways, seen in Figure 15, suggesting that, in proximity to Rathcroghan, cost effective routes were utilized.

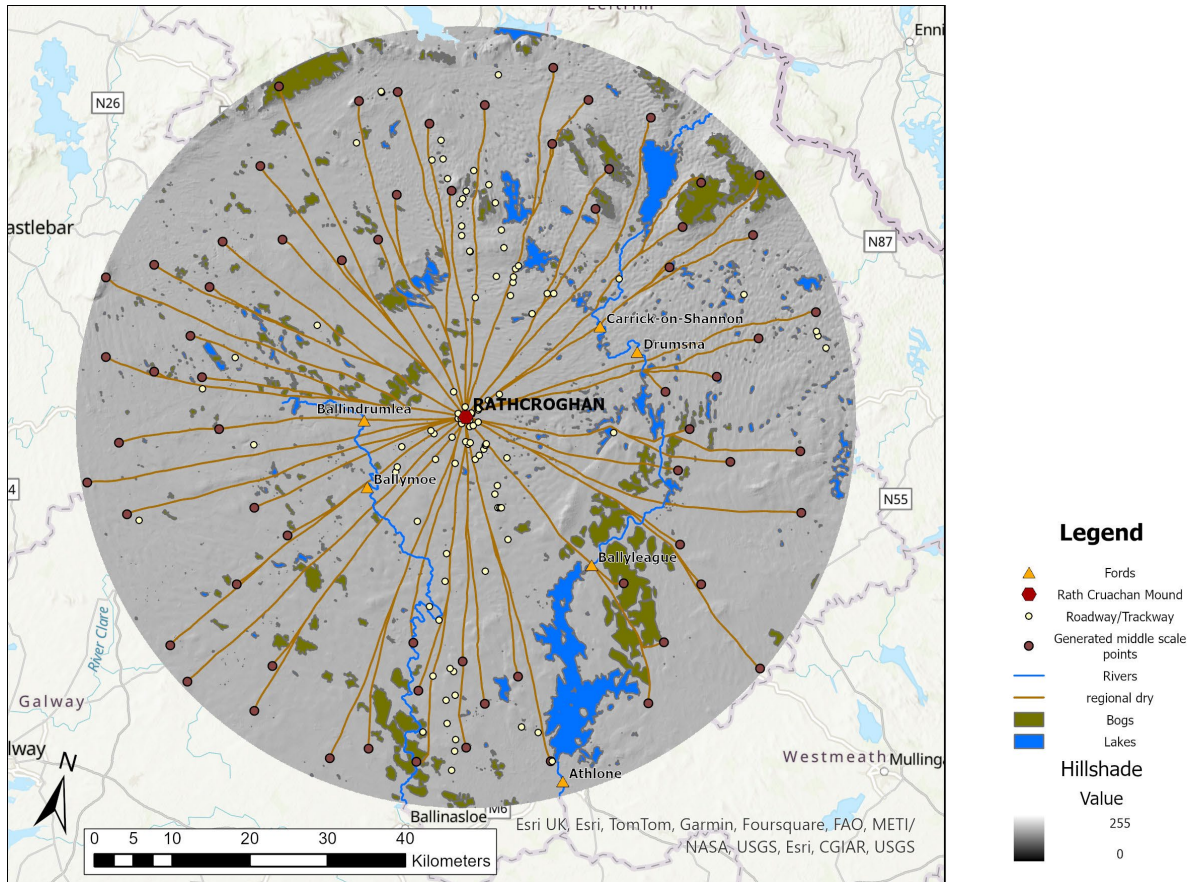
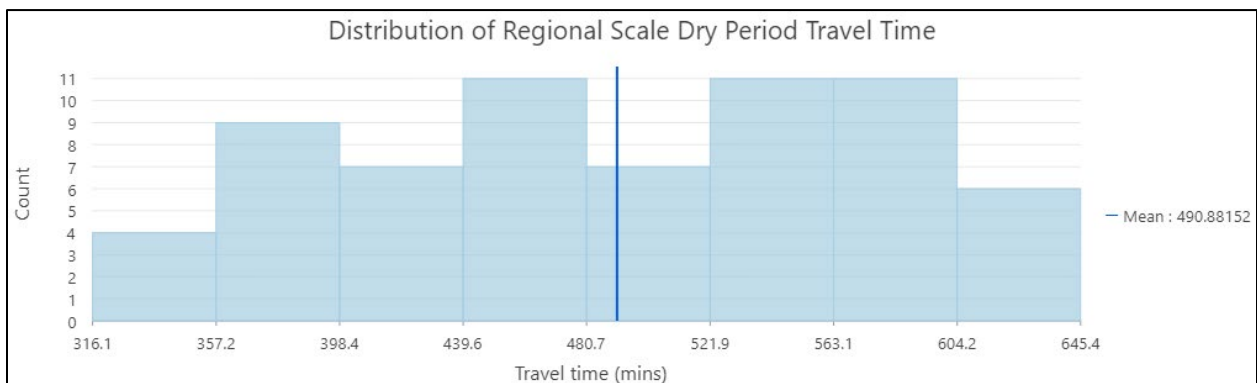


Fig. 15 Dry period regional scale path alignment with known roadways

The use of ford sites by these regional dry-period pathways was limited. For most paths, it seems that navigation out of the way to cross the river at a fording site was more costly than crossing at the nearest bank. Here, the limits of the GIS analysis and agency of past communities become clear. Navigating a river crossing with herd animals would be significantly more difficult in unknown locations, where the dangers of the river are not as familiar. Therefore, traveling out of the direct way to a ford may have been worth it in ways that are not adequately captured by the cost values assigned in this analysis. If people were travelling without herds, they might be more

likely to attempt a crossing at a location which would not put them further out of their way. However, it is likely that fording sites continued to draw travelers seeking to cross the river due to the knowledge of landscape held by individuals. As previously mentioned, the River Shannon, while relatively shallow, is still a large river. Movement across it would still have posed a significant hinderance to travel on foot. The associated cost of this long-distance movement is clear in the travel time. The average travel time for regional, dry period pathways was 490.88 mins, or 8.18 hrs., demonstrated by Table 3 below. These travel times do not account for movement with herds of livestock, and it is likely that herds would increase travel time.

Table 3 Travel Time Distribution (in minutes) for regional scale dry period modeled pathways



Local ($r=25\text{km}$) paths during dry periods largely follow the same, or similar, highway routes as the regional scale paths as they near the Rathcroghan complex, shown by Figure 16.

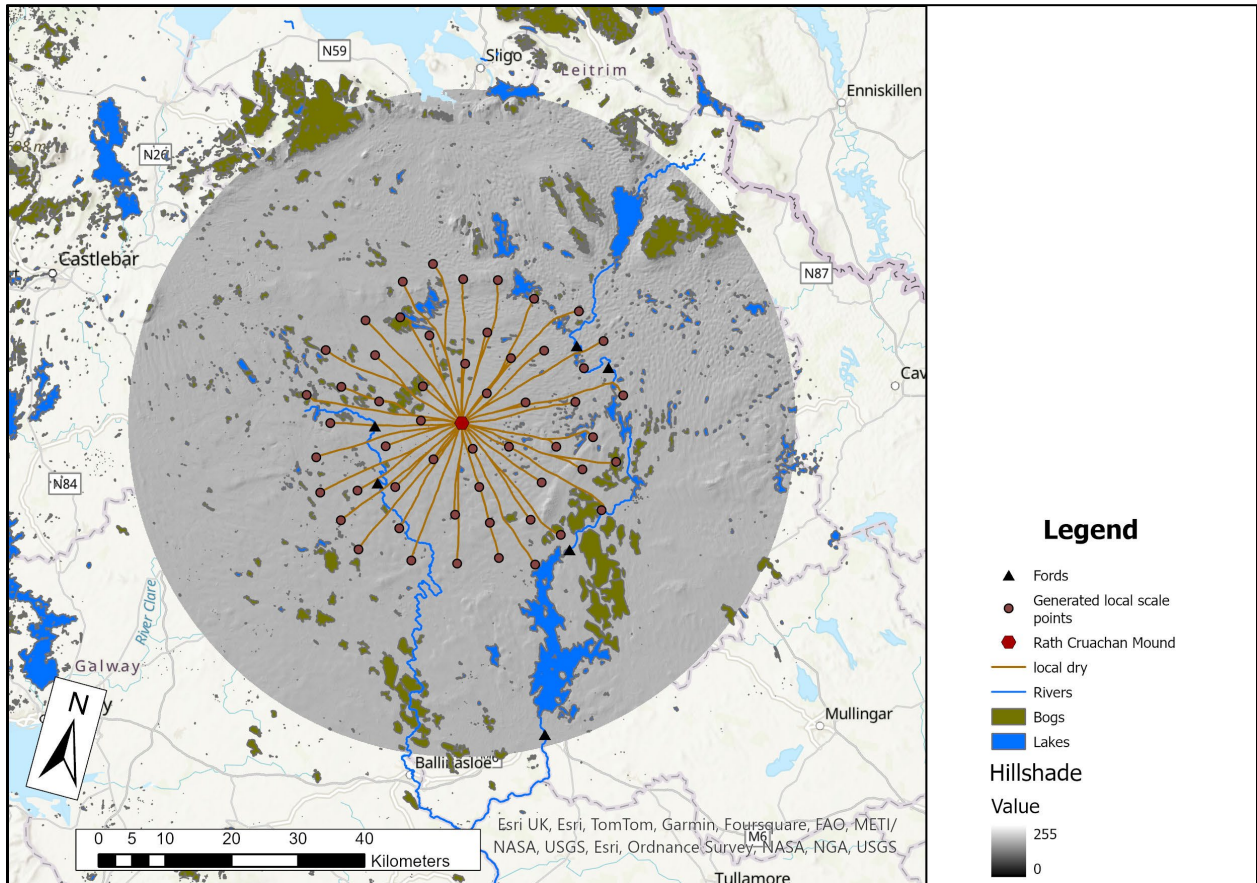


Fig. 16 Dry period local scale paths within Rathcroghan hinterland

These, too, exhibit some similarity in placement with known roadways, demonstrated by the spatial alignments in Figure 17.

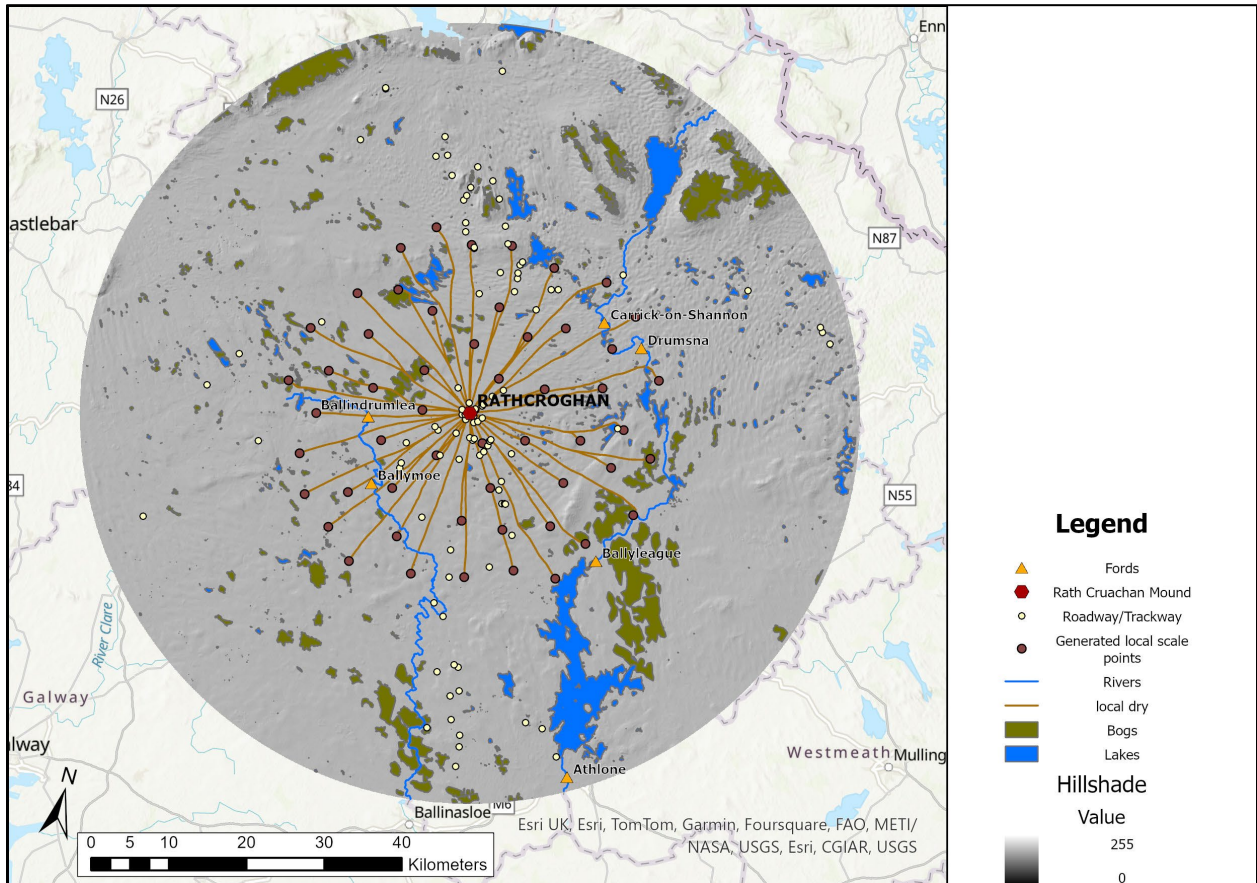
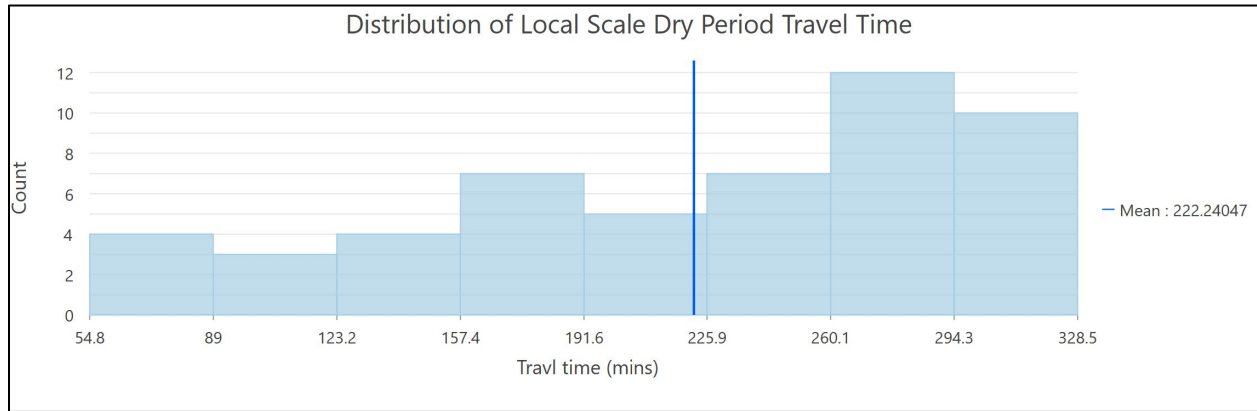


Fig. 17 Dry period local scale path alignment with known roadways

This lack of variation between the two scales is not unexpected. The proximity of these paths to the destination of movement decreases the hinderances facing travelers. Most local paths do not have to cross either the River Suck or the River Shannon, and those which do cross these rivers do not demonstrate preferential utilization of fords. It may be that at this local scale, the danger posed by rivers in the navigation of landscape is lesser, as is the need to cross them.

Associated with this, the mean travel time for generated paths in this model was 222.24 mins, or 3.70 hrs. The distribution of travel time, in minutes, is included in Table 4 below.

Table 4 Travel Time Distribution (in minutes) for local scale dry period modeled pathways



4.3.2 Wet Period Paths

In contrast with the paths of dry periods, the model of routes of movement during wet periods demonstrates much more out-of-the-way travel to reach fording locations, demonstrated by figure 18, below. The increased hindrance posed by rivers in this model incentivizes such movement to save the cost of crossing at the nearest bank. Each of the fording locations in this analysis, except one, were utilized by cost paths. The one that did not see any use, Ballymoe, was likely avoided due to the morphology of the River Suck. Ballymoe sits in an S-curve of the river along the border of Counties Roscommon and Galway. The avoidance of this ford is due to the assessment of cost based on the values assigned in this analysis. The S-curve where the Ballymoe ford facilitates river crossing would require individuals to veer sharply to the south-east to avoid a

second crossing approximately 500m away. Rather than participate in this, the model avoided the S-curve entirely, choosing instead to cross the Suck ~1 km to the south.

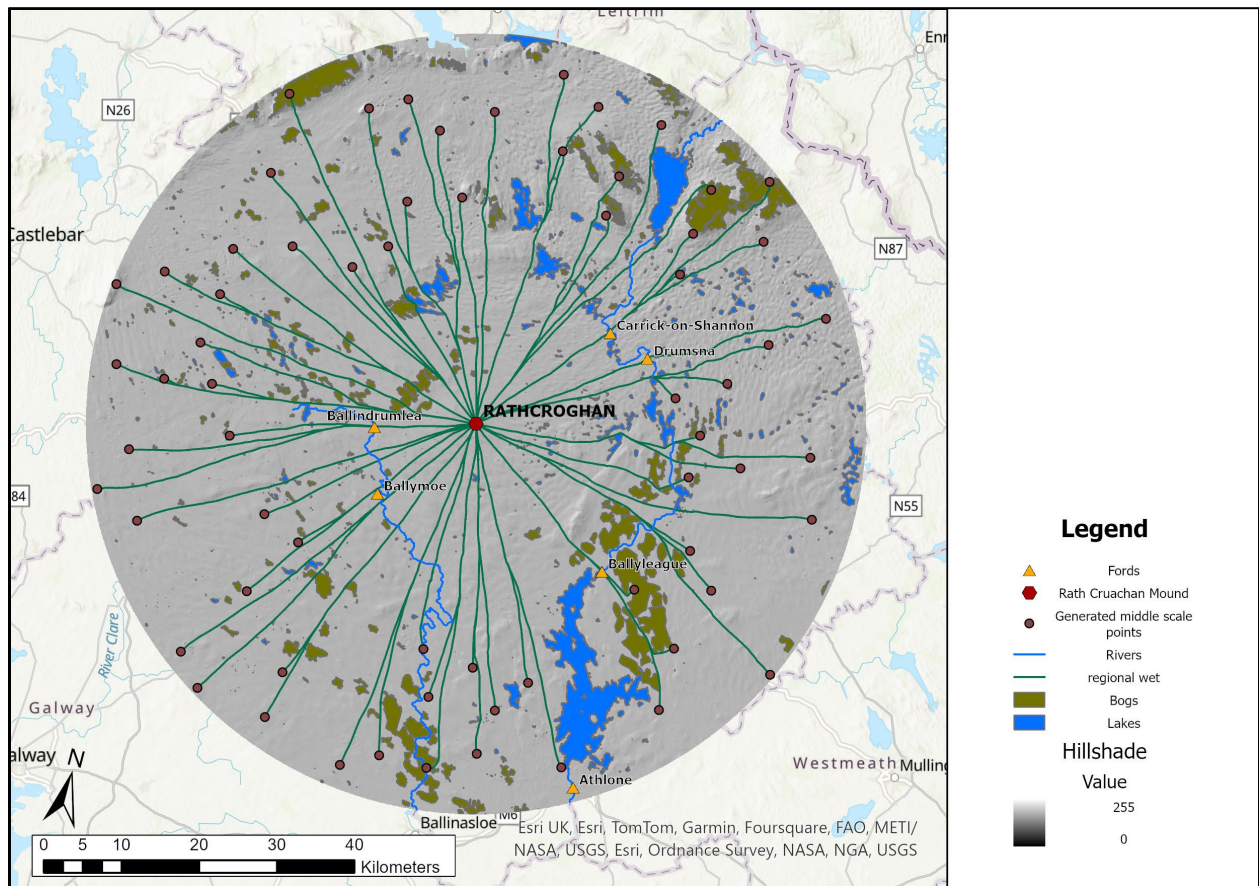


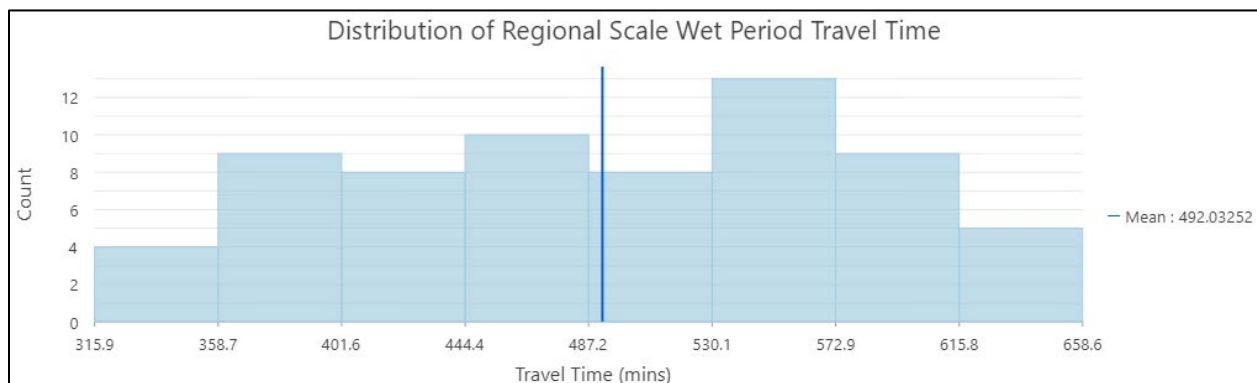
Fig. 18 Wet period regional paths within Rathcroghan Hinterland

Because the River Suck is a smaller river than the Shannon, it may be that real-world conditions mean that the dangers associated with crossing at a non-fording location are lesser. Assuming this to be true, travelers may have chosen not to journey out of the way to reach a designated ford location. This analysis has modeled it at the same cost as the Shannon due to account for movement with livestock. In addition, paths which were already forced to navigate around a lake did not follow this pattern of travel to fords, likely due to the already increased cost of circumnavigation of the impassable barrier. This is particularly clear at Lough Boderg located in the east-northeast of the hinterland region. Here, a few paths must navigate around the eastern

shore of the lake in order to access and cross the River Shannon. They ford the river at the first available location. This might not actually correspond to movements in the past when the River Shannon was in flood. The increased travel up to the ford of Drumsna, a mere 4 km north of Lough Boderg, might outweigh the risk of crossing at the mouth of the lake.

The avoidance of cost-based hinderance can be seen in boglands as well. Regional paths modeled for wet periods move significantly out of the way to limit their exposure to peatlands. This near complete avoidance of bogs reflects the increased cost coefficient assigned to bogs in the wet season model. Given the instability of peatlands in wet periods (e.g., bog bursts), it is reasonable to believe Iron Age people also adopted less direct and more cost-effective paths of movement to avoid bogs. The navigational avoidance of cost is demonstrated by travel times. The average travel time at this regional scale for wet periods is 492.03 mins., or 8.20 hrs., demonstrated by Table 5, below.

Table 5 Travel Time Distribution (in minutes) for regional scale wet period modeled pathways



Local scale paths modeled for wet periods were less affected by the rivers of the hinterland in the movement to Rathcroghan. However, few of the paths that had to cross a river traversed the additional distance to a ford site, choosing instead to limit cost by crossing at the closest point. Local routes were also subject to the cost hinderances posed by peatland. These routes and the costs they are subject to are visualized in Figure 19, below. The travel time associated with this

local scale has a mean travel time of 222.49 mins., or 3.71 hrs. Demonstrated by Table 6 below. This average travel time is only slightly higher than the mean of local scale dry period paths, likely due to the similarity of cost between these two models.

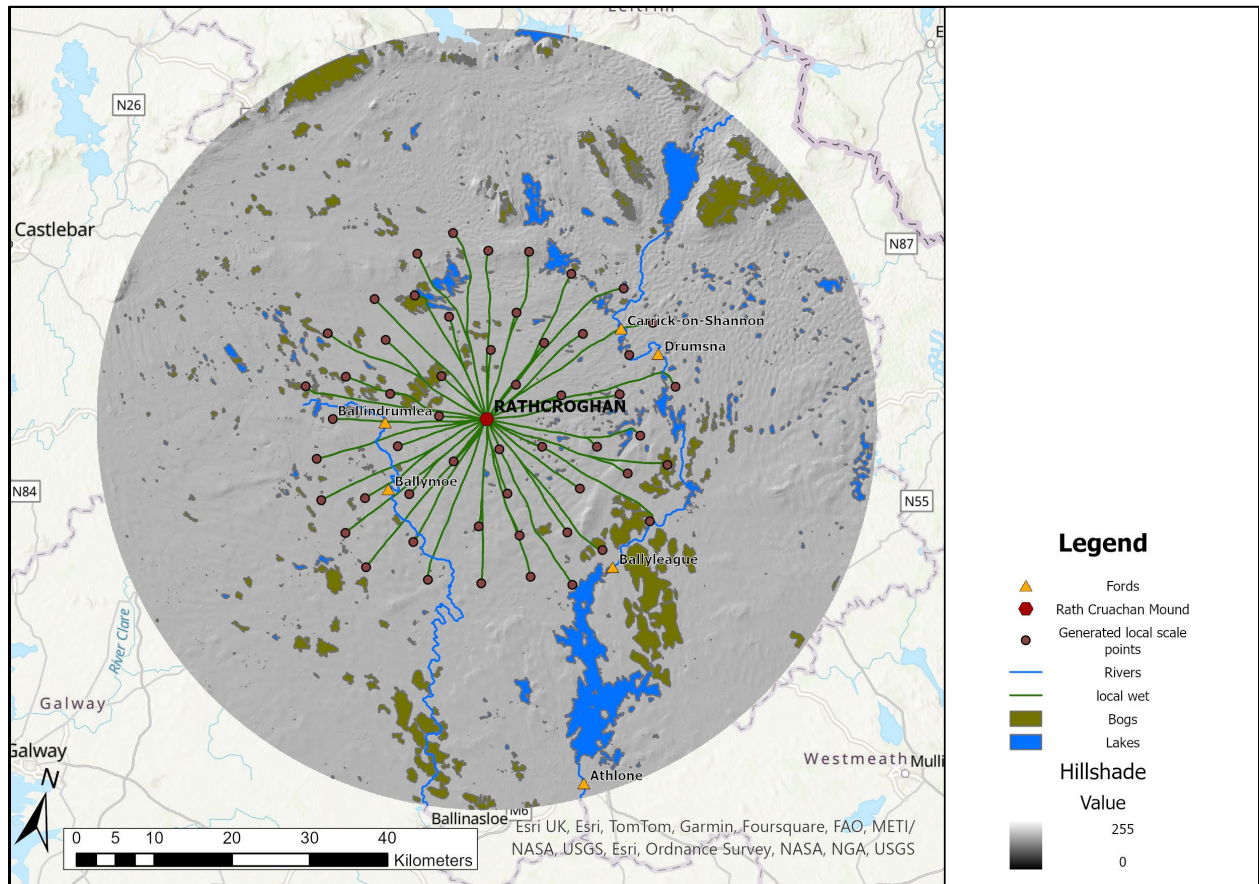
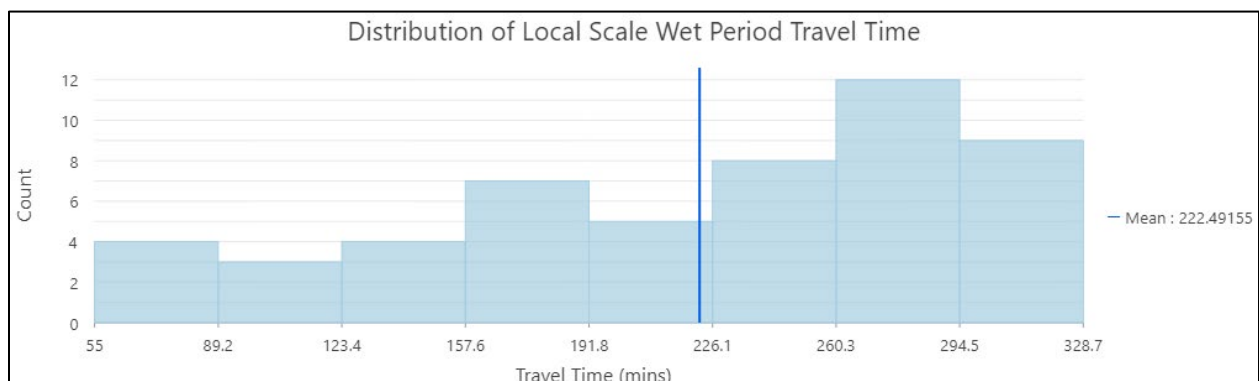


Fig. 19 Wet period local scale paths within the Rathcroghan Hinterland

Table 6 Travel Time Distribution (in minutes) for local scale wet period modeled pathways



Wet season routes of movement avoid peatland at a higher rate than their dry season counterparts. While dry season paths avoid bogs, those of the wet season take what appear to be shorter paths across peatland where their origin point was generated in a bog environment.

Cost-distance paths modeled for multi-annual wet periods also demonstrate alignment with known points for dryland roadways, demonstrated by Figures 20 and 21. However, under wet environmental conditions, further impediments to movement are present (seen in the navigation of boglands and traversing to ford sites). These complicate the alignment pattern. This may be another situation where social behavior and landscape knowledge takes precedence as travelers might have chosen to navigate to dryland roadways as soon as they were free of peatland impediments. Traveling along the roadways represented by the points included in this analysis might have eased cost-based burdens associated with wet environments. But it is also important to consider non-cost related benefits to the use of roads. Roads of many types, including trackways, paved roads, and hollow ways, become part of the network of traditional knowledge specific to culture and landscape. These roadways may be part of the web of persistent places (Schlanger 1992) which made up the hinterland of Rathcroghan during the Early Iron Age.

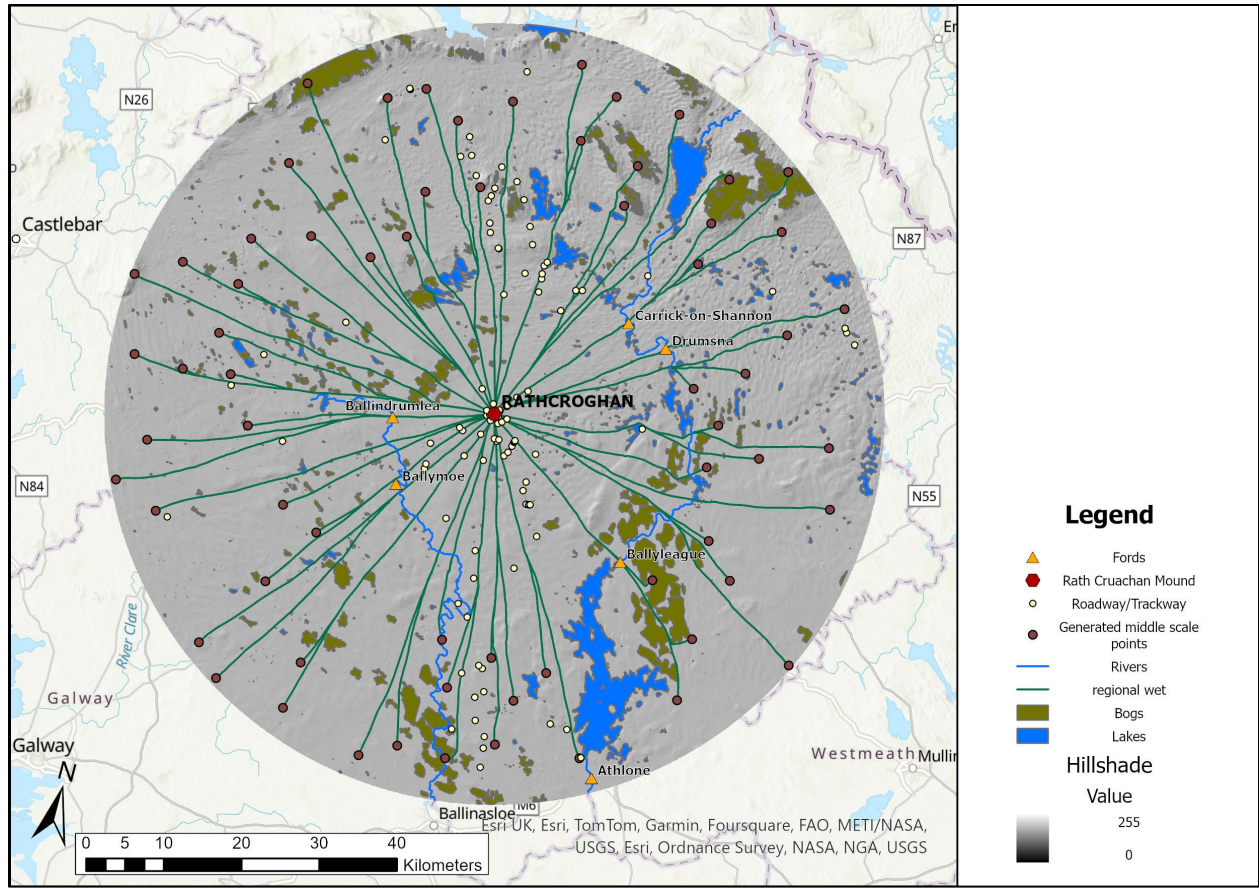


Fig. 20 Wet period regional scale alignment with known roadways

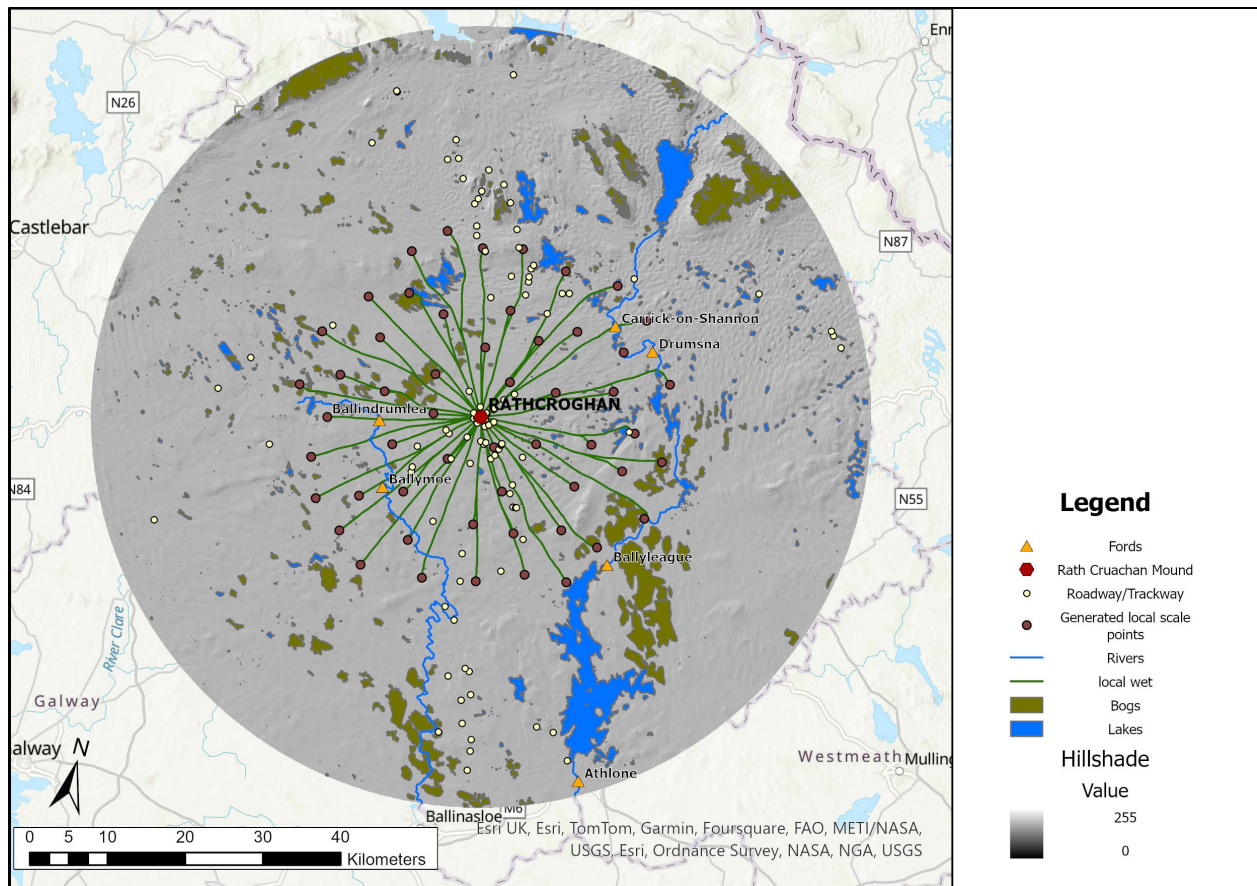


Fig. 21 Wet period local scale alignment with known roadways

The effects of seasonality in the movement to Rathcroghan is best understood through the comparative visualization of paths. Here, Figures 22 and 23 overlay modeled paths in wet and dry seasons at the local and regional scale, respectively. Variation in paths at both scales is apparent through this comparison, and the preferential use of fords during wet periods is also visible. Variations occur primarily in the outer periphery of the hinterland and are resolved to a certain extent with increasing proximity to Rathcroghan. The decisions which informed past movement cannot be fully replicated through the use of GIS modeling; however, the presentation of this analysis allows for the development of an understanding of potential paths of movement which might have been utilized by mobile pastoral communities in the Rathcroghan hinterland. Through the exercise of modeling seasonal movement using cost distance, it becomes clear how much Irish

Iron Age mobile pastoralists must have relied on a detailed cultural landscape knowledge of the location, conditions, and hazards of bogs and rivers.

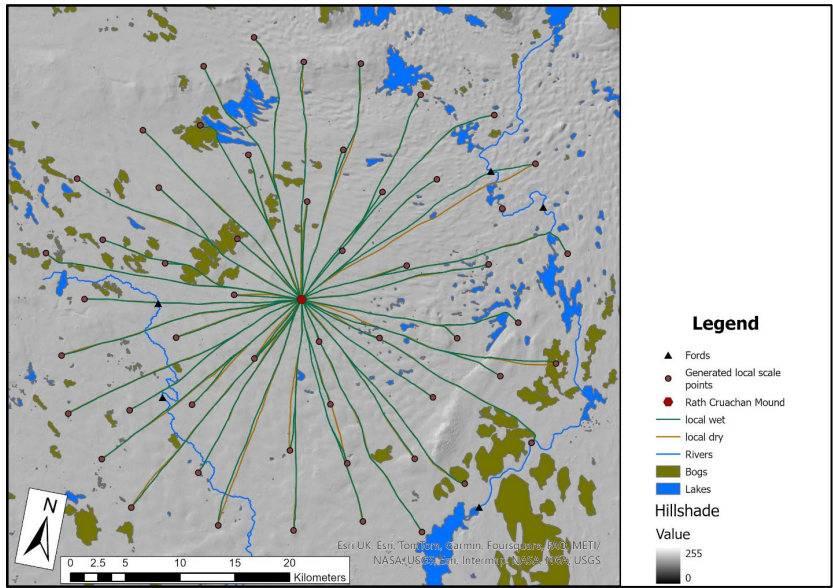


Fig. 22 Local scale comparison of modeled cost distance pathways

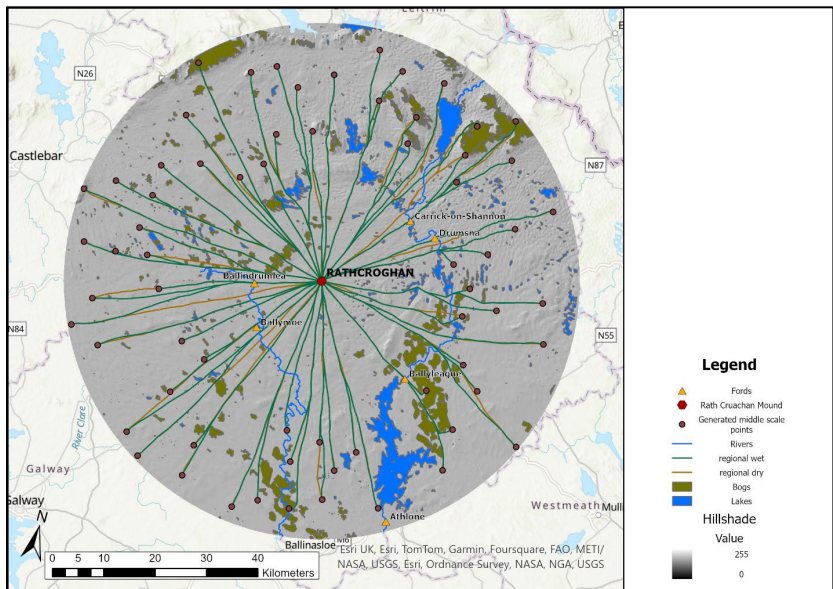


Fig. 23 Regional scale comparison of wet and dry modeled cost distance pathways

5.0 Interpretation and Discussion

5.1 Discussion of Results

Using Rathcroghan as a landscape anchor (Hammer 2014), my analysis investigates the seasonality of movement as both local and regional pastoralist groups were drawn into the Rathcroghan locality for social, economic, and political activities. The paths of movement modeled in the GIS analyses conducted here provide some useful points for the future investigation of a multi-resource pastoralist Iron Age. Through GIS analysis, potential mobility can be analyzed as an optimally efficient strategy minimizing energy expenditure of both human and herd populations. However, the cultural significance of movement and of landscape features, as well as the preference of individuals to follow or avoid certain paths would have played a significant role in the decision-making process of pastoral communities. The comparison between modeled paths and points of known roadways which I have attempted to make as part of this analysis illustrates the influence of culturally specific knowledge and individual preference in movement. This comparison is, admittedly, hindered by the lack of comprehensive dating evidence associated with the historic roadways available from the Historic Environment Viewer. However, assuming that these known roadways, or earlier versions of them, were present and used by Iron Age communities, a comparison of these locations to the pathways modeled in cost distance analysis reveals social factors, such as landscape knowledge, cultural sensibility, and preference. As some data is available for known historic roadways, demonstrated in the figures of chapter three, the importance of cost-efficient movement to the mobile communities can be visualized. Known roadways, toghers, and fords create a picture of movement against which cost-distance models can

be tested. Through this testing, places where cultural evidence of movement do not correspond with least cost efficiency can be seen, and the role which social factors played in the guiding of movement can be conjectured. This difference between cost-efficiency and social routes of movement has been previously illustrated by Supernant's analysis of Métis movement (2017), which demonstrated the importance of social factors in choice of pathways.

The role of culturally specific landscape knowledge is particularly visible as paths of movement interact with the major rivers within the hinterland zone, the Shannon and the Suck. Fording locations for these rivers are well established due to the development of settlements at these crossings. Many of these ford towns were founded during the medieval era, including Athlone. However, it is not a significant stretch to assume that sites which were good for crossing the river during the Medieval era also provided easy fording locations during prehistory. Indeed, in the town of Drumsna, located on the River Shannon, an Iron Age *dún* or fort, has been located (de V. Kane 1915). The name of this town, from the Irish *Droim ar Snámh*, also provides a clue as to the variation of movement associated with crossing the river. *Snámh* is the Irish word for 'swim', and *droim* is a form of the word for 'ridge' (logainm.ie). Together, these words suggest that Drumsna was a location where one could swim in the Shannon, perhaps as a method of crossing the river.

This differs from Athlone, *Baile Átha Luain* in Irish, the name of which breaks into *baile* meaning 'town', *átha* a form of the word meaning 'ford' (logainm.ie), and *luain* meaning 'loin', referring to the tale of the Cattle Raid of Cooley, where the loin of the white bull of Connacht fell into the River Shannon (duchas.ie). In this context, locations with names which include *áth* may indicate a site of formalized and regulated crossing of the river. This Irish word figures prominently across Ireland in the naming of towns which sit in proximity to rivers. In the case of Athlone, the

connection to the major canon of Connacht folklore demonstrates the ordering and tethering of knowledge to the inhabited landscape. The ford town of Athleague, which sits on the River Suck, also bears the name and title *áth*. The second half of Athleague translates from the Irish *liag*, a form of the word for ‘stone’ or ‘pillar’ (logainm.ie). These placenames describe the landscape or landforms associated with the location, a commonality of Irish names. The intrinsic connection between the Irish language and the landscape of Ireland very likely originates in prehistory, creating a connection where language and sociality is organized in land features to the same degree that physical movement is.

The models of movement created in this analysis were especially intended to investigate wet and dry conditions. Due to the general temperate climate of Ireland, these differences are likely the result of years or extended periods of climatic change rather than representing a single annual cycle. These long-term environmental shifts would have certainly informed the ways that people moved in their landscape through the alteration of the landscape. In the models developed here, seasonal effects on movement can be seen in the utilization of designated fords along the River Shannon and Suck. Under modelled dry environmental conditions, cost paths show some utilization of these fording locations, but generally did not navigate to these sites. Rather, cost paths tend to cross rivers at the nearest bank. This decision appears to be the result of the navigation of lake and peatland environments. The higher cost associated with travel around these loci disincentives the additional movement to reach a ford, leading to the lack of gathering at ford sites.

During wet periods, cost distance paths do show a much higher degree of preferential ford use. The increased burden of river crossings during the ‘wet season’ model, created through the widening of river buffers, poses a greater hindrance to movement than navigation out of the way to a ford would. This higher degree of ford use likely reflects reality. Crossing flooded bodies of

water can pose serious risk to safety, and if fords are interpreted as locations where crossings are facilitated, either through some form of infrastructure or through sociocultural knowledge, then the greater safety of crossing at one of these locations would outweigh any increased burden of travel.

There is no evidence to suggest that either the River Shannon or River Suck were impassable except at the ford towns utilized in this analysis. Indeed, it is highly possible that fording locations other than the six selected for this analysis were used by prehistoric communities, and the areas where cost paths of this model crossed rivers may well have served Iron Age pastoralists as sites of fording. However, given the tendency for people and animal communities to continue usage of roads, fords, and other high-traffic features through time, it seems likely that this is an instance where cultural practices and understanding of landscape would take precedence over the energy efficiency modelled in cost distance analysis. Such behavior is difficult to model, partly due to the limitations of available data, but also due to the intangible nature of cultural practice and knowledge organization. These inherently ephemeral social aspects can be inferred on the basis of patterning of features and artifacts within pastoral landscapes. When such patterns are compared to cost distance models, the cultural value of landscape features, social knowledge, and energy efficiency can become clear.

Another pattern of divergence between cost distance paths and archaeological patterning occurs in peatland environments. As previously discussed, these unstable landscape features are inherently at odds with energy-efficient movement. However, excavations within peatlands have demonstrated that these landscape features played an important role in the socio-economic world of Iron Age communities. Thus, boglands are another place where agency and social knowledge is made visible in the landscape. The togher clusters of western County Longford, such as those

of Corlea bog, evidence a network of paths which navigate peatland either for the purposes of movement across the bog or movement into the bog. While the small-scale nature of excavations of toghers has resulted in significant gaps in our understanding of the ways these roadways were utilized, exploitation of peatland resources and ritual deposition of artifacts suggests that bogs held important social and economic value.

The bogs of prehistoric Ireland were doubtless a very different environment than those today. Barry Raftery paints a vivid picture of prehistoric wetlands, describing them as “dangerous, menacing worlds of reeds and rushes with stagnant pools and quaking mosses lying in wait to engulf the unwary traveler... they must have been grim and foreboding places and the lights from combusting bog-gasses were probably a subject of superstitious awe and dread” (Raftery 1994: 98). Despite this, much of the information known about the Irish Iron Age has been retrieved from peatland and lake contexts. The deposition of La Tène style metal work and quern stones along with the human remains illustrates the importance which these features held within the landscape and to the people who occupied it. Further, the construction of toghers suggests that the access of bogs in itself was important. Given the unstable nature of peat, the construction and subsequent maintenance of togher roads would have required significant labor. By including togher data as a comparative test for the potential paths of movement modelled in this analysis, alternative routes, those through peat environments, can be visualized.

This analysis highlights the difficulty of travel to Rathcroghan at the regional scale. The major rivers of the region and the abundant boglands pose significant impedances to movement into the royal center. This is particularly clear during wet periods when such obstacles are at their most costly. Such difficulty requires careful consideration of the effort and landscape knowledge which must have been involved in the periodic gathering of communities from more distant

locations. Due to this, it may be that these gatherings were strategically timed to avoid the worst of Ireland's rainy season. Seasonal associations with Rathcroghan indicate that the monument and wider complex held particular significance around Samhain, the festival of transition from autumn to winter and precursor to modern Halloween. As winter is typically the wettest season in Ireland, the seasonal transition in early November may have been the latest that a large-scale aggregation of people could feasibly occur. Long-distance travel might have already become more costly at this time of year, and the growing darkness and increasing rainfall would create a landscape which was difficult to traverse.

5.2 Applications and Future Research

This thesis, and the analysis of archaeological data associated with it, represent an initial phase of investigation of a potentially pastoral Irish Iron Age. While the scope here is limited to a hinterland of radius=50 km around Rathcroghan Mound, the use of GIS modelling to investigate potential paths of movement in relation to landscape anchors has wider applicability. Little research of this kind has been carried out in investigations of Iron Age Ireland, but through the use of these models, a new method of remote investigation is available. Without comparison to archaeological data and ground truthing of potential paths, these models remain purely theoretical proposals. However, such modelling may be used to inform archaeological investigation. Just as geophysical methods are utilized to inform excavation, so too can GIS models be used to inform geophysical survey. The parameters selected here have been chosen for a variety of reasons, as described in the previous chapter, but these parameters are associated with a degree of uncertainty and are somewhat arbitrary. Boglands might be classified as impassable but for the presence of

toghers, or rivers might be considered uncrossable except at designated fords. These changes would have potentially significant results not only on the models created, but also in the comparison with known archaeological data. Given the ephemerality which has come to define the Irish Iron Age, the utilization of GIS within a lens of landscape archaeology may help to close the gap of the archaeological record.

Further excavation explicitly of the Irish Iron Age is needed to continue to refine our understanding of the role which multi-resource pastoralism may have played in the socioeconomic world of late prehistory. Much of the data associated with the Iron Age has been uncovered during cultural resource management projects, such as those led by the National Roads Authority of Ireland. While these data are collected and published, they do not substitute the need for research programs. The Discovery Programme's Late Iron Age and Roman Ireland (LIARI) project (2014) is an excellent example of this. The LIARI project sought, through multi-method analysis, to investigate political, social, and economic organization in Ireland during the last several centuries of the Iron Age. Similar programs are needed for investigation of the Early Iron Age to assess the socioeconomic and political organization of society as well as land use. The ephemerality of the Iron Age archaeological record should not prevent the use of new techniques in archaeological science from being applied in investigation.

5.3 Conclusion

In the undertaking of this project, I have sought to understand the influence of landscape and wet-dry multi-annual cycles on the movement of Early Irish Iron Age populations within the Rathcroghan hinterland. My assumption that the ephemeral archaeological record represents a shift

in socio-economic organization to a form of multi-resource pastoralism follows the widely discussed proposal for Irish Iron Age socio-economic organization. This proposal stems from a variety of evidence, including the lack of settlement and habitation at the local level, increase in faunal deposits at royal sites, regrowth of woodlands, and construction of complexes of bogland trackway systems.

This project sought to answer the following questions:

1. Based on available geospatial data, how would movement within the Rathcroghan hinterland have been affected by regional rivers and the use of fording locations? How would movement have been affected by lakes, slopes, bogs, and other impediments?
2. How might movement have been affected by wet conditions versus dry conditions, in seasonal or multi-annual fluctuations?
3. Would movement inward or outward from farther areas (e.g., for periodic ceremonial gatherings) result in different routes from local movement inward and outward from Rathcroghan to the nearby hinterland? How long might these journeys have taken?
4. Do these GIS modeled pathways correspond to known historical roadways and toghers in the region of study?

Through GIS analysis, I created models of potential pathways of movement which may have been utilized by Iron Age communities within the hinterland of Rathcroghan mound, an important landscape anchor in the historic province of Connacht. These models of movement are intended to serve as a next step in the archaeological investigation of multi-resource pastoralism

in the Rathcroghan region and may have further application to the other three major royal sites of Ireland: Navan Fort, Knockaulin, and Hill of Tara.

The results from analyses indicate that pastoralist communities deviated from cost distance paths in the interaction with rivers, water bodies, and wetland environments, indicating that the navigation of these landscape features may have played a significant role in the choice of paths utilized by Iron Age pastoralists. By examining the deviation of these models from known points of archaeological data for roadways and wetland toghers, the decisions which went into the management of mobility and livestock herds may be visible. While a degree of this deviation may be due to the parameters utilized in the creation of models, some aspects of past human decisions cannot be modelled by a quantitative analysis. Alignment between cost distance paths and data points for roadways was observed in dry land contexts, indicating that when traveling across dry land local communities may have utilized paths which optimized energy expenditure. However, the movement across bogs and rivers deviates. We do not know for sure that Iron Age people used known fords, but the medieval ford towns utilized in analysis likely have their origins in prehistory due to the consistency with which humans continue to use fords through time. The point at which travelers would deem a ford too great a distance to sidetrack to is difficult to quantify or model. This point would certainly change when traveling with livestock and depending on the mode of transportation available to the traveler and seasonal conditions.

In peatland contexts, too, the cultural value of non-optimal routes of movement becomes clear. Through the archaeological investigations of toghers, it is clear that bogs were locations into which people moved for a variety of purposes. It is not known with what frequency livestock were driven along these constructed roadways. Some, such as Corlea 1 were constructed in ways which might have facilitated movement with wheeled vehicles (Raftery 1994: 104), however, due to the

incidental nature of discovery of toghers, it is not clear how widespread they were in Irish peatlands. Recently, it has been suggested that many toghers may not have been constructed solely for the management of movement across peatlands, but also into them (O'Sullivan 2007: 175). This corroborates Stanley's (2003) argument that the focus of the major routeway-like toghers has caused Iron Age archaeology to treat bogs only as a burden which people must cross rather than also considering what people were doing within bogs (65). The analysis conducted for this project certainly does consider bogs to be a cost burden. However, we also know these environments were socially important locations with which individuals and communities built close relationships. Further, the ability to access and move within bogland environments may have been highly dependent on seasonal and climate shifts.

By accounting for seasonality in this analysis, I seek to create a dynamic model of movement which may reflect the real-world conditions which Iron Age communities may have experienced. Understanding multi-annual fluctuations in the potential environmental conditions of the Rathcroghan hinterland is important to the development of a model for local and regional pastoral mobility. The differences between the 'dry' and 'wet' analyses indicate the changeable nature of cost-based movement. This demonstrates that even if energy efficiency was the primary goal of Iron Age travelers, the specific routes of movement chosen in any instance would require a highly specialized knowledge of the landscape in which that traveler dwelled. Paleoenvironmental data indicate that the Irish Iron Age was a period of increased hydrological activity and temperature downturn, and the 'wet' analysis demonstrates that wet conditions would have had significant impacts on the movement of pastoral communities, both through the increased cost of movement and through the constraint of movement along certain routes. The differences in

conditions presented by the seasonality model should be taken as two potential snapshots of conditions along a spectrum of environmental circumstances.

The multi-scalar nature of the analysis conducted for this study was important for the consideration of differing routes of movement which may have been selected by communities travelling to Rathcroghan on a seasonal or annual basis for ritual and ceremonial activity rather than movement into the complex by local populations who may have been using both social and economic resources within the locality. Utilizing two scales, radius=25 km and radius=50km allowed for the exploration of single-day travel as opposed to multi-day travel. The results indicate that different paths of movement were selected to some extent. However, with increasing proximity to Rathcroghan mound, all travelers were drawn into a few 'highways' which funneled movement to the site. It is not clear at this time if any of these highways align with the funnel-shaped avenue of approach to Rathcroghan Mound detected in geophysical survey by the University of Galway.

These models can continue to be refined in the future through the inclusion of new data and cost parameters, and they will no doubt need to be updated as new Iron Age research is published. However, based on currently available data, these analyses serve as a model of potential Iron Age pastoralist movement in western Ireland. Such modeling has potential applicability throughout Ireland, for example at other royal sites, and is an important step in the characterization of the socio-economic organization during a period when this remains poorly understood.

6.0 Bibliography

- Aldhouse-Green, Miranda. *Bog Bodies Uncovered: Solving Europe's Ancient Mystery*. Thames & Hudson.
- Ashmore, Wendy, & Arthur Bernard Knapp. 1999. Archaeological Landscapes: Constructed, Conceptualized, Ideational. In *Archaeologies of Landscape: Contemporary Perspectives*, edited by Wendy Ashmore and Arthur Bernard Knapp, pp. 1-21. Malden, Massachusetts: Blackwell Inc.
- Armit, Ian, G. T. Swindles, K. Becker, G. Plunkett. 2014. Rapid Climate Change Did Not Cause Population Collapse at the End of the European Bronze Age. *Proceedings of the National Academy of Sciences*.
- Armit, Ian. 2007. Social Landscapes and Identities in the Irish Iron Age. *The Later Iron Age in Britain and Beyond*, edited by Colin Haselgrove and Tom Moore, pp. 130-139. Oxford: Oxbow Books.
- Barrett, John C. 1999. Mythical Landscapes of the British Iron Age. In *Archaeologies of Landscape: Contemporary Perspectives*, edited by Wendy Ashmore and Arthur Bernard Knapp, pp 253-265. Malden, Massachusetts: Blackwell Inc.
- Becker, Katharina. 2019. Irish Iron Age Settlement and Society: Reframing Royal Sites. *Proceedings of the Prehistoric Society* 85: 273-306.
- Becker, Katharina, Ian Armit, and Graeme T. Swindles. 2017. New perspectives on the Irish Iron Age: the impact of NRA development on our understanding of later prehistory. In *Stories of Ireland's Past: Knowledge gained from NRA roads archaeology*. Edited by Michael Stanley, Rónán Swan & Aidan O'Sullivan, pp. 85-100. Transport Infrastructure Ireland. Dublin: Wordwell
- Becker, Katharina, Ian Armit, James Eogan, and Graeme Swindles. 2011. Later prehistoric radiocarbon dates from Ireland: an audit. *The Journal of Irish Archaeology* 20: 19-25.
- Becker, Katharina, John Ó Néill, and Laura O'Flynn. 2008. Iron Age Ireland: Finding an Invisible People. *Final Report to the Heritage Council Project 16365*.
- Becker, Katharina. 2009. Iron Age Ireland—Finding an Invisible People. In *Relics of Old Decency: Festschrift for Barry Raferty: Archaeological Studies in Later Prehistory*. Edited by Gabriel Cooney; Katharina Becker; John; Michael Ryan; and Susanne Sievers, pp. 353-361. Dublin: Wordwell.
- Bradley, Richard. 2000. *An Archaeology of Natural Places*. London: Routledge.

- Brindley, A. L and J. N Lanting. 1998. Radiocarbon Dates for Irish Trackways. *The Journal of Irish Archaeology* 45-67.
- Brück, J. 1999. Ritual and Rationality: Some Problems of Interpretation in European Archaeology. *European Journal of Archaeology* 2(3): 313-334.
- Caseldine, Chris, and Jackie Hatton. 1996. Early Land Clearance and Wooden Trackway Construction in the Third and Fourth Millennia BC at Corlea, Co. Longford. *Biology and Environment: Proceedings of the Royal Irish Academy* 96B (1):11-19.
- Caseldine, Chris, and Benjamin Gearey. 2005. A multiproxy approach to reconstructing surface wetness changes and prehistoric bog bursts in a raised mire system at Derryville Bog, Co. Tipperary, Ireland. *Holocene* 15 (4): 585-601.
- Collis, John. 1996. Celts and Politics. In *Cultural Identity and Archaeology: The Construction of European Communities*. Edited by P. Graves-Brown, Sian Jones, and C.S. Gamble, pp. 167-177.
- Condren, M. 2023. Holiday herd: Cows cross the Shannon for pastures new. *Irish Independent*. Electronic Document. Accessed Nov. 2023.
- Connolly, J., and N. M. Holden. 2013. Mapping peat soils in Ireland: updating the derived Irish peat map. *Irish Geography* 42(3): 343-352.
- Connolly, J., N. M. Holden, and S. M. Ward. 2007. Mapping Peatlands in Ireland using a Rule-Based Methodology and Digital Data. *Soil Science Society of America Journal* 71: 492-499.
- Cotter, Claire. 2012. *The Western Stone Fort Project: Excavations at Dún Aonghasa*. Dublin: Wordwell.
- Crabtree, Pamela, Susan A. Johnston, and Douglas V. Campana. 2009. The Use of Archaeological and Zooarchaeological Data in the Interpretation of Dún Ailinne, an Iron Age Royal Site in Co. Kildare, Ireland. In *Integrating Social and Environmental Archaeologies; Reconsidering Deposition*, edited by James Morris and Mark Maltby, pp. 1-6. BAR Publishing.
- Crabtree, Pamela J. 1990. Zooarchaeology and Complex Societies: Some Uses of Faunal Analysis for the Study of Trade, Social Status, and Ethnicity. *Archaeological Method and Theory* 2:155-205.
- Cribb, Roger. 1991. *Nomads in Archaeology*. Cambridge: Cambridge University Press.
- Crushell, P., A. Connolly, M. Schouten, and F.J.G. Mitchell. 2008. The changing landscape of Clara Bog: The history of an Irish raised bog. *Irish Geography* 41(1): 89-111.
- Cunningham, J. *Conquest and Land in Ireland: The Transplantation to Connacht, 1649-1680*. Melton, Woodbridge, Suffolk: Boydell & Brewer, The Royal Historical Society.

- Curley, David, and Mike McCarthy. 2023. *Rathcroghan: the Guidebook*. 2nd Edition. KPW Print Management. Ballinasloe, Co. Galway: Ireland.
- Darvill. T. 2008. *The Concise Oxford Dictionary of Archaeology*, 2nd Edition. Oxford: Oxford University Press.
- de V. Kane, W.F. 1915. The Dun of Drumsna. A Frontier Fortification between the Kingdoms of Aileagh and Cruaghan. *Proceedings of the Royal Irish Academy: Archaeology, Culture, History, Literature*. 32: 324-332.
- Dolan, Brian. 2014. Beyond Elites: Reassessing Irish Iron Age Society. *Oxford Journal of Archaeology* 33(4): 361-377.
- Dolan, Brian. 2016. Making Iron in the Irish midlands: the social and symbolic role of Iron Age ironworkers. *The Journal of Irish Archaeology* 25: 31-48.
- Dowling, Ger. 2015. Exploring the Hidden Depths of Tara's Hinterland: Geophysical Survey and Landscape Investigations in the Meath-North Dublin Region, Eastern Ireland. *Proceedings of the Prehistoric Society*, 61-85.
- Dowling, Ger. 2014. Landscape and Settlement in Late Iron Age Ireland: Some Emerging Trends. *Late Iron Age and 'Roman' Ireland*, Discovery Programme Reports 8, pp. 151-174. Dublin: Wordwell.
- Dúchas.ie. *Christian Brothers', Athlone*. <https://www.duchas.ie/en/cbes/5009134/4989954>. Electronic Document. Accessed Feb. 2024.
- Discovery Programme Reports: 8. 2014. *Late Iron Age and 'Roman' Ireland*. Wordwell, Dublin.
- Environmental Protection Agency of Ireland. GeoPortal. <https://gis.epa.ie/>. Accessed Jun. 2023.
- Eogan, G. 1964. The Later Bronze Age in Ireland in the light of recent research. *The Prehistoric Society* 14: 268-331.
- Farrell, C.A., and G.J Doyle. 2003. Rehabilitation of industrial cutaway Atlantic blanket bog in County Mayo, North-West Ireland. *Wetlands Ecology and Management* 11:21-35.
- Fenwick, Joseph, Eve Daly, and Shane Rooney. 2020. Rathcroghan Revisited: A Renewed Archaeological and Geophysical Exploration of Selected Areas of the Focal Ritual Complex. *Emania* 25: 81-98
- Fenwick, Joseph. 2018. The late prehistoric 'Royal Site' of Rathcroghan, Co. Roscommon: An enduring paradigm of enclosed sacred space. *Emania* 24: 35-51.
- Fitzpatrick, Andrew P. 2014. Great Britain and Ireland in 2200 BC. Climate Change as the cause of the collapse of the Old World? 7th Central German Archaeological Day, Conferences of the State Museum of Prehistory Hall 12, State Museum of Prehistory Halle.

- Gearey, Benjamin R., Katharina Becker, R. Everett, and S. Griffiths. 2020. On the brink of Armageddon? Climate Change, the Archaeological Record and Human Activity across the Bronze Age-Iron Age Transition in Ireland. *Proceedings of the Royal Irish Academy* 120C: 1-24.
- Ginn, Victoria, and Gill Plunkett. 2020. Filling the Gaps. *The Journal of Irish Archaeology* 29: 41-62.
- Gleeson, Patrick. James O'Driscoll, Gordon Noble, Eileen Murphy, and Jacqueline McDowell. 2023. Radiocarbon dating of human remains from Navan Fort: their implications for understanding the wider ceremonial complex. *Journal of Irish Archaeology* 32: 54-69.
- Gowen, Margaret. 1996. *The Lisheen Mine archaeological Project*. Margaret Gowen & Co, Ltd. Unpublished Report.
- Hammer, Emily. 2014. Local landscape organization of mobile pastoralists in southeastern Turkey. *Journal of Anthropological Archaeology* 35: 269-288.
- Hammond, R. F. 1979. The peatlands of Ireland. Soil Survey Bull. 35. Dublin: An Foras Taluntais.
- Harding, Dennis W. 2017. *The Iron Age in Northern Britain: Britons and Romans, Natives and Settlers*. London: Routledge.
- Harding, D. W. 2009. *The Iron Age Roundhouse: Later Prehistoric Building in Britain and Beyond*. Oxford: Oxford University Press.
- Honeychurch, William, and Cheryl A. Makarewicz. 2016. The Archaeology of Pastoral Nomadism. *Annual Review of Anthropology*. 45: 341-359.
- Howey, Megan C.L. 2007. Using multi-criteria cost surface analysis to explore past regional landscapes: a case study of ritual activity and social interaction in Michigan, AD 1200-1600. *Journal of Archaeological Science* 34: 1830-1846.
- Huang, Chun Chang. 2002. Holocene Landscape Development and Human Impact in the Connemara Uplands, Western Ireland. *Journal of Biogeography* 29(2): 153-165.
- Hutchinson, John. 2001. Archaeology and the Irish rediscovery of the Celtic past. *Nations and Nationalism* 4: 505-519.
- Jia, Xin, D. Zhao, M. J. Storz, H. Shi, G. Bai, Z. Liu, Z. Hu, L. Sun, Q. Wang, and H. Li. 2022. The "2.8ka BP Cold Event" Indirectly Influenced the Agricultural Exploitation During the Late Zhou Dynasty in the Coastal Areas of the Jianhuai Region. *Frontiers in Plant Science* 13: 1-12.
- Johnson, M., 1999. *Archaeological Theory: An Introduction*. Oxford: Blackwell Publishing.

- Johnston, Susan A., Pam J. Crabtree, Douglas V. Campana, and Zenobie Garrett. 2016. *Final Report: Excavations at Dún Ailinne, Co. Kildare, 2016*. Unpublished Report for the National Monuments Service.
- Johnston, Susan, Pam J. Crabtree, and Douglas V. Campana. 2014. Performance, place and power at Dún Ailinne, a ceremonial site of the Irish Iron Age. *World Archaeology* 46(2): 206-223.
- Johnston, Susan, Douglas Campana, and Pam Crabtree. 2009. A Geophysical Survey at Dún Ailinne, County Kildare, Ireland. *Journal of Field Archaeology* 34(4): 385-402.
- Johnston, Susan, and Bernard Wailes. 2007. *Dún Ailinne: Excavations at an Irish royal site, 1968-1975*. Philadelphia: University of Pennsylvania Museum of Archaeology and Anthropology.
- Knight, Charles. 1848. *The National Cyclopaedia of Useful Knowledge, Vol IV*. London: Charles Knight & Co.
- Koch, John T. 2007. Mapping Celticity, Mapping Celticization. In *Communities and Connections: Essays in Honour of Barry Cunliffe*. Edited by Chris Gosden, Helena Hamerow, Philip De Jersey, and Gary Lock. Oxford: Oxford University Press.
- Lamb, Andrew W., and Martin Schönfelder. 2022. Spearbutts for horse bits: a new interpretation for certain bronze fittings from the Irish Iron Age. *Journal of Irish Archaeology* 31: 69-80.
- Logainm.ie. Athleague. <https://www.logainm.ie/en/1414612>. Electronic Document. Accessed Feb. 2024.
- Logainm.ie. Athlone. <https://www.logainm.ie/en/50734>. Electronic Document. Accessed Feb. 2024.
- Logainm.ie. Drumsna. <https://www.logainm.ie/en/29232>. Electronic Document. Accessed Feb. 2024.
- Lucas, A.T. 1985. Toghers or Causeways: Some Evidence from Archæological, Literary, Historical and Place-Name Sources. *Proceedings of the Royal Irish Academy: Archaeology, Culture, History, Literature*, 85C: 37-60.
- Lynn, Chris. 2003. *Navan Fort: Archaeology and Myth*. Dublin: Wordwell.
- Maguire, Rena. 2021. *Irish Late Iron Age Equestrian Equipment in its Insular and Continental Context*. Dublin: Archaeopress.
- Mallory, J.P. 2015. *The origins of the Irish*. London: Thames and Hudson.
- Mallory, J. 2009. The conundrum of Iron Age ceramics: the evidence of language. In *Relics of Old Decency: festschrift for Barry Raftery*, edited by Gabriel Cooney, Katharina Becker, John Coles, Michael Ryan, and Susanne Sievers, 181-192. Dublin: Wordwell.

- Mallory, J.P, and Chris J. Lynn. 2002. Recent excavations and speculations on the Navan complex. *Antiquity* 76(292): 532-541.
- McDermott, C. 2009. A Colossus of Roads: the Iron Age archaeology of Ireland's peatlands. In *Relics of Old Decency: festschrift for Barry Raftery*, edited by Gabriel Cooney, Katharina Becker, John Coles, Michael Ryan, and Susanne Sievers, 49-65. Dublin: Wordwell.
- Molloy, Barry. 2023. Was there a 3.2 ka Crisis in Europe? A Critical Comparison of Climatic, Environmental, and Archaeological Evidence for Radical Change during the Bronze Age—Iron Age Transition. *Journal of Archaeological Research* 31: 331-394.
- Molloy, Karen. 2005. Holocene vegetation and land-use history at Mooghaun, south-east Clare, with particular reference to the Bronze Age. In *The North Munster Project, The later prehistoric landscape of south-east Clare*, edited by Eoin Grogan, pp. 255-301. Discovery Programme Monographs 6. Bray: Wordwell.
- Moore, Caitríona. 2021. *Between the Meadows: The Archaeology of Edercloon on the N4 Dromod-Roosky Bypass*. Transport Infrastructure Ireland. Dublin: Wordwell.
- Morse, Michael A. 1996. What's in a name? The 'Celts' in presentations of prehistory in Ireland, Scotland, and Wales. *Journal of European Archaeology* 4: 305-328.
- Mulhall, Isabella. 2019. Banking for the Future: The National Museum of Ireland Bog Tissue Samples Bank. *Journal of Wetland Archaeology* 1: 89-114.
- National Monuments Service of Ireland. Historic Environment Viewer. <https://heritagedata.maps.arcgis.com/apps/webappviewer/index.html?id=0c9eb9575b544081b0d296436d8f60f8>. Database. Accessed Jun. 2023.
- National Museum of Ireland – Archaeology. *Bog Bodies Research Project*. [https://www.museum.ie/en-IE/Collections-Research/Irish-Antiquities-Division-Collections/Collections-List-\(1\)/Iron-Age/Bog-Bodies-Research-Project](https://www.museum.ie/en-IE/Collections-Research/Irish-Antiquities-Division-Collections/Collections-List-(1)/Iron-Age/Bog-Bodies-Research-Project). Webpage. Accessed Oct. 2023.
- National Museum of Ireland – Archaeology. *Kingship and Sacrifice*. <https://www.museum.ie/en-IE/Museums/Archaeology/Exhibitions/Kingship-and-Sacrifice>. Webpage. Accessed Oct. 2023.
- National Parks and Wildlife Service of Ireland. <https://www.npws.ie/maps-and-data>. Web database. Accessed Jun. 2023.
- Newman, Conor, M. O'Connell, M. Dillon, and K. Molloy. 2007. Interpretation of charcoal and pollen data relating to a late Iron Age ritual site in eastern Ireland: a holistic approach. *Vegetation History and Archaeobotany* 16: 349-365.
- Newman, Conor. 1998. Reflections on the Making of a 'Royal Site' in Early Ireland. *World Archaeology* 30(1): 127-141.

- O'Brien, Elizabeth. 2020. *Mapping Death: Burial in Late Iron Age and Early Medieval Ireland*. Dublin: Four Courts Press.
- O'Brien, T. 2023. Summer flooding creates fears of a severe fodder shortage for farmers along the Shannon: Farmers protest in Banagher about what they claim is lack of action to prevent flooding on the Shannon Callows. *Irish Times*. Electronic Document. Accessed Jan. 2024.
- O'Donovan, M., D. Hennessey, and P. Creighton. 2021. Ruminant grassland production systems in Ireland. *Irish Journal of Agricultural and Food Research* 59(2): 225-232
- O Drisceoil, C. 2007. Life and Death in the Iron Age at Carrickmines Great, Co. Dublin. *Journal of the Royal Society of Antiquaries of Ireland* 137: 5-28.
- O'Driscoll, James. 2023. Head for the Hills: Nucleated Hilltop Settlement in the Irish Bronze Age. *Journal of World Archaeology*.
- O'Driscoll, James, Patrick Gleeson, and Gordon Noble. 2020. Re-imagining Navan Fort: New Light on the Evolution of a Major Ceremonial Center in Northern Europe. *Oxford Journal of Archaeology* 39(9): 247-273.
- O'Driscoll, James. 2017. Hillforts in Prehistoric Ireland: A Costly Display of Power? *World Archaeology* 49(4): 506-525.
- Ó hOireabhárd, S. 2018. The Assassination of Tigerán Ua Ruairc, The Last King of Meath. *Peritia*.
- O'Sullivan, Aidan. 2007. Exploring Past People's Interactions with Wetland Environments in Ireland. *Proceedings of the Royal Irish Academy*. 107C, 147–203.
- O'Sullivan, Aidan, and Kinsella, J. 2013. Living with a sacred landscape: interpreting the early medieval archaeology of the Hill of Tara and its environs, AD 400-1100. In *Tara: from the past to the future*, edited by M. O'Sullivan. Bray: Wordwell. pp 321-344.
- Piggott, Stuart. 1958. *Scotland Before History*. London: Nelson.
- Plunkett, Gill. 2008. Land-use patterns and cultural change in the Middle to Late Bronze Age in Ireland: Inferences from pollen records. *Vegetation History and Archaeobotany* 18(4):273-295.
- Plunkett, Gill, Conor McDermott, Graeme T. Swindles, and David M. Brown. 2013. Environmental indifference? A critique of environmentally deterministic theories of peatland archaeological site construction in Ireland. *Quaternary Science Reviews* 61: 17-31.
- Pryor, Francis. 2003. *Britain BC: Life in Britain and Ireland Before the Romans*. HarperCollins.
- Raftery, Barry. 1994. *Pagan Celtic Ireland: The Enigma of the Irish Iron Age*. London: Thames and Hudson Ltd.

- Raftery, Barry. 1987. Ancient Trackways in Corlea Bog, Co. Longford. *Archaeology Ireland* 1(2): 60-64.
- Raftery, Barry. 1984. *La Tène in Ireland: problems of origin and chronology*. Marburg: Veröffentlichung des Vorgeschichtlichen Seminars Marburg, Sonderband 1.
- Raftery, Barry. 1983. *A Catalogue of Irish Antiquities*. Marburg: Veröffentlichung des Vorgeschichtlichen Seminars Marburg, Sonderband 2.
- Rahman, Aziz, Marry Anne Clarke, and Sean Byrne. 2017. The Art of Breaking People Down: The British Colonial Model in Ireland and Canada. *Peace Research* 49(2): 15-38.
- Reeves-Smyth, T., and Fred Hammond. 1983. *Landscape Archaeology in Ireland*. BAR British Series 116.
- Scott, B. G. 1974. Some Notes on the Transition from Bronze to Iron in Ireland. *Archaeological Research Forum* 1(1): 9-24.
- Schlanger, Sarah H. 1992. Recognizing Persistent Places in Anasazi Settlement Systems. In *Space, Time, and Archaeological Landscapes*, edited by Jacqueline Rossignol., and LuAnne Wandsnider, pp 91-112. Boston: Springer.
- Soule, R.G., and Ralph F. Goldman. 1972. Terrain Coefficients for Energy Cost Prediction. *Journal of Applied Physiology* 22(5): 706-708.
- Stanley, M. 2003. Archaeological survey of Irish bogs: information without understanding? *Journal of Wetland Archaeology* 3: 61-74.
- Supernant, Kisha. 2017. Modeling Métis mobility? Evaluating least cost paths and indigenous landscapes in the Canadian west. *Journal of Archaeological Science* 84: 63-73.
- Tobler, W. 1993. Three Presentations on Geographical Analysis and Modeling: Non- Isotropic Geographic Modeling, Speculations on the Geometry of Geography, and Global Spatial Analysis. *National Center for Geographic Information and Analysis*, Technical report 93-1.
- Waddell, John. 2022. *The Prehistoric Archaeology of Ireland*. Dublin: Wordwell.
- Waddell, John. 2014. *Archaeology and Celtic Myth: an exploration*. Dublin: Four Courts Press.
- Waddell, John., Joseph Fenwick, and Kevin Barton. 2009. *Rathcroghan: Archaeological and Geophysical Survey in a Ritual Landscape*. Dublin: Wordwell.
- Waddell, John. 1983. Rathcroghan—A Royal Site in Connacht. *Journal of Irish Archaeology* 1: 21-46.
- Waterman, D.M. 1997. *Excavations at Navan Fort 1961-71, County Armagh*. Northern Ireland Archaeological Monograph 3. Belfast: Belfast Stationary Office.

Weir, D.A. 1995. A Palynological Study of Landscape and Agricultural Development in County Louth from the Second Millennium BC to the First Millennium AD. In *Discovery Programme Reports 2* :77–126.

Wilde, William. 1852. *Irish Popular Superstitions*. Dublin: James McGlashen.