Social Network Analysis and the People of Medieval Scotland 1093-1286 (PoMS) Database

by

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with contributions by Cornell Jackson

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PREFACE

By John Bradley

At first glance one would think that there should be an entirely natural affinity between the study of history and the domain and techniques of Social Network Analysis (SNA). On one hand, out of the documents that historians study arise the historical interpretations of the events, people, and interactions that they describe. On the other, from SNA's perspective, as Steve Borgatti (one of the developers of the highly influential piece of SNA software called UCINET) is quoted as saying in Gretzel 2001, SNA "is the study of social relations among a set of actors". At least a part of what history is about is this too. Furthermore, work in the early 1990s by SNA researchers such as Padgett and Ansell (1993) provided at least one example of useful historical analyses arising from a formal SNA study of the political, economic, friendship and marriage networks of the Medici. Are there other sets of historical data that would benefit from SNA analysis techniques?

From 2006 to 2012 a small group of historians and digital humanities specialists worked to create a representation of material from medieval charters in the People of Medieval Scotland (PoMS) (PoMS 2012) project. When we finished creating PoMS some of us came to realise that the materials we had created could be used to explore what potential there might be for using SNA analysis to support historical thinking about Medieval Scotland. In 2012 there certainly appeared to be at least some potential for an affinity between the PoMS materials and the SNA methodologies. Thus, we approached the Leverhulme foundation for funding to, among other things, explore how well this potential affinity between SNA and medieval history could actually be explored through PoMS. As we said in our proposal, we believed that SNA might offer "a method for processing thousands of individual interactions in different contexts and locations to reveal changing patterns and intensities in social relationships." We are very grateful to Leverhulme that our proposal was funded by them, and the work you see described in this book is the direct result of this funding.

Why were we thinking of PoMS particularly as a source for historical data that might fit with SNA? There were several rather obvious reasons and one that was perhaps not so obvious. First, those who have looked at the published version of PoMS database through its website will be aware that PoMS is in significant part a prosopography. The names of people and institutions that appear in PoMS's medieval charter documents are turned into references to corresponding digital surrogates of historical people

and institutions. Indeed, the formal identifications of these persons was very much one of the things that the PoMS project was about. As a result PoMS researchers went to some length to identify more than 15,000 specific historical people and institutions that are referenced in its documents. Clearly, this identification of individuals that was done as a part of PoMS was an essential preliminary step to applying SNA approaches.

Furthermore, PoMS was not only a prosopography, but also an example of a highly structured one (see a description of PoMS's structure in Bradley and Pasin 2013). Thus, as a structured prosopography, PoMS used the modelling techniques of a relational database not only to focus on the formal identification of historical persons and institutions, but also to formally represent other kinds of historical entities and to record the interconnections between them: things like the historical documents themselves, possessions described in them, pieces of land, permissions and privileges, and many other entities.

Indeed, because PoMS is a relational database, it is able to exploit the relational technology's inherent nature that allows its materials to be queried from many different perspectives. Although PoMS is to a significant degree a prosopography and can draw out material selected by person or institution, we can also ask of the database questions centered around any of the other formally identified objects as well: "what is the total number of charters, and how many have knight service specified as a render", for example, or "what are the places associated in some way with a woman". By being a highly structured database which can be queried for data from many different perspectives PoMS is an example of an entity that in fact enables a "thousand entrances" into its materials (using a phrase that, to some degree, consciously echoes Roland Barthes's influential description of narrative networks as "readerly texts" (Barthes 1974, p. 12)). To repurpose Barthes again, a database like PoMS has "no beginning; it is reversible; we gain access to it by several entrances, none of which can be authoritatively declared to be the main one" (Barthes 1974, p. 5). Like Barthes's readerly texts perhaps, any of the entities that PoMS's structure formally represents (persons or institutions, places, charters, etc) can be exploited as an entry point into its material more or less equally easily.

We mentioned earlier here that there is one not particularly obvious reason why the PoMS database might be suitable for SNA exploration. This particular reason is perhaps rather more hidden from most of PoMS's user community because they access it through PoMS's reasonably rich and sophisticated web interface, and it only allows certain types of questions to be asked of the PoMS data – only some

of PoMS's "thousand entrances" are available there. As mentioned earlier, other kinds of questions that are difficult to explore through the web interface can be asked directly of the database, and it turns out that these fit best with SNA. Thus, by going behind the web interface and getting at the database directly one can select materials that are difficult or virtually impossible to approach through the web interface, and it is the shift in perspective that is thereby enabled that made it seem, at the time the Leverhulme proposal was written, evident to us that an SNA interpretation of the data was a plausible one. What was this shift in perspective?

We quoted Borgatti's short definition of SNA here briefly earlier, and elsewhere in it one finds a bit more of what SNA is about: that it "focus[es] on relationships between actors" (in PoMS its historical persons and institutions) "rather than [their] attributes", that for this reason SNA focuses on a "sense of interdependence: a molecular rather atomistic view", and that one can observe a new set of "emergent effects" and "substantive outcomes" from working on this structure of relationships. Although PoMS's web interface shows relationships between, say, specific people primarily in the context of specific pieces of property, say, or a particular charter, it does not allow for data to be selected that is centred on the relationships themselves. Nonetheless, behind this web interface, PoMS's database allows one to readily extract all relationship-oriented data between people that PoMS has recorded (more than 11,000 grantor-beneficiary relationships, for example) and present this data to SNA methods for processing. What happens then if, as Borgatti suggests, we take up an SNA perspective on this data and focus on its relationship-driven data; for example on PoMS's 11,000 grantor-beneficiary relationships? What new structures (using Borgatti's sense of the word) can be detected between the interdependence between PoMS's historical persons by their establishing of connections of granter and beneficiary? This is, indeed, one of the questions you can find explored later in this book. Furthermore, PoMS does not record only grantor-beneficiary relationships between people but several other kinds too: through family connections, tenurial and lordship relationships, and employment relationships. Indeed, a look through the rest of this book will show how SNA techniques have been applied to these other relationships that PoMS reveals. Furthermore, considerable work has been done in our research to explore evidence of relationships between people that arise from co-witnessing of charters. In all these cases, relationship-centred data was first drawn from PoMS's database, and then fed into a range of different SNA processes to explore what might be revealed.

Although you will see much energy and enthusiasm about exploring SNA in evidence in this book, it was also evident from the very beginning that the team had to approach this SNA exploration in a critical spirit.

First, PoMS works with data that the PoMS team has extracted from its medieval documentary sources into a formal structure that by its very nature could of course only partially correspond to what was actually happening in that medieval period. The charters that survive to the present day and that we could use to harvest our data are incomplete records of all the legal and legal-like transactions that happened in Medieval Scotland – likely even an incomplete record of transactions that originally had charters. Because of what happened in their transmission to us today what has survived is almost certainly skewed in various ways. Does this partial and skewed data characteristic of PoMS need to constrain our interpretation of what SNA suggests to us? Furthermore, the database modelling approach forces clarity of structure upon us for material that was created in an era and in a society where such structures were no way nearly as clearly defined as a database suggests. Is our data model too rigid to accommodate the subtleties of this medieval society?

Finally, we have the concern about the appropriateness of SNA's "world view" and its mathematical network-orientation to this material. We quote here an article with, truth be told, quite different purposes than the ones we were working with in PoMS: Nishant Shah's analysis of events that have happened in modern-day China. Talking of recent political events, Shah notes that:

> The event has to be legible: it can be written, quantified as data, visually mapped and attributed to definite actors, and graphically reduced to transactions, actions and processes. The event has to be intelligible: once it has been documented, it can be sorted, put into databases, forced to reproduce itself only in a language that the network understands, and can be extricated from its contexts of meaning making, (Shah 2013, p. 670, highlighting added)

Like the events Shah is writing about here which, he claims, had to be formalised and processed in the ways he describes to fit with the world view he was interested in exploring, PoMS too has, in its formalisation process that extracted data for the database, turned its material that it has drawn from medieval charters into relatively clear-cut events, has attributed these events to specific historical actors, and turned them into explicit formal transactions with relationships between these individuals.

The process seems highly reductive. Once the material had been formalised in this way it was, of course, possible to extract networks of individuals that could be given to SNA techniques for processing. However, in squeezing these medieval sources into this particular expression of formal structured data, and then further processing that data into suitable formal SNA "networks", and thereby taking the material out of its richer and more complex social and historical context, are we losing important aspects of the material that therefore prevents whatever the network analysis seems to show from being historically significant? Can the structures that we think we are seeing emerging from this reductive process be satisfactorily turned into proper historical insights?

Of course, SNA is not the only time that highly formal models have been explored as a way of reductively thinking about historical phenomena, and some of these formal approaches have been well established as historical sub-disciplines. Take the field of economic history as an example. Like our SNA application to historical materials, economic history attempts to take the reductive approaches of economics, with its highly formal mathematical models, and uses its perspective to try to explain historic human behaviour in terms of a set of these underlying mathematical models. As the well-known economic historian Marc Flandreau says in his 2001 article:

> The seduction of economics was its abstraction, its ability to operate a fairly sophisticated conceptual machine capable of moving at high speed and to land it, as a helicopter, in the tidy glades that can be found in even the most inaccessible jungles. The seduction of history came from qualities that are exactly opposite. The same jungles are explored on foot with a duty to collect every single exotic flower along the way, taking the petals, leaves and roots together, writing where they were picked in a booklet, and studying them back in the office both for themselves and in relation to each other. While in history elegance and scholarly achievement is often a thick book, in economics, it is a lean one. (Flandreau 2001)

Later he proposes the idea that the essence of economic history is not in the proportion between the two contrasting approaches, but in the challenge of striking the balance itself – not in the building of a permanent intellectual bridge between the methods of history and economics, but in the view one gets from this bridge's provisional construction. Something useful can come from this work, in spite of the fact that "a clear and systematic explanation" that connects the two fields cannot be satisfactorily found.

Perhaps a similar sense of potential, but with some significant discomfort, is where we find we have ended up in the application of SNA to support an historical analysis of medieval charters through the PoMS database. Like Flambeau, this tension has turned out to be one of the major constant concerns of our work. We found ourselves doing our best to put SNA analyses into an historical context and trying to say, as historians, "what does this presentation usefully say to us about medieval Scotland". In fact, we suspect that even after several years of work here, we find that we've really just beginning to understand some of the aspects of this question…

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1 STARTING POINTS

Part One: Social Network Analysis, Prosopography, and History

In 1998, Charles Wetherell argued in the International Review of Social History that Social Network Analysis offered 'real potential' for historians, potential which had hitherto been almost completely ignored. Nearly two decades later, while the sociological field of SNA has grown apace, and software for analysing social networks has continued to become more sophisticated, Wetherell's call has largely gone unanswered by historians. Wetherell's call-to-arms was about the potential for SNA to offer new approaches to the study of kinship and village communities for social historians.[1] Already in 1998, however, Wetherell lamented that the kinds of social historians who used quantitative methods were a small minority, and this situation has hardly changed in the interim. Moreover, in 1996, Wetherell had teamed up with Barry Wellman to argue in the journal History of the Family that network studies offered important new ways of conceptualizing communities (Wellman and Wetherell 1996). While it is certainly true that a general appreciation for networks, loosely defined, has greatly influenced the study of history, this has usually taken place under the aegis of those methods of interpretation which are conventional for historians, especially in medieval history. Most humanities scholars retain a certain reticence about quantitative data and sociological, anthropological, and mathematical theory, combined with a healthy concern about how far we can push our always-problematic source material.[2] In any event, the few examples of SNA touching on medieval history prior to recent years were the results of happy coincidences in which individuals managed to break free from the 'small worlds' of their disciplines (an SNA concept). What is more, these innovators were often social scientists working in historical studies rather than more traditionally defined historians. As social network theory makes clear, however, many brave innovators do not succeed in getting their innovations accepted and followed more broadly. That is the role of the 'opinion leaders'. The good news is that in the recent past several such hard-working and influential figures have made great strides in putting Historical SNA on the map.

[1] It is arguably in this area that Historical SNA has yielded the most fruit. The study of kinship and village communities has long been a field of great interests for historians, sociologists and anthropologists. Most of the work in this area has focused on the early modern period and the long nineteenth century.

[2] On this, see also the comments by Isabelle Rosé in her 2011 article, at pages 200-203.

Some of these SNA opinion leaders have gathered under the umbrella of an organisation called Historical Network Research. The first three Historical Network Research conferences, held at Hamburg in 2013, at Ghent in 2014 and at Lisbon in 2015, stand as a testament to the growing popularity of network approaches to historical topics. Further, they allow a handy thumbnail sketch of the field of HSNA. The full programmes of the conferences can be found at http://historicalnetworkresearch.org/hnr-conferences/. The conferences have attracted speakers from a broad swathe of nations, including Belgium, Netherlands, Luxembourg, Germany, France, Spain, Portugal, United States, United Kingdom, Ireland, Austria, Switzerland, Italy, Denmark, Finland, Norway, Poland, Croatia, Russia, Ukraine, Romania, Greece, and Colombia. The number of institutional departments and disciplines from which the speakers have been drawn reveal something of the remarkable yet quite dispersed nature of the field of HSNA. They include Archaeology, Classics, Communications, Computational Linguistics, Computer and Information Science, Economics, History, Ancient History, History of Art and Architecture, History of Medicine, History of Science, Physics, Political Science, Religious Studies, and Sociology. A wide range of historical periods have been represented at these three conferences, from the ancient world to contemporary society. A number of different subjects and themes have been profitably explored. Among the most fruitful seams have been intellectual and scientific networks, networks of marriage and kinship, social and political elites in various contexts, networks of traders, merchants, sailors, migrants, settlers, and so forth, urban networks, and networks of religious and other beliefs. Medieval topics have included social structure in Norman Sicily, 11th-century monastic reform, book circulation in the ninth century, Anselm of Canterbury, Old Norse sagas, and 16th-century politics in the Low Countries. The conferences give a sense of a field of academic endeavour that is young and fresh: the lion's share of the papers have been given by postdoctoral researchers or PhD students. Some of these have been part of collaborative research projects reflecting centres of activity in HSNA, such as the University of Ghent's Centre for Digital Humanities. While there have been a number of excellent papers on ancient, medieval and early modern topics, the impetus and the momentum seems often to focus on the period since 1800. Historical SNA's opinion leaders themselves mainly work on modern and contemporary questions. Christophe Verbruggen of U. Ghent works on transnational intellectual and cultural history around 1900. Claire Lemercier, a historical sociologist based at Sciences-Po in Paris, specialises in 19th-century French economic history. Martin Stark of Social and Economic Sciences at the University of Hamburg has worked on 19th-century social history. Marten Düring of the University of Luxembourg writes about networks of Jews in the Nazi Holocaust. Nick Crossley, professor of Sociology at the University of

Manchester, works on punk music communities in 1970s Britain. The relative scarcity of established academics working on pre-modern historical topics, especially in the faculties of Humanities, is noteworthy, although a few significant exceptions will be mentioned in greater detail below. In general, historical SNA has so far found most institutional support in faculties and schools of social, political and economic sciences. This is partly an indication, in my opinion, of the general move by the broader discipline of History away from quantitative methods since the 1980s, noting the exception of departments of Social and Economic History in the United Kingdom. As the remarkable and continuing success of the Historical Network Research conferences has shown, there are no shortage of green sprouts popping through the fertile topsoil of historical studies. The extent to which their humanist colleagues will pick the fruits of their labour largely remains to be seen.

Medieval History and Social Network Analysis

Various scholars have applied the concepts or methods of Social Network Analysis to the study of medieval Europe since SNA started to come into its own in the 1970s. For the most part, these studies have been relatively isolated, although in more recent years this has begun to change. The earliest example of such an isolated innovation which I have found is Richard M. Smith's 'Kin and Neighbors in a Thirteenth-Century Suffolk Community', published in the Journal of Family History in 1979 (Smith 1979). Smith, a population historian based in the Geography department at Cambridge, was aware of some of the concepts and methods behind Social Network Analysis, but it is clear that this understanding was provided solely by John A. Barnes (1918-2010), who was Professor of Sociology at Cambridge from 1969 to 1982, and had been a student of Max Gluckman of the 'Manchester school' of anthropologists. Barnes's 1954 study of a Norwegian island parish was seminal for the development of social network analysis (Barnes 1954). Richard Smith wanted to test a hypothesis about whether kinship or community were more important to the lives of residents in the manor of Redgrave in Suffolk in the 1280s. The detailed records of the manorial court there allowed him a sophisticated approach to the question, and he applied various SNA concepts to the task, apparently without the use of any computer software. This included creating formulas for various network densities as well as several tables laying out numbers for what he called 'Star and Zonal Multiplexities'. 'Star' refers to actors who are adjacent to ego while 'multiplexity' refers to the existence of ties in a variety of distinct fields or settings. Smith wanted to ask whether networks were denser at different socioeconomic levels and in four geographical

zones. The results, however, were interesting but ultimately inconclusive, which may account for why Smith seems to have abandoned SNA approaches in his later work.

In her 1984 article 'The tie that binds: peasant marriages and families in late medieval England', Judith M. Bennett, at the time an Associate Professor of History at the University of North Carolina, used SNA techniques to examine the social worlds of two prominent families in the village of Brigstock, Northants, in the early fourteenth century (Bennett 1984). Like Smith, Bennett used local court records, from which she constructed personal networks for 31 individuals, categorising interactions along the lines of giving or receiving of assistance or of land, of acting jointly or engaging in a dispute. She was able to come to some worthwhile conclusions about how marriages changed social relationships in village society. Bennett explicitly thanked Richard Smith for his suggestions, and mentioned his article, as well as a 1979 book-length treatment of another English village in the early modern period, as examples of two works of English history to have adopted the SNA model (Wrighton and Levine 1979). All three studies treated the subject of family and community relations at the village level, and were an outgrowth of the larger 1960s-1970s project of social and economic history. I have been unable to find any historical work on the middle ages produced in the decade or so after 1984, although this is not to say that none ever existed. If the trail did run cold at this point, it may have been due to the turn away from the preoccupations of the 1960s-70s social history.

The next major advance touching on the middle ages came not from historians but from sociologists. In Renaissance Florence, John F. Padgett and Christopher Ansell found a rich seam of data where historians had already prepared the ground. The result was one of the most well-known and influential historical SNA studies yet produced, Padgett and Ansell's 'Robust Action and the Rise of the Medici, 1400-1434', appearing in 1993 in the American Journal of Sociology. Padgett, a Professor of Political Science at the University of Chicago, and Ansell, a political scientist based at UC Berkeley, are not themselves medieval historians but were able to build on the work of a large number of historians and social scientists on the excellent dataset surviving from Renaissance Florence. Crucially, they took advantage of the prosopographical work of Dale Kent in The Rise of the Medici (1978). The evidence was rich enough to allow analysis of various different kinds of networks, for example, marriage, economic, 'political' and friendship networks of 92 elite families in 1400s Florence. Using block model analysis, Padgett and Ansell succeeded in demonstrating how the Medicis controlled the conduits of power by placing themselves at the nexus of these various parties (the 'blocks'), in multiple contexts. All business had to flow through Cosimo de Medici because of the way the network was structured.

Padgett has returned to Renaissance Florence in 2006 and 2011. ‘Robust action’ is an example of how SNA can be used in a remarkably effective way to demonstrate elite power dynamics in medieval Europe, but sadly there are very few places with the richness of sources and of scholarly endeavour that would allow it to be replicated.

Padgett and Ansell’s study was part of a wider renewal of interest in elites happening in the Humanities and Social Sciences in the 1990s. This trend is also evident in Christine Carpenter’s 1994 article, ‘Gentry and Community in Medieval England’. Carpenter used social network concepts as a way out of several intractable problems around trying to identify communities at the county level. Wary of lending the evidence a ‘spurious mathematical precision’, however, Carpenter rejected the deployment of tables and sociograms (Carpenter 1994, p. 365). She did make good use of a number of SNA theoretical concepts, nevertheless, including network density, brokerage, and effective versus extended networks (p. 366). Carpenter’s network analysis used charters and dealt with gentry society in Staffordshire. In the article, the personal network of Philip Chetwynd of Ingestre (d. 1307) was reconstructed and analysed (pp. 369-374). At the time of writing, the study was ‘still in its early stages’, but she apparently never published any more of the results (pp. 369, 374). Her University of Cambridge web profile does not mention an interest in social networks nor even include the 1994 article (http://www.hist.cam.ac.uk/directory/mcc1000@cam.ac.uk). Moreover, other historians studying medieval English gentry have failed to pick up the baton of historical SNA. IN her 2006 article entitled ‘The social networks of the Buckinghamshire gentry in the thirteenth century’, Anne Polden makes reference to Carpenter’s ‘computer aided network analysis’ (Polden 2006, p. 373). Polden analysed twenty gentry families in Bucks, using charter evidence to consider the geographical range and social status of their contacts. Despite acknowledging Carpenter’s influence, Polden did not follow her in the use of SNA concepts like brokerage, opting for a more traditional analytical regime. This tendency to reject or ignore the methods and concepts of SNA by mainstream historians has been widespread, even as interest in networks as models or metaphors has grown steadily. A 2016 monograph by Kathryn Reyerson of the University of Minnesota (https://cla.umn.edu/about/directory/profile/reyer001), Women’s Networks in Medieval France: Gender and Community in Montpellier 1300-1350 is a good case in point. There, Ryerson explains her decision to opt-out of SNA: ‘While acknowledging the usefulness of social network analysis for studying society’, she writes, ‘given the problems of medieval data, I have chosen to privilege individuals, particularly Agnes, and their stories as a means of

discovering linkages, a more informal term than networks that is perhaps better suited to medieval social and economic history' (Reyerson 2016, xxiii).

Interest in elites has found expression through the study of correspondence as well as record sources. Margaret Mullett of Queens University Belfast brought SNA to the study of a medieval letter collection in 1997, with her monograph Theophylact of Ochrid: Reading the Letters of a Byzantine Archbishop. The letter collection, dating from around 1090 to around 1100, was fertile ground for the reconstruction of a 'complex network of friends, colleagues, patrons and clients within Byzantine Bulgaria' https://www.routledge.com/Theophylact-of-Ochrid-Reading-the-Letters-of-a-Byzantine-Archbishop/Mullett/p/book/9780860785491) Mullett also wrote an introduction in 2005 to a special issue of the Revue Belge de Philologie et D'Histoire which published three articles by young scholars who use SNA on medieval letters and narrative sources (Mullett, 2005). Julian Haseldine of the University of Hull has also used social network analysis in his work on medieval friendship. (http://www2.hull.ac.uk/fass/history/our-staff/julian-haseldine.aspx). Haseldine published an article, 'Friendship networks in medieval Europe: New models of a political relationship', in the inaugural issue of Amity: the Journal of Friendship Studies in 2013, wherein he carefully considers the thorny methodological issues involved in studying medieval friendship, proposing a provisional model for future work. Haseldine holds up Mullett's 1997 study as an example of what is possible, but notes the limitations inherent in the genre (Haseldine 2013, p. 84). As his 2014 position paper (available for download at http://www2.hull.ac.uk/fass/history/our-staff/julian-haseldine.aspx) lays out, Haseldine is currently working on a database which will incorporate SNA techniques.

Work on monastic networks has proceeded apace in continental Europe as well. Isabelle Rosé, through her work on the aristocratic networks around Odo of Cluny, abbot of Cluny (926-942), has demonstrated that it is possible to put social network analysis and theory profitably to work in the early Middle Ages. Rosé's project has been to develop a new form of biography based on the idea of an itinerary – a series of distinct events – as opposed to a narrative. SNA offered her the possibility of exploring Odo's social capital at different points in his life. Rosé's excellent disposition of this, published in the Spanish journal Redes in 2011, lays out her method in exact detail as well as how her network analysis allowed a reassessment of Odo's biography. Rosé used three types of sources – diplomatic acts, personal letters, and narratives, and constructed a database in MS Excel of each link between two actors, as well as details on date, source, and the nature of the relationship. She then created a node table and link table to enter into Netdraw. These had fields which allowed various attributes to be

displayed visually. These included status, familial group, and, for the links, the nature of the relationships. Using this, Rosé produced 63 annual graphs, from 879 to 942, which she then analysed in terms of the aristocratic networks around Odo's life (Rosé 2011, 214-24). Rosé's work certainly deserves to garner interest by students of what is known in France as the Haut Moyen Âge. Rosé has noted how extensively medievalists have taken to talking about networks in an imprecise and metaphorical way; her lengthy article was partially aimed at getting scholars like these to start thinking about SNA (Rosé 2011, 202-4). Koen Vanheule, a PhD student at Ghent since 2011, (http://research.flw.ugent.be/en/koen.vanheule) is an example of a younger scholar who has incorporated social network theory into his research on monastic reformers in the tenth and eleventh centuries. Vanheule uses personal networks based around abbots, monks, and aristocratic familiae as an alternative method of understanding change to conventional interpretations of reform (Vanheule).

Others have taken a more theoretical tack in the study of religion. In the early 2000s, medieval historian Andrew Roach teamed up with economist Paul Ormerod on two studies which sought to apply SNA concepts to historical themes. These took the approach that medieval heresy and Protestantism, respectively, spread through society according to the patterns of scale-free networks, a kind of network 'whose degree distribution follows a power law ... so that any part of the network has a similar structure to the whole (Wikipedia, 'Scale-free networks'). The first study, which is wholly qualitative, considers medieval heresy in the paradigm of a disease contagion. SNA has been particularly influential in the field of epidemiology, and this is a very interesting theoretical approach (Ormerod and Roach, 2004). The second study includes some quantitative analysis but does not involve any matrix-based SNA method (Ormerod and Roach, 2008).

The work mentioned so far has been mostly done in English or French, but a large body of work on SNA and the middle ages has built up in the German language. Among the most significant and influential of these have been Johannes Preiser-Kapeller and Robert Gramsch. Preiser-Kapeller, a lecturer at the University of Vienna, has conducted extensive research on long-distance networks of trade and migration in the Byzantine empire and its neighbours. These have relied heavily on social and spatial theory and often take into account other large themes, like religion and climate (http://rapp.univie.ac.at/project-team-members/johannes-preiser-kapeller/). His work ranges across many centuries: for example, he has examined the ego-networks around fourteenth- and fifteenth-century emperors and the social networks of participants in fourteenth-century ecclesiastical synods, Jewish trading networks between the sixth and eleventh centuries, and early-medieval competition and

conflict between Byzantium and the Arab Caliphate, particularly in Armenia. Preiser-Kapeller's approach, which emphasizes a strong geographical dimension to network analysis, he calls 'Entangled Worlds', itself the title of a conference exploring 'network analysis and complexity theory in historical and archaeological research' held at Vienna in April 2016. (http://www.dasanderemittelalter.net/conference-entangled-words/entangled-worlds-the-programme/). Preiser-Kapeller is an avid disseminator of his many lectures, papers, and publications on www.academia.edu and elsewhere (https://oeaw.academia.edu/JohannesPreiserKapeller/; https://oeaw.academia.edu/TopographiesofEntanglements), and is a major 'opinion leader' in Historical Network Research. Preiser-Kapeller has a forthcoming monograph in English called The Connected Empire. A Global History of Byzantium´s long 14th century (1282-1402). A number of scholars are now studying commercial networks. For example, in his monograph Der hansische Bergenhandel im Spätmittelalter (Cologne 2009) Mike Burkhardt uses SNA to cast light on the trading networks of the Hanseatic Bergen.

One speaker at the 'Entangled Worlds' conference was Robert Gramsch (now Gramsch-Stehfest), a lecturer at the University of Jena in Germany (http://www.histinst.uni-jena.de/Bereiche/Mittelalterliche+Geschichte/PD+Dr_+Robert+Gramsch_Stehfest.html). His subject is the Holy Roman Empire in the thirteenth century and he has published mostly in German (https://uni-osnabrueck.academia.edu/RobertGramsch). While Preiser-Kapeller has done much to push the envelope in terms of apply new theory and methodology to big historical questions, Gramsch has been most successful at incorporating SNA into a deeper, more focused historical study, in a way which bears fruit in terms of integrating with the traditional historiography. Gramsch created a dataset using a variety of historical sources for his study of the 'Empire as a network of princes' in the decade of Henry (VII)'s rule as king under his father, Emperor Frederick (II), which lasted from 1225 to 1235. This dataset include evidence of kinship, alliances, competition, conflicts and so forth between 68 different actors at the highest level of the Empire at this time. Gramsch's method has been to emphasise negative ties and conflicts as much as positive links between actors, and he has relied on Heider's theory about structural balance for his theoretical underpinnings. He formulated his own cluster detection algorithm based around structural balance (pers. comm.; Gramsch et al., 'Community Detection'). Gramsch created a series of sociograms and did cluster analysis on the 68 actors, discovering there were very few distinct clusters with high internal densities. This allowed Gramsch to challenge the traditional view that Henry (VII) was removed from power in 1235 by his father due to

his inefficacy in dealing with the princes. The network analysis revealed that there were two factions engaged in a number of conflicts across the Empire, and that Emperor Frederick and King Henry supported opposing factions. The emperor removed his son from the throne in an attempt to re-forge some unity in his empire (Gramsch, 2013; Gramsch, 'Conflicts'). This is an excellent example of social network techniques and ideas being applied to a specific historical question and producing results that the broader field of historians can engage with.

At the time of writing, in January 2017, it is possible to look back and realize that enough studies have accrued over the last decades to make the claim that all of the thematic fields of endeavour discussed above have now been represented in the area of medieval studies, even if, ironically, these have emerged from pockets of interest with little connective tissue between them. The studies highlighted above deal with the divergent issues of kinship, local communities, friendship, political ties and conflicts, geographical patterns of trade, migration and belief. We can add to this the history of science and intellectual networks. For example, Dominique Raynaud, who describes himself as 'a sociologist and historian of science who previously trained as an architect', has published on medieval science and the origins of perspective since the 1990s. In a 2012 monograph, Raynaud used the theory of network knowledge diffusion as well as 'advanced network analysis and modelling' to uncover cast light on the 'topography' of a knowledge network based in central Italy in the thirteenth and fourteenth centuries (Raynaud 2012).

Digital Prosopography and Social Network Analysis

At first glance, prosopography and social network analysis seem to be natural bedfellows. This is especially true of digital prosopography, given that the people, places, and other potential actors have already been structured in appropriate fields in databases. The marriage of these two fields of endeavour, however, has been gradual, although it could be argued that the two disciplines are fast becoming more mutually familiar. One decade ago, Katharine Keats-Rohan's influential handbook on the practice of prosopography included two contributions that sought to combine the two approaches. These two chapters also give a good thumbnail sketch of the direction this project has taken more broadly. One piece, by Shawn Graham and Giovanni Ruffini, proposed the application of SNA to Greco-Roman Prosopography (Graham and Ruffini, 2007). The second, by Christophe Verbruggen, suggested

combining SNA and prosopography in a more tightly-focused modern case study, in his case, Belgian literary journals between 1880 and 1914 (Verbruggen, 2007).

It is probably in the study of ancient history that social network analysis of prosopographies has made the most headway. Giovanni Ruffini's 2008 monograph, Social Networks in Byzantine Egypt is touted as 'the first book-length application of this method to the ancient world' (Ruffini, 2008). While Ruffini tapped the two best archives from sixth-century Egypt for his work, the story of digital humanities and the broader corpus of papyrus evidence is much bigger than this. KU Leuven's 'Trismegistos' web resource bills itself as 'an interdisciplinary portal of papyrological and epigraphical resources formerly Egypt and the Nile valley (800 BC-AD 800), now expanding to the Ancient World in general' (www.trismegistos.org). While Trismegistos is not a prosopography (http://www.trismegistos.org/ref/about_prosopography.php), its data is structured in such a way as to allow the extraction of source and person data for two-mode networks straightforward. Trismegistos 'includes almost half a million attestations of individuals in Greek and Egyptian texts between 800 BC and AD 800'. Yanne Broux has completed a prosopographical analysis of Greco-Egyptian naming practices which incorporates social network analysis (Broux 2015a, 2015b). Project member Silke Vanbesaelere has created a number of interactive Gephi visualizations for the Trismegistos website (http://www.trismegistos.org/network/index#menu). The work of all three scholars mentioned so far has relied on the same SNA methodology, which involves the creation of a two-mode network with written sources and persons/names, and then the production of a one-mode affiliation network from this, to show the intersection of the actors. This was also the method used in most of the SNA work on the PoMS database – that involving co-witnessing. Prosopographical work on the ancient and classical world is so advanced that the academics are now aiming to draw together a number of existing resources using new technology. (https://snapdrgn.net/). Further, it is becoming more common for scholars of the ancient world to consider social network techniques. Diane Harris Cline of The George Washington University has also been applying SNA to cuneiform tablets (The Amarna Letters) and has already made excellent use of SNA visualization techniques for various dimension of ancient Greek history (http://www.dianehcline.com/index.php/about/). Caroline Waerzeggers of the University of Leiden, in her study of First-Millenium-BC Babylonia, has used SNA in her study of cuneiform tablets (Waerzeggers 2014a, 2014b). Shawn Graham's study of the brick-making industry in imperial Rome incorporated SNA (Graham, 2006). Classical archaeologist Anna Collar, at the University of Aarhus, has explored the spread of religious ideas in the Roman Empire using network theories and methods (Collar

2011, 2013). As of January 2017, the Historical Network Research bibliography lists 90 publications on the topic of Ancient History, as compared to only 35 for Medieval History (http://historicalnetworkresearch.org/resources/bibliography/). Anne Herzberg, at Leipzig, is creating a prosopography of Memphis in Egypt based mainly on epigraphic sources. Her work follows a model whereby social network analysis is seen as a necessary follow-up to the production of the prosopographical database- necessary for the proper interpretation of the results (Herzberg 2015). We may be entering a phase whereby SNA is seen as a natural partner of digital prosopography, where its concepts and methods are seen as vital tools for any prosopographer.

Of the projects combining SNA and prosopography which deal with the ancient and classical world, Ruffini's Social Networks in Byzantine Egypt bears the most relevance to the work put forth in this current volume, so it merits some deeper examination (Ruffini 2008). Ruffini used the evidence of thousands of papyri from the sixth-century settlements of Oxyrhynchos and Aphrodito, building on a long tradition of prosopographical study of the ancient and late Antique Greek-speaking areas. Moreover, digital humanities has served the vast papyrus collections from Greco-Roman Egypt very well, with multiple projects based in Duke University, Heidelberg and Leuven, respectively providing unusually ample textual material for the ancient world. Ruffini's method combines prosopography with SNA: for each of the two settlements, he has one prosopographical chapter and one SNA chapter. The evidence for Oxyrhynchos highlights vertical links in society across a broader region and an emergent elite kinship-group (the Apions), while the evidence from Aphrodito is due to the chance survival of a single family's archive (that of Dioskoros), and shows very close multiplex horizontal relationships within a single village. For his network studies of each, however, Ruffini relied upon pre-existing printed reference sources. In the case of Oxyrhynchos, no complete prosopography had been created, so he instead conducted a topographical network analysis, based on a pre-existing register of about 600 place-names. For Aphrodito, Ruffini built his database on a 1938 prosopographical index of nearly 2,000 villagers created by V. A. Girgis (Girgis 1938).

The method used by Ruffini for Aphrodito is essentially the same as that used by the PoMS project for our co-witnessing studies. Ruffini created two-mode networks with individuals (or places) on one axis and documents (as events) on the other. Then, affiliation networks were produced in order to create valued data about the strength of ties between individuals. Ruffini then used UCINet to reveal the properties of the network and of individuals. Ruffini was able to highlight a few of the most central actors in the network and to shed light on important players who had previously been obscured by

scholarly focus on Dioskoros and his family. He also draws attention to groups with 'high tie strengths'. Ruffini examines the methodology in a critical light, testing the results by simulating change over time. While Ruffini emphasises the importance of multiplexity in the nature of connections between actors, he reveals very little about the roles played by these actors in the papyri themselves. This is possibly partially down to Ruffini using an old-style prosopography for his database, but there is not enough explanation of how historical players interacted in the sources.[3] There is no typology of the papyri or consideration of whether the sources were, for example, transactional versus narrative or epistolary. There is also no typology of the social roles played by the actors, as witnesses, parties to disputes, and so on. Needless to say, the network analysis presumes that different document types are comparable and that SNA of actors in a variety of roles (without any attempt to incorporate these) are equivalent. While the PoMS analysis relies on the same kind of affiliation networks, our case studies have been defined strictly according to type of document and the roles played by the historical actors. Ruffini is now an Associate Professor of Classical Studies at Fairfield University in Connecticut (https://www.fairfield.edu/lassochannel/academic/profile/index.lasso?id=295). Social network analysis has apparently been only a minor interest since 2008.[4]

That same year (2008), four mathematicians from France used a dataset based about 1000 'contracts' dating to 1250-1350 from ten villages in the seigneurie of Castelnau-Montratier in the Lot region of France. With this, they produced a two-mode network of 615 vertices and 4193, from which they produced a sociogram (Boulet et al, 2008, pp. 1264-65). As the title of the article from the journal Neurocomputing suggests ('Batch kernel SOM and related Laplacian methods for social network analysis'), this study was in really only interested in medieval history to the extent that it needed a dataset with which to explore its mathematical project. Historians Jonathan Jarrett and Rachel Stone have both subjected this work to healthy scrutiny (Jarrett 2008; Stone 2012). This work was part of a larger project called 'Graph-Comp' (http://graphcomp.univ-tlse2.fr/), which saw the mathematicians team up with medieval historians and digital information specialists at the Universities of Toulouse and Nantes. The database of notarial acts copied down in the eighteenth century is freely available online (http://graphcomp.univ-tlse2.fr/spip.php?article46). A 2007 paper by the team demonstrated some basic cluster analysis, marking the links between groups involved in documents, what they called

[3] There are a couple of exceptions to this, a record of a dispute and a petition to the empress, explored on pages 168-72 and 177-9 respectively.

[4] He published a Social and Economic History of Medieval Nubia with OUP in 2012 and a A Prosopography of Byzantine Aphrodito the previous year.

‘réseaux de sociabilité’ (‘networks of sociability’), as well as the evolution of these over time (Boulet et al, 2007). There has arguably not been enough critical questioning of the historical contexts and social phenomena reflected in the documents, which is why the use of the term riches for individuals with high degree centrality, and the characterisation of a sub-graph as a communauté feels like putting the cart ahead of the horse (Boulet et al, 2007, p. 8). A 2013 article in the Digital Medievalist revealed the final results of the project. Their ‘Global Network Analysis’ demonstrated a two-mode network with transactions and individuals using Gephi (Rossi et al., 2013, Figure 2). They then produced an affiliation network of the interactions of actors (Figure 3) out of which 34 clusters were identified, and central actors determined. In their ‘Local Network Analysis’, they examine degree and betweenness centrality figures. While this project showed that medieval record sources could be ‘mined’ for social networks, and identified key issues like the chronological issues inherent in datasets spanning centuries (which are explored further in this present volume), the model was somewhat idiosyncratic and the level of analysis fairly rudimentary.

As part of the ‘Making of Charlemagne’s Europe 768-814’ project, which ran from 2012 to 2014 (http://www.charlemagneseurope.ac.uk/), Rachel Stone examined the possibility of applying social network analysis to a major prosopographical database. This resource, like PoMS, uses a factoid-prosopography developed by John Bradley of Kings College London. Like PoMS, the Carolingian database used charters as its source material. Stone’s 2013 IMC Leeds conference paper identified a number of methodological concerns. One of these was the difficulty for the prosopographer to identify individuals with non-unique simple names. Further, she identified a dearth of relationship factoids available. She also explored the methodology used by Ruffini in his study – affiliation networks based on appearing in the same document and highlighted the need to include the roles played by actors in the document in the creation of the dataset. Stone concluded that while the database could easily provide plenty of fodder for SNA work, producing meaningful graphs would be much more challenging. In the end, it was decided not to pursue the SNA route. While it is obviously possible to produce worthwhile small social networks dealing with the middle ages before about 1100, there are serious – possibly insurmountable – disincentives to producing social network analysis of digital prosopography, such as the Charlemagne project or the ‘Prosopography of Anglo-Saxon England’ (www.pase.ac.uk). The first is the problem of forgeries and the difficulties in establishing authenticity of charters from this period. The second, as Stone intimated, is that due to the frequent lack of surnames and/or by-names,

it is much harder to identify individual actors. Both of these problems decrease markedly when one is working with the twelfth century.

The 'ChartEx' project, funded by the Digging into Data programme from 2011 to 2013, explored a number of digital tools for working with medieval charters (https://diggingintodata.org/awards/2011/project/chartex). At the heart of the project were natural language processing and data mining, but SNA was also considered. Like PoMS, the 'ChartEx' tool breaks down charters into their components, but using a very different methodology. They did produced some sociograms using structured data taken from charters, and proposed a novel approach which took into account probabilities when seek to associate actors from multiple documents. Because this method was solely document-focused and did not involve creating a prosopographical database, the problem of generating a program to determine these probabilities while building up aggregates of documents ('record linkage') was likely to present major hurdles. While their final report includes a section on 'reconstructing social networks' (pp. 34-37), there is no discussion of SNA concepts, and the two 'histograms' produced there seem to be purely illustrative.

There are various currently ongoing projects which seek to combine medieval prosopography and social network analysis. Nükhet Varlık of Rutgers University and Abdurrahman Atçıl of Queens College, CUNY, are producing a prosopography of sixteenth-century Ottoman medical elites to which they will apply SNA (http://globalmiddleages.org/project/prosopographical-study-sixteenth-century-ottoman-medical-elite). Hervin Fernández-Aceves, a doctoral student at the University of Leeds, is producing a relational database using twelfth-century charters, with the aim of better understanding the composition and structure of the South Italian aristocracy. His model is a variation on John Bradley's factoid prosopography design. He has produced sociograms in Gephi for both documents and actors, and has also made visualizations for relationships of kinship and legal interactions (Fernández-Aceves 2016). At Harvard University, the work of the massive China Biographical Database Project is ongoing, covering a vast spread in time from the third century BC through to the 20th century AD. Their methodology combined prospography, GIS mapping, and SNA. They have created a number of interesting sociograms in Pajek, exploring networks based on letter correspondence, ties of kinship, and geographical location (combining SNA with GIS) (http://projects.iq.harvard.edu/cbdb/social-networks).

Most prosopographies dealing with post-medieval periods aim at more tightly defined categories of people and tend to have less all-encompassing aims than medieval projects such as PASE, PBW, Charlemagne's Europe, and PoMS. The most profitable seam of endeavour in early modern historical

prosopography and SNA has been based around correspondence networks. The 'Early Modern Letters Online' (EMLO) project includes letters from over 19,000 people from the 16th, 17th, and 18th centuries (http://emlo.bodleian.ox.ac.uk/). The ongoing 'Cultures of Knowledge: Networking the Republic of Letters, 1550-1750' project, based in Oxford, which incorporates EMLO, has been groundbreaking in its analysis of the 'virtual communities' of scholars and intellectuals active in the early modern era (http://www.culturesofknowledge.org/). Connected to this is Stanford University's 'Mapping the Republic of Letters' project, which has created remarkable visualization exploring various dimensions of the corpus of letters in a geographical context (http://republicofletters.stanford.edu/). As part of the 'Cultures of Knowledge' project, Robin Buning of Huygens Institute of Netherlands History led a team which produced a model of prosopography and social network analysis for two historical figures, Samuel Hartlib (c.1600-1662) and John Amos Comenius (1592-1670). Martin Hadley of Oxford produced sociograms using the program R Studio Shiny, with a model that allows users to highlight the specific kinds of relationships that interests them (Buning, 2016). However, at this time, the work has been 'proof-of-concept' and 'experimental', and is not yet available to the wider public.

One other early modern project deserves special mention. The only person to have applied social network analysis to Scottish history, as far as I have been able to uncover, has been the historical sociologist Anna Mitschele, in a Columbia University PhD completed in 2013 (Mitschele, now Anna Kaiser, is currently based at the University of Mannheim, Germany.) Using the pre-existing online Survey of Scottish Witchcraft (http://www.shca.ed.ac.uk/Research/witches/), Mitschele produced a series of spatial analysis sociograms for several periods of increased witch-hunting activity in seventeenth-century Scotland (Mitschele 2013, 2014). She found that previous explanations of the geographical and chronological distribution of witch cases could not explain the seemingly haphazard pattern whereby nearly half of cases crossed parish boundaries. Mitschele postulated that local patterns of witch-hunting were defined not institutionally but by the witch-hunters themselves, upwardly mobile members of the gentry class who sought to make a name for themselves when vacancies in government service came available. She also used a Girvan-Newman cluster analysis on sociograms representing two-mode matrixes of prosecutors and parishes. Mitschele's work is highly creative and original and adds a great deal to our understanding of sixteenth-century society, so it says a lot that she conducted it completely outwith the academic framework of Scottish History as a discipline in Scotland or indeed in the UK altogether. Mitschele's career has taken place in Germany and the USA, within the discipline of sociology, her attention drawn to Scotland by the excellent online resources provided. Mitschele's

case is salutary and instructive of several trends – the ability of online primary source tools to stimulate excellent new research, the relevance of Scottish historical topics to broader historical and conceptual questions, but also the insularity and reticence of history as a discipline in the face of dynamic new viewpoints, methods, and challenges presented by the social sciences.

In the last five to ten years, there has been a growing development of a sense of Historical SNA as a distinct field, at least in Europe, broadly defined. Various new groups have helped fuel this growth. The international and interdisciplinary Connected Past group, whose by-line is 'People, Networks, and Complexity in Archaeology and History', has held several workshops and conferences since 2011 (http://connectedpast.net/). They published in 2016 a volume entitled The Connected Past. Challenges to Network Studies in Archaeology and History (Brughmans et all, 2016). The contents include several useful methodological essays, but also reveal the strong emphasis on archaeology espoused by the group. Most relevant to historians is Marten Düring's chapter, 'How Reliable are Centrality Measures for Data Collected from Fragmentary and Heterogeneous Historical Sources? A Case Study'. Its contents also demonstrate the important new advances that the combination of archaeology and SNA have offered for the study of the classical world. The work of Anna Collar, one of the group's leading members, is a good case in point. In 2011, she used the evidence of material culture to demonstrate how the cult of Jupiter Dolichenus was disseminated across Europe through Roman military networks (Collar, 2011). Issue number 135 of the journal Les Nouvelles de l'archéologie, which was dedicated entirely to the use of SNA in archaeology, further demonstrates this trend. The articles therein show a strong predilection for study of the eastern Mediterranean from the Bronze Age to the Roman period. This also included a piece by Collar and others involved in the Connected Past group on the state of SNA in archaeology and history (Collar et al, 2014).

One of the co-authors of that piece, Claire Lemercier, has been responsible for establishing a French spin-off group, called Réseaux et Histoire ('Networks and History'), or groupe RES-HIST (http://reshist.hypotheses.org/). The group has organised a number of workshops and their website publicises details about ongoing research in HSNA. One recent workshop, held in December 2016 at Tours, was on the topic of SNA in ancient and medieval history (http://reshist.hypotheses.org/1097). RES-HIST reveals a growing number of doctoral projects employing SNA with medieval topics. Laurent Nabias' thesis examines social capital, lineage, and networks of nobility in the Île-de-France between 1180 and 1437 (http://reshist.hypotheses.org/384; http://reshist.hypotheses.org/760). Anne-Laure Méril-Bellini delle Stelle examined the sociability of religious women in the thirteenth-century Low

Countries (http://reshist.hypotheses.org/687). Henri Simonneau has considered the networks and prosopography of heralds in Burgundy, 1386-1519 (http://reshist.hypotheses.org/368). Agnès Bellini-Martin looks at commercial and political networks of Florentines in Lyon around 1500 (http://reshist.hypotheses.org/114).

The group responsible for the Historical Network Research conferences explored in greater detail above, is based in Germany and the Low Countries, and is organized by Martin Düring (http://martenduering.com/), along with Linda von Keyserlingk, Martin Stark and Ulrich Eumann. They have been holding workshops since 2009 and annual Historical Network Research conferences since 2013, and are now launching a new Journal of Historical Network Research (http://historicalnetworkresearch.org/). This journal is specifically aimed at correcting the fact that 'much of the groundbreaking and recent research into historical networks in the English-speaking world has been carried out by historical sociologists, rather than social historians, and has thus remained mostly outside the sphere of traditional academic history departments' (http://historicalnetworkresearch.org/journal/). Groups like the Connected Past, Réseaux et Histoire (RES-HIST) and Historical Network Research (and there is a considerable amount of overlap of personnel in their activities) are now providing the framework for SNA to begin to make a mark on the discipline of History more broadly. As the work of Res-Hist shows, there is clearly space for medievalists within this framework. The opinion leaders in these groups have been working hard as ambassadors for the discipline of SNA. Realising that effective use of SNA by students of history has often been hampered by the high learning curve involved in tackling the software, these groups have offered workshops. The conferences, workshops, and now the journal are doing much to link up what has too often been the isolated nodes and 'small worlds' of interest in SNA, allowing people to become more 'embedded' in their own supportive network.

To conclude, the persistent theme in the relationship between Social Network Analysis and the Humanities, and the conventionally-defined discipline of History in particular, has been one of stops and starts, of real progress tempered by limited engagement from the broader discipline. None of this is to gainsay the refreshing and innovative interdisciplinarity which characterises the field. Historians do not own the study of the past: archaeologists and social scientists have just as much a right to engage with history. But the story of SNA and the broader, Humanities-oriented swathe of academic History, including lecturers, researchers, students and the broader community, has been one of lack of engagement, with perhaps some bafflement or resistance. The relationship of capital-H 'History' and

SNA has meant historians venturing onto the academic turf of social scientists, working profitably and fruitfully with them, but not often being able to adequately translate their new skills and findings into the language and theoretical world of the Humanities. Making nice illustrations with SNA software is relatively easy; taking the quantitative results and translating them into worthwhile historical conclusions which other historians will pick up and include in the continuing discourse has proven more challenging. What we hope to offer in this current volume is a sustained attempt to marry up the digital prosopography and SNA with various significant historical contexts and actors, one that is hopefully pregnant with future possibility, but one that is only a snapshot of the research journey. The end of the road is not yet clear.

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Part Two: Introduction to SNA Concepts (by Cornell Jackson)

This introduction to SNA concepts will start by defining social networks and social network analysis, followed by a discussion on the importance of the structural view social network analysis provides. Next will be a look at what research has discovered about the rules on how networks work. Part Two ends with how this impacts our understanding of Scottish medieval society and the ways it can be used to provide new perspectives. Social networks are defined and measured as connections among people, organisations, political entities (states and nations) and/or other units. Social network analysis is a theoretical perspective and a set of techniques used to understand these relationships (Valente 2010, p. 3). The science of social networks provides a distinct way of seeing the world because it is about individuals and groups and how the individuals become groups. (Christakis and Fowler 2010, p. 32).

The Importance of Social Networks

Social network analysts view society through its structure. The structural view says that the organisation of society and the relationships that form them are as important as the attributes of individuals in explaining what happens in society. Why is the structural view of society so important? Why are the relationships that form social networks so important? Valente (2010, pp 3-7) says that bonds matter because these influence a person's behaviour above and beyond the influence of his or her attributes. A person's attributes do influence who people know and spend time with – their social network. Valente quotes Borgatti et al. (2009): 'One of the most potent ideas in the social sciences is the notion that individuals are embedded in thick webs of social relations and interactions'. The reason that social networks are so important is because human beings are ultra-social animals that create social networks (Haidt, 2006). Syed (2010, p. 110) concurs by quoting Geoffrey Cohen: 'The need to belong, to associate, is among the most important human motives. We are almost certainly hardwired with a fundamental motivation to maintain these associations'. Christakis and Fowler (2010, p. 214) add that human beings just don't live in groups, they live in networks. Valente argues the traditional social science approach of using random sampling is not adequate for measuring network concepts because random sampling removes individuals from the social context that may influence their behaviour. Valente explains that one primary reason social network research has grown in recent

decades is that scholars have become dissatisfied with attributes theories of behaviour. Many attribute theories have not explained why some people do things (e.g. quit smoking) while others do not. Social network explanations have provided good explanations in these cases. Social network analysis concepts and techniques have found wide application across a number of scientific disciplines including anthropology, business, communication, computer science, economics, education, marketing, medicine, public health, political science, psychology and sociology to name a few.

Freeman (2004, p. 2) also believes that the unique contribution of social network analysis is its structural approach which looks at the social structure as a whole rather than focusing on the individual. For him, the social network approach is grounded in the intuitive notion that the patterning of social ties in which actors are embedded has important consequences for those actors. Network analysts, then, seek to uncover various kinds of patterns. And they try to determine the conditions under which those patterns arise and discover their consequences. Comparing the structural approach of social network analysis to the traditional random sampling approach of social science, Freeman (2004, p. 1) quotes Allen Barton, a Columbia University sociologist,

> For the last thirty years, empirical social research has been dominated by the sample survey. But as usually practiced, using random sampling of individuals, the survey is a sociological meat grinder, tearing the individual from his social context and guaranteeing that nobody in the study interacts with anyone else in it. It is a little like a biologist putting his experimental animals through a hamburger machine and looking at every hundredth cell through a microscope; anatomy and physiology get lost, structure and function disappear and one is left with cell biology..... If our aim is to understand people's behaviour rather than simply to record it, we want to know about primary groups, neighbourhoods, organizations, social circles and communities; about interaction, communication, role expectations and social control.

Key Social Network Analysis Concepts

Therefore, social network analysis allows one to take a holistic, structural view in addition to the traditional approaches. There are several key concepts of social network analysis being used in this research that need to be discussed.

Small worlds

The first is small world networks. This is defined as a network in which most people have few connections yet the overall distance between any two people in the network is shorter than expected by chance (Watts, 1999). Small world networks are characterised by local clustering which indicates dense pockets of interconnectivity. There are bridges, however, that connected these subgroups and these bridges enable people to connect to seemingly distant others by fewer steps than would occur in a random network (Valente, 2010, pp. 9-19).

Homophily

Homophily is the tendency for people to affiliate and associate with others like themselves. As a result, a person's social network tends to be a reflection of him or herself because people feel more comfortable being with people like themselves rather than with people who are different. Homophily helps to explain why the small world effect occurs. The set of people from which contacts are drawn are narrowed by homophily and the probability that two people have an acquaintance in common is much higher than random chance alone would dictate. Homophily also explains why new ideas and practices have difficulty in getting a foothold within most social networks because most people talk to others like themselves and usually hold similar attitudes, beliefs and practices and as a result avoid those who do not share their views slowing the spread of new ideas. However, homophily can also speed the diffusion of an idea. Once a new idea does gain a foothold in the social network, the trust generated by homophily causes it to spread quickly (Valente, 2010, pp. 9-19). The concept of homophily was developed by Almack (1922) who asked children to name those they would like to invite to a party and then compared the similarities between the choosers and the chosen to study the effect of homophily.

Sociometry

One of the key innovators in social network analysis was Jacob Moreno (1934). Moreno, along with Helen Hall Jennings, created sociometry, an experimental technique obtained by application of quantitative methods that inquire into the evolution and organization of groups and the position of

individuals within them (Freeman 2004, p. 37). His work's aim was to investigate how psychological well-being is related to the structural features of what he called social configurations. His major innovation was to devise the sociogram as a way of representing the formal properties of social configurations (Scott 2000, p. 9). The sociogram turned out to be one the most powerful innovations in social network analysis because it allowed the visualisation of social networks. Because human beings are so visually oriented, visualisation is an efficient way to present a lot of network data in a way that is easily understood.

Centrality

Another key concept is centrality which focuses on who is the most central player in the network. The reason centrality is important is that Alex Bavelas (1948) said that the degree to which a single individual dominates its communication network – the degree to which it was centralised – affected its efficiency, its morale and the perceived influence of each individual actor. Bavelas and the group around him developed a formal model, drew graph theoretic images of social structures, designed an experiment and collected experimental data on efficiency, morale and the recognition of leadership which showed that Bevelas had been correct. As a result, a formal model for centrality was developed (Freeman 2004, pp. 68-70). In the data analysis chapter there will be a focus on centrality to identify the central players in the network who would be probably be the best link for new information for the sari sellers taking part in this research.

Ego networks

The Manchester anthropologists were extremely influential in social network analysis in Britain, with their work focused on ego networks. Ego networks are networks that focus on one individual and the individual's connections including connections between the people connected to the individual. The Manchester Anthropologists include John Barnes, Elizabeth Bott, Max Gluckman, J. Clyde Mitchell and Sigfried Nadel. Alfred Reginald Radcliffe-Brown, who espoused the structural perspective in anthropology, was a great influence on the Manchester Anthropologists (Scott 2000, pp. 26-33; Freeman 2004, p. 105). Of all the Manchester anthropologists, Scott (2000, pp. 28-32) considered Mitchell the most important contributor of this tradition. Mitchell, an anthropologist, said that the pattern of interactions that people have among themselves is the sphere of network analysis. These

networks are built on a flow of information and the transfer of resources and services. Mitchell's focus was mainly on ego networks. Mitchell's major contribution was to translate graph theory and sociometry into a sociological framework. From this came the concepts of density, the completeness of the network and reachability which measures how easy it is for all people in a network to contact one another through a limited number of steps. This research will measure the density of networks collected.

Strength of Weak Ties and Structural Holes

There has been a debate in social network analysis about the benefits of how loosely or strongly connected a network is. Burt (2000) argues that a strongly interconnected network has what is called closure. The benefits of network closure are the advantages created by lowering the risk of cooperation and that it facilitates sanctions that make it easier for people in the network to trust one another. This is because network closure means safety, security and social cohesion for its members.

The advantage of more loosely connected networks is that these offer the opportunity for brokerage. Brokerage refers to ability of people to broker connections between disconnected network segments. Those who serve as brokers act as bridges for new information helping to diffuse innovation from one group to another. Burt (1992) called the spaces between the network segments structural holes. The benefit of brokerage across structural holes is that it increases the value of cooperation.

Burt based his analysis on the seminal work of Granovetter (1973). In this work, Granovetter argues for the strength of weak ties in networks. Before Granovetter, weak ties were seen as a source of alienation (Wirth, 1938). Granovetter showed that if you are in a part of the network that has a high degree of closure, everyone there tends to have the same information. Building a weak bridging tie over a structural hole gives access to new information. Since network closure tends to breed trust, this gives the opportunity for the person to become an opinion leader and help spread the new information in that part of the network because of the confidence closure breeds.

Networks Rules

Christakis and Fowler (2010, pp. 17-26) described five rules on networks discovered through research.

The First Rule

The first rule is that individuals shape their network. One example they give of how individuals shape their networks is homophily which was described above. Individuals also decide the structure of the network by deciding how many people they are connected to, influencing how densely interconnected their family and friends are and by controlling how central they are to the social network. Individuals also shape their networks through transitivity, which is the tendency where an individual has strong ties to two separate people; those two people will know each other thus forming a triangle. The importance of transitivity will be discussed in the theoretical framework.

The Second Rule

The second rule is that the network shapes us. The network shapes individuals because the number of social contacts can affect people, transitivity, or the lack of it, can affect individuals and how many contacts an individual's friends and family have can affect them. How an individual can be constrained by its network will be discussed in the theoretical framework and the discussion of the results.

The Third Rule

The third rule is that friends affect individuals. Due to the human tendency to influence and copy one another, friends help determine the content that flows across the network which affects the individual. This seems obvious and will be shown in the impact of the number of strong ties in the collected ego networks.

The Fourth Rule

The fourth rule is that our friends' friends' friends affects individuals. Two examples of this rule are described. First is hyper dyadic spread which is the tendency of effects to spread from person to person to person beyond an individual's direct social ties. The second example is Milgram's famous sidewalk experiment (Milgram et al, 1969). In this experiment, researchers would stop and look up at a window

and record how many other passers-by also looked up. The more researchers that looked up, the more passers-by that looked up. This illustrated the importance of a threshold in influencing a network.

The Fifth Rule

The fifth rule that the network has a life of its own, or to put it another way, a network is more than the sum of its parts. Christakis and Fowler give two reasons why the network has a life of its own. First, networks combine properties and functions that are neither controlled nor perceived by its members. They can only be understood by studying the whole network. Second, networks also have emergent properties. Emergent properties are new attributes of a whole that arise from the interaction and interconnection of the parts.

Influence on the Network

One question that comes up is how far does an individual's connections and influence reach into the social network? Christakis and Fowler (2010, pp. 26-30) give different answers to the question for connections and influence. For connections, they point to Milgram's famous six degrees of separation experiment. In this experiment (Travers and Milgram, 1969), Milgram gave a few hundred people who lived in Nebraska in the USA a letter addressed to a businessman in Boston more than 2300 kilometres to the east in the USA. These people were asked to send the letter to someone they knew personally. The goal was to get the letter to someone they thought would be more likely to have a personal relationship with the Boston businessman. The number of times the letter changed hands was tracked and it was found that on average it changed hands six times. Dodds, Muhamad and Watts (2003) repeated Milgram's experiment using e-mail instead of letters. This time 98,000 subjects were recruited. Each subject was randomly assigned a target from a list of eighteen targets in thirteen countries. The subjects sent an e-mail to someone the subject knew who might in turn know the targeted person. Again, it took roughly six steps to get the e-mail to the targeted person replicating Milgram's results. Therefore, Christakis and Fowler conclude that an individual reach extended six steps or degrees into their networks.

For influence, Christakis and Fowler conclude that the reach of an individual's influence is much shorter. They promulgate the three degrees of influence rule. This rule states that an individual's influence through the network gradually dissipates and ceases to have a noticeable effect on people beyond the social frontier that lies at three degrees of separation. They give three reasons for this. First is the

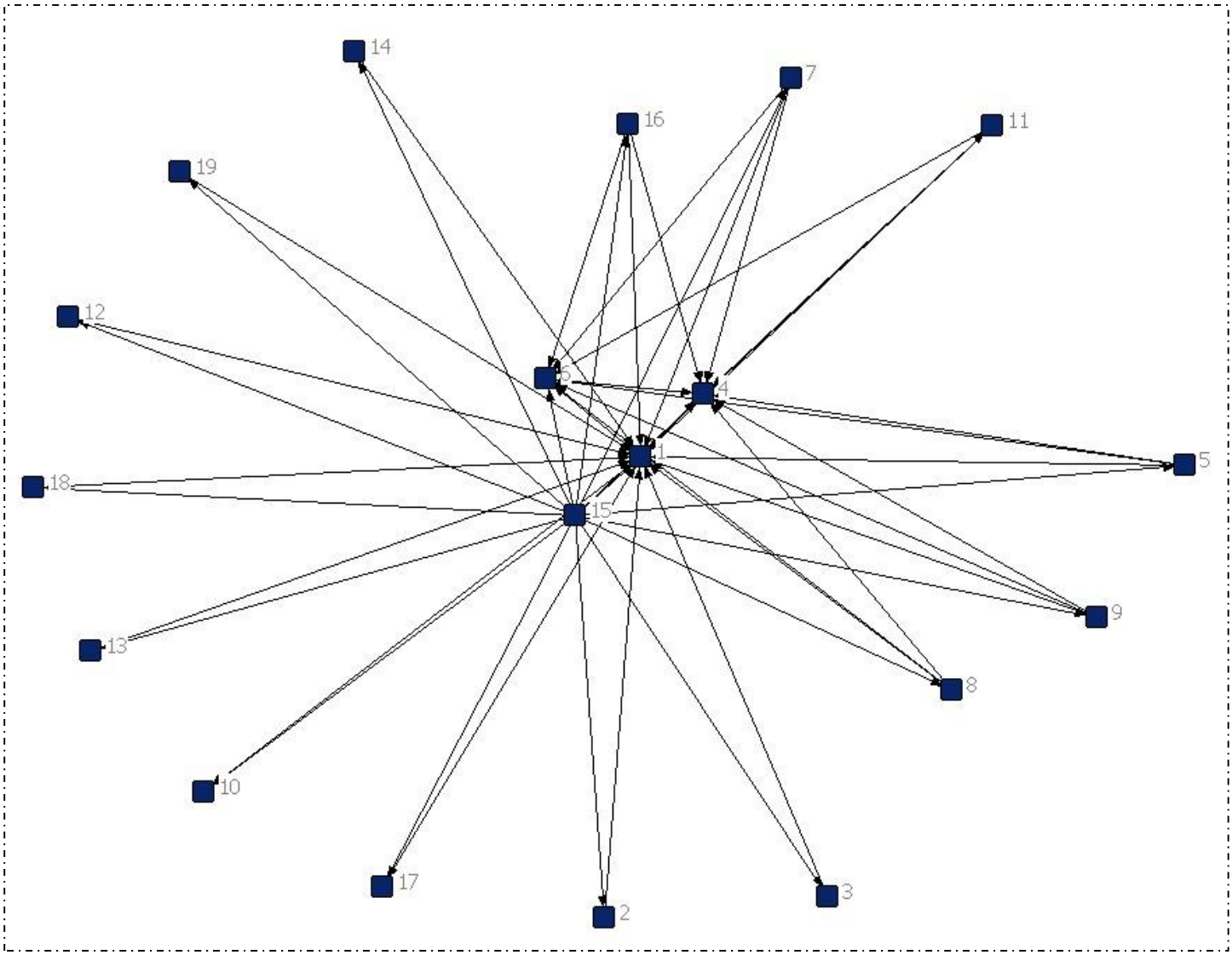
Intrinsic Decay Explanation, which says that influence eventually peters out as information loses it fidelity. Second is the Network Instability Explanation. This explanation says that links beyond three degrees have a tendency to become unstable as the network evolves. Third is the Evolutionary Purpose Explanation, which says that humans evolved in small groups in which everyone was connected to everyone else by three degrees which constrains influence going beyond three degrees.

Visualisations

One of the key advantages of social network analysis is the ability to use software to visualise the network. Features not readily apparent looking at the numbers become very apparent when looking at the visualisation. The software used to do the network calculations was UCINET (Borgatti et al, 2002) and NetDraw (Borgatti, 2002) was used to visualise the network. NetDraw uses a spring-embedded algorithm where the edges in the network behaves as springs and does not like long lines.

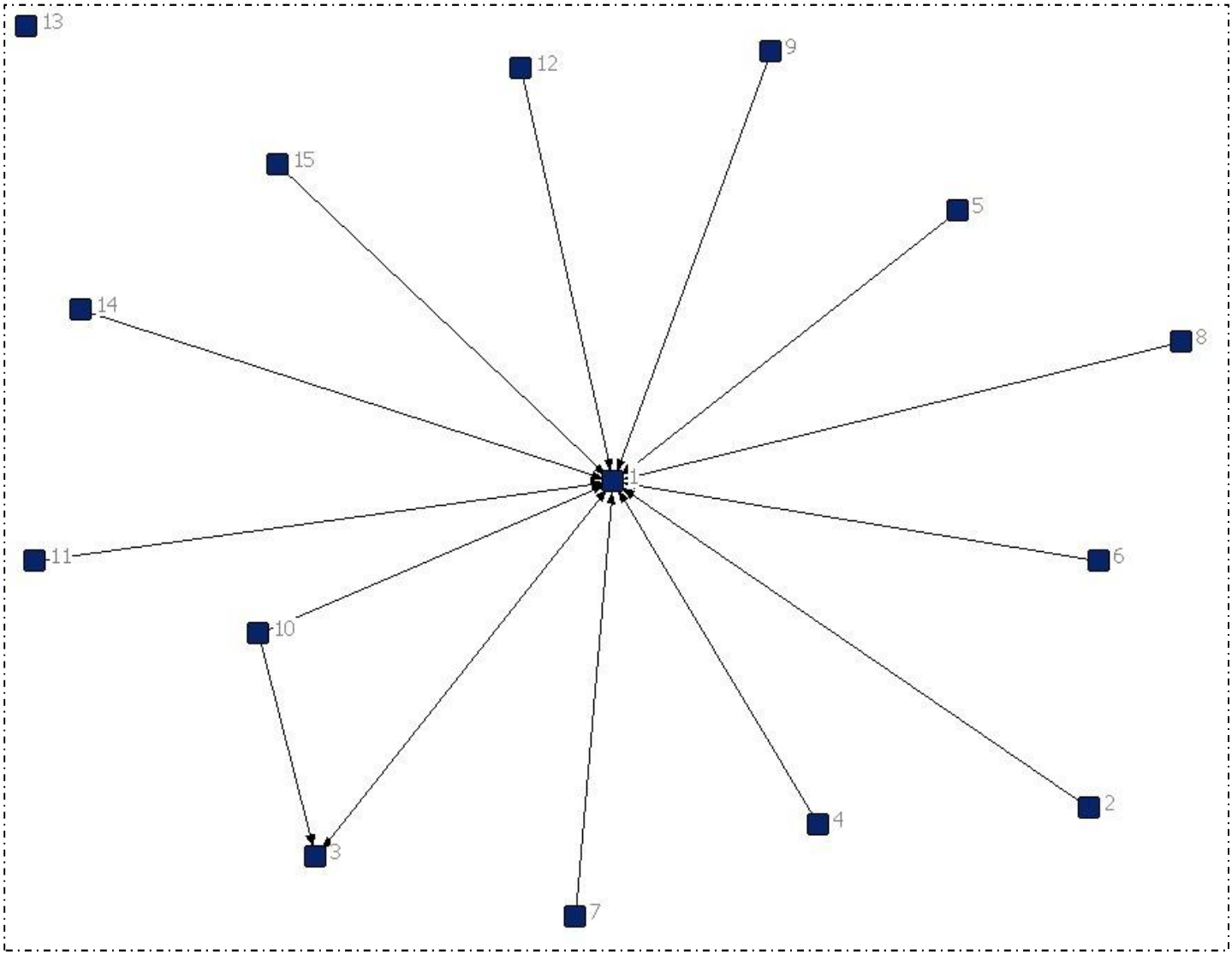
Using examples collected during a field trip from a separate PhD research project in India, each respondent was asked to identify which members of the Self Help Group (SHG) who did the most work. SHGs are essentially microbanks owned by its members. In looking at the visualisation, it is important to note that direction is important. In this case, the base of the arrow is at the respondent and the arrowhead points to the people the respondent thinks are important. The more arrowheads a person has, the more important the person is within the SHG.

Figure 1.1. Male SHG: Who Does the Most Work?



In Figure 1 above is the visualisation of the answers for the male SHG and Figure 2 below is the visualisation for one of the female SHGs.

Figure 1.2. Female SHG: Who Does Most of the Work?



In Figure 1.1, most of the arrows point to the animator (SHG leader) and the two representatives (deputy SHG leaders). In Figure 1.2, almost all of the arrows point to the animator. In one sense, this is not surprising that the leaders would have the most arrows pointing at them. However, another way to interpret these is to say that if anything happened to the leader of the male SHG, there are two ready replacements. The female group, on the other hand, could be in considerable difficulty if their leader disappeared. These two figures show the power of visualisation in social network analysis.

Using Two-Mode Networks

There is a special type of network used in this research called two-mode networks. In these networks, there are two different sets of actors and all of the relationships are between sets and not within them. In our research, one set consisted of charters and the other set consisted of people who had witnessed these documents. Looking at the sociogram of this network, you would see lines from each charter to those who had witnessed it. However, using a software process, more useful data can be generated by creating what are called affiliation networks. The affiliation we are looking for is how often people witnessed charters together. The more often people witness charters together, the more probable they have a real social relationship. The software process sets up a matrix which holds the results of the calculations of the number of times two people have witnessed charters together.

Applying Social Network Analysis to Medieval Scottish History

What social network analysis gives is another perspective to view medieval Scottish history that is independent of the perspective given by traditional historical methods. It is important to understand that social network perspective is in addition to and not a replacement for the perspective given by traditional historical methods.

This is especially true of the structural elements of the networks. A social network analyst can identify a group from the network diagram who are working together over time that invites the questions what are they working on why are they working on this and what historical processes are keeping this group together? The network diagram identifies individuals who are extremely well connected and the question becomes why these people so well connected and what are the processes that generated these connections? Is it possible for the structure of the network to identify patterns What social network analysis gives is another perspective to view medieval Scottish history that is independent of the perspective given that could possibly identify what the historical data might look like?

The true power of social network analysis is this ability to provide new perspectives. The rest of our discussion will be describing what new perspectives were uncovered in our research.

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2 Relationship Networks

The People of Medieval Scotland database has the capacity to provide datasets for two broad categories of social networks. The first, and simpler, category is defined by relationships which are explicitly defined in the database, and thus, in the medieval sources. One of the four factoid types in the PoMS database is the relationship factoid (the others are transactions, possessions, and titles/occupations) (Bradley and Pasin, 2013). These relationship factoids represent explicit statements about relationships made in the sources. This chapter examines the networks revealed by putting these data through SNA software. The second broad category are inferred relationships between individuals, which are drawn from information embedded in the transaction factoids. The most common of these are the (implicit) relationships between grantors and beneficiaries (examined in chapter three) and between individuals who witness alongside one another (examined in chapters four and five).

There are currently 191 distinct relationship types in the PoMS database, though many of these were only added in the second phase of the project, covering the years 1286-1314. There were 158 relationship types as of the end of the first phase of the project, and these are reflected in what follows. Of these, 40 are categorised as 'Familial relationships', while 81 are described as 'Employment relationships' and 36 are described as 'Tenurial and lordship relationships'. (One, 'infirm', is categorised only as 'other'.) We are going to now examine the networks of these three categories of explicitly-defined relationships in turn.

Part One: Familial Relationships

It is very important to remember that the sociogram of family relationships reflects only those statements which have been explicitly made in the written sources. While these are fairly frequent in terms of father-son relationships, e.g., as expressed in patronymic name forms, statements about daughters and mothers are made much less often in the documents. There is, moreover, an element of randomness in the evidence about maternal relationships, which tend to rely on joint donations to religious establishments and land transactions regarding marriage portions and dowerlands. Most significantly is the division immediately noticeable between the most powerful in society (represented in the two basic sociograms immediately following) and the less powerful. We have a relatively good understanding of marriages among the royal family and higher aristocracy, especially in the thirteenth

century, while for the lower aristocracy and middling sorts, we often only know the names of one or two relatives. Thus the kingdom's elites appear as a highly interconnected group in the core region, while the lesser families appear as a constellation or penumbra surrounding them. This is not entirely a matter of the survival of sources. While better documentary evidence would certainly reveal a good deal more interconnection, the central place of the royal family and kingdom's magnates would not change; indeed some of the additional interconnectedness would likely result in an even thicker web linking up this power elite.

Table 2.1. Familial Relationships

The following table lists the 40 specific familial relationship types.

Relationship Types
Ancestor
Aunt
Bride/betrothed (f.) (*sponsa*)
Bridegroom/betrothed (m.) (*sponsus*)
Brother
Children (*liberi*)
Cognata (kinswoman/female cousin)
Cognatus/*consanguineus* (kinsman/male cousin)
Consort
Countess
Daughter
Father
Father-in-law
First-born (*primogenitus*)
Foster-brother (*collactaneo*)
Grandfather
Grandmother
Great-grandfather
Great-grandmother
Great-great grandfather (*abavus*)
Great-great-great grandfather (*atavus*)
Heir
Husband (*maritus*)
Man [husband] (*vir*)
Mother
Nepos (nephew/grandson)
Neptis (niece/granddaughter)
Parents (*parentes*) [recté: kindred]
Queen (i.e. consort/wife)

Sister
Son
Son-in-law (*gener/filius in lege*)
Sororius (sister's husband/sister's son)
Stepmother
Stepson (*priuignus*)
Successor
Uncle - maternal (*avunculus*)
Uncle - paternal (*patruus*)
Widow (*vidua*)
Wife (*uxor*)

Even though the evidence for the core elite network of family relationships is incomplete and indicative rather than exhaustive, it still illustrates a very real phenomenon whereby social 'connections' reinforced and reproduced wealth and power in society. Sociologist Robert Merton dubbed this the 'Matthew effect'; this concept of accumulated advantage applies to status, fame, and economic wealth (Merton 1968). This concept has been usefully applied to many areas of endeavour, including the network dynamics of Hollywood "A-Listers" (Currid-Halkett 2010). If research on the Matthew effect can be successfully applied to the Scottish case, we might surmise that family connections between the most powerful and wealthiest society are a proxy for more social relationships of other kinds between the same families, in terms of friendships, formal landholding and 'business' ties, and so on. This means that this core group spends more time with each other, leading to a self-replicating structure of power. Further, because these elites have more landed and other interests spread across a wider geographical range, and because we see them operating in more social, judicial, and political arenas in a broader variety of roles, offices, and contexts, they are likely to be connected to more people than non-elites (for example, as co-witnesses), and more of their connections are likely to be 'weak ties' rather than strong ones. While strong ties are necessary for protection and security, it is through weak ties that new information, ideas, money, or other things pass into a network. This is reflected in the density of their ego-networks, a concept to which we will return in chapter 8. Opinion leaders in a network are characterised by low ego-network densities. For now, we can simply posit a hypothesis that the elites of Scottish society, as illustrated (albeit imperfectly) by the family relationships sociograms, have more weak ties and lower ego-network densities than their less powerful contemporaries. We will return to this hypothesis in the book's conclusion.

Core-and-periphery in family relationships

Figure 2.1. Gephi-generated sociogram, using Force Atlas 2.

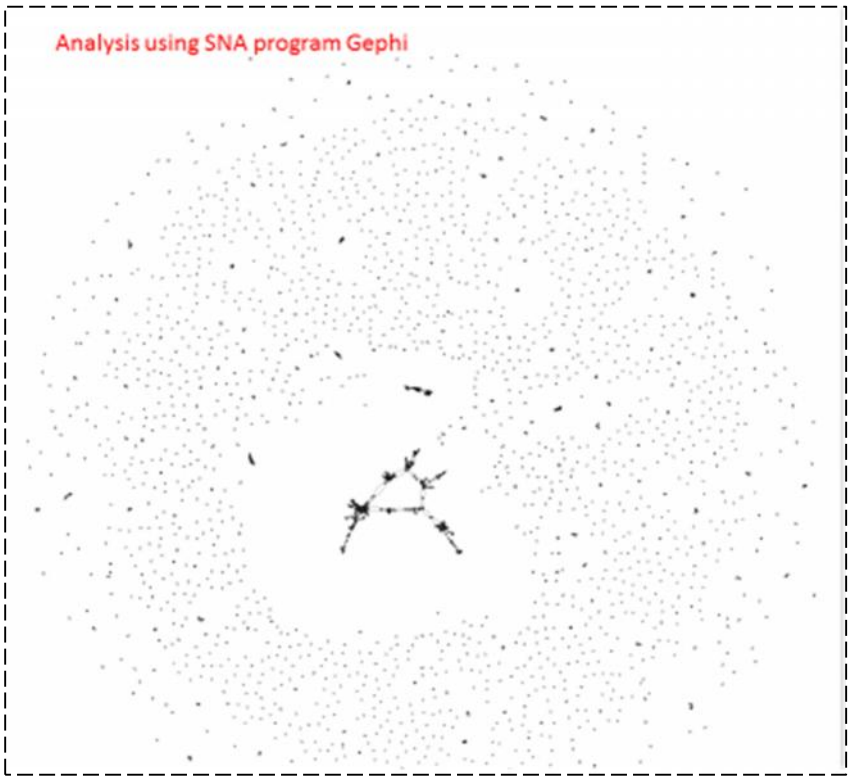


Figure 2.2. Gephi-generated sociogram, using Yifan Hu.

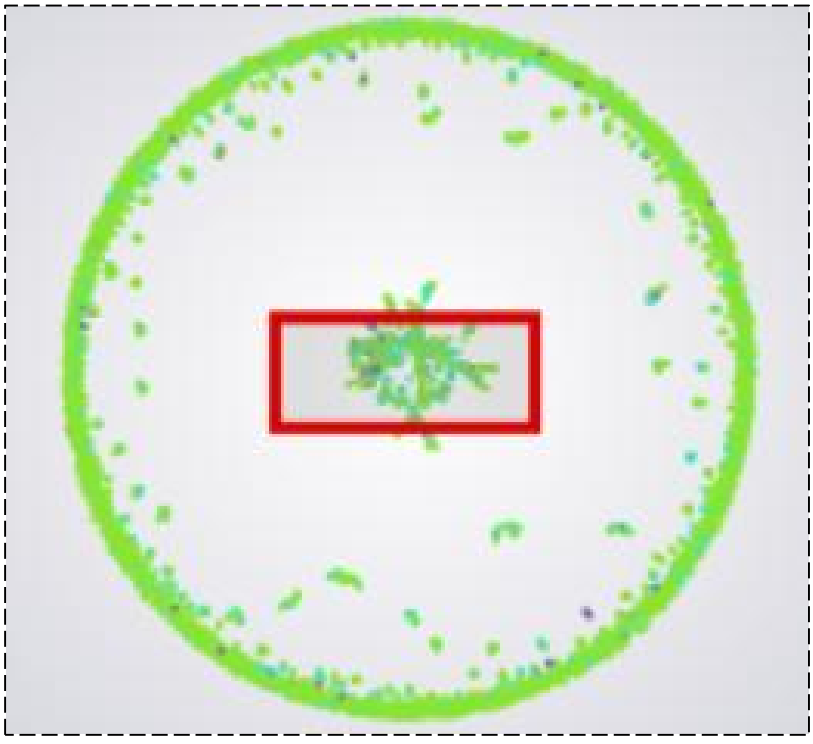


Figure 2.3. Elite family groups, simplified

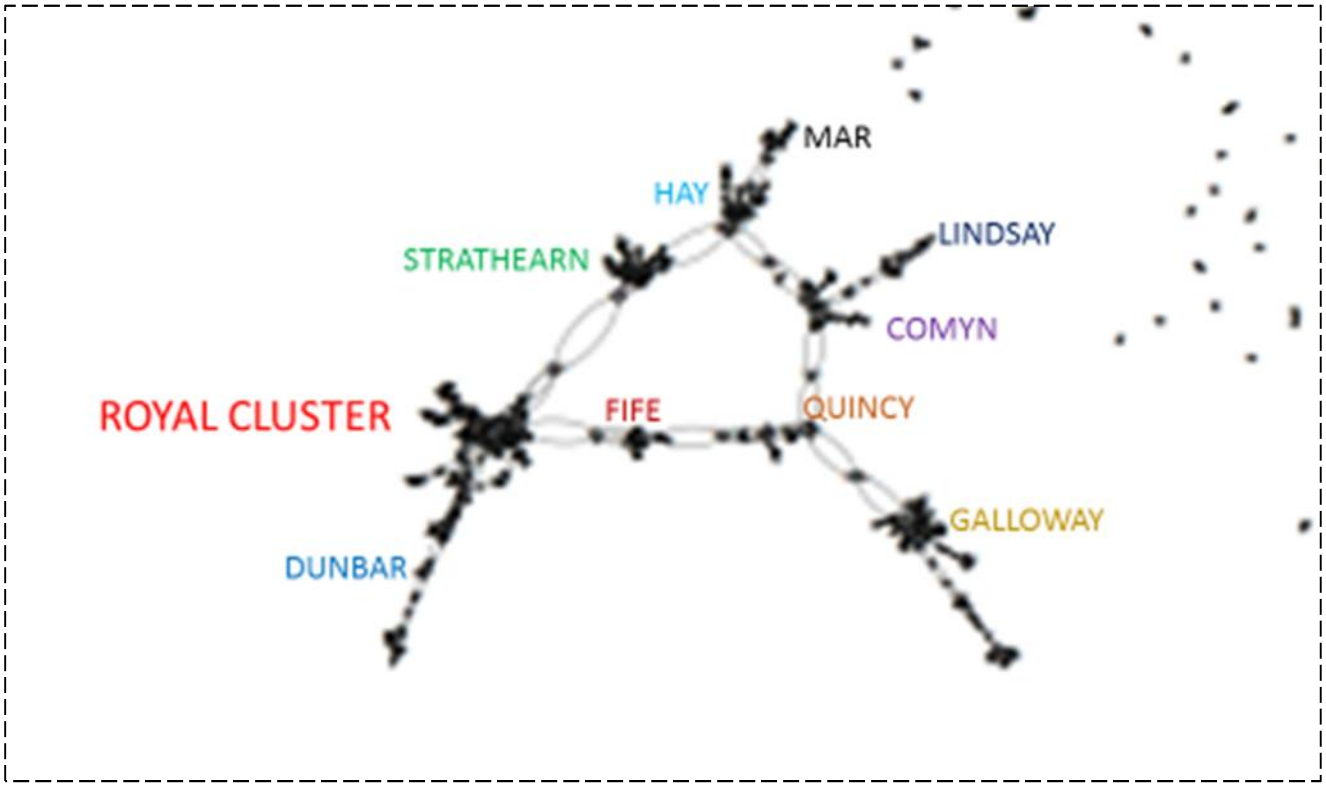
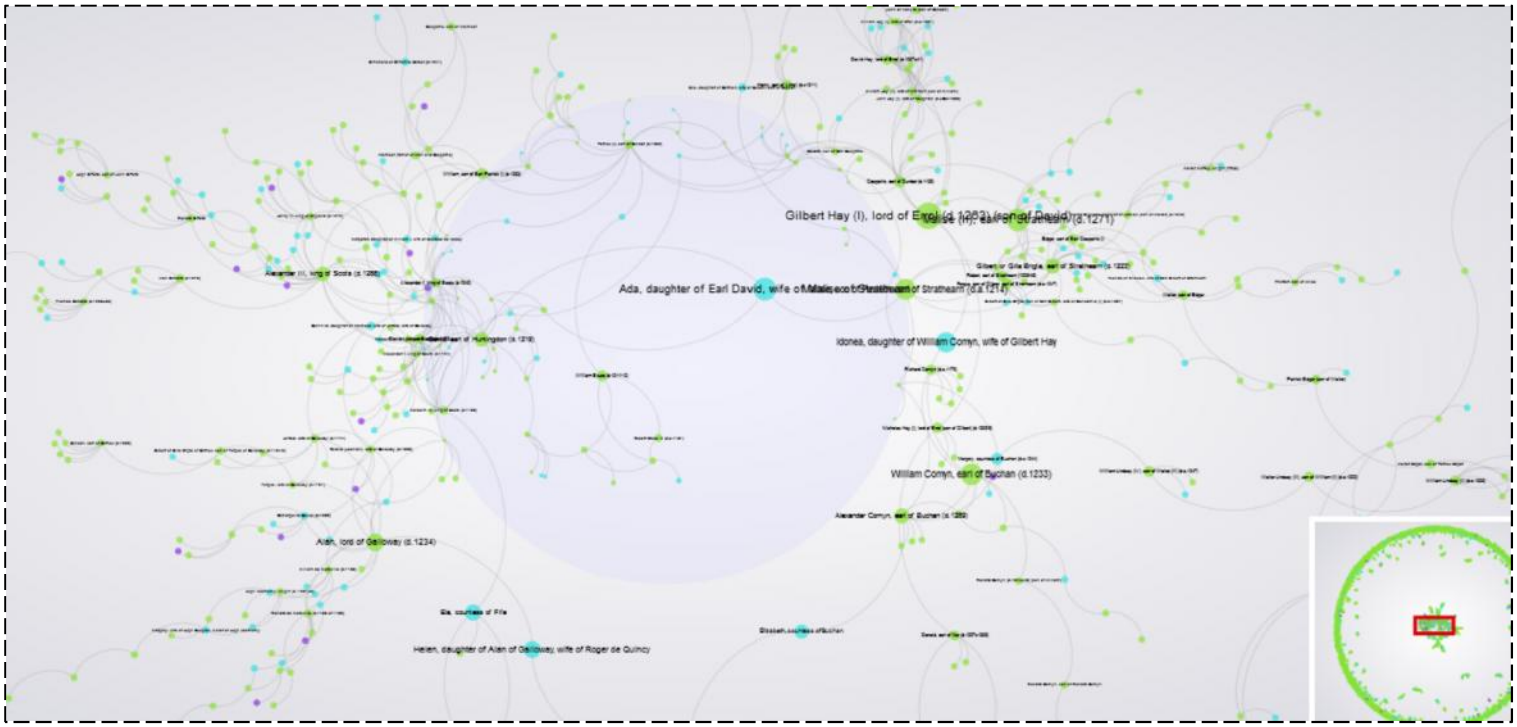
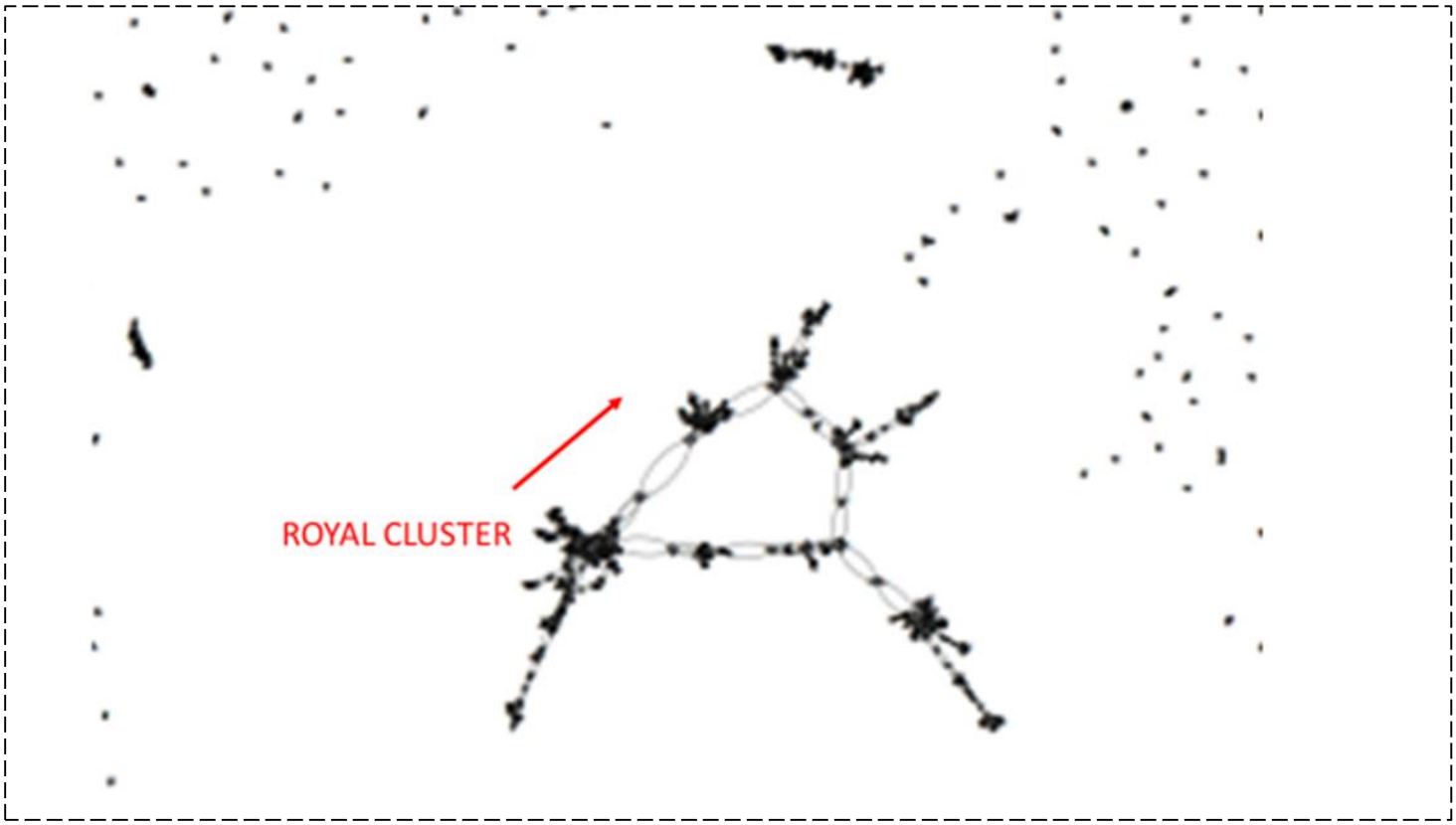


Figure 2.4. Core section, Gephi Yifan Hu. Node size and text size reflects betweenness centrality



Because family groups cluster together in the sociogram, it is possible to think of the core elite section as a collection of families. These are represented in simplified form in Figure 2.3. The largest of these groups is the royal family. It is possible to 'tour' this elite circle relatively easy; Figures 2.5 though 2.9 illustrate a clockwise movement from the royal family through the various elite families. The best represented families are those based around the earldoms of Fife, Dunbar, Mar, Strathearn, the lords of Galloway, and the noble families of Hay, Lindsay, Comyn, and Quincy, although members of other families are sometimes interspersed. These sociograms were made using the Force Atlas 2 design in Gephi[5]; the use of Person ID numbers instead of names makes the images less crowded, although this sacrifices legibility. The size of the nodes reflects the betweenness centrality of the persons, a point to which we will come on soon.

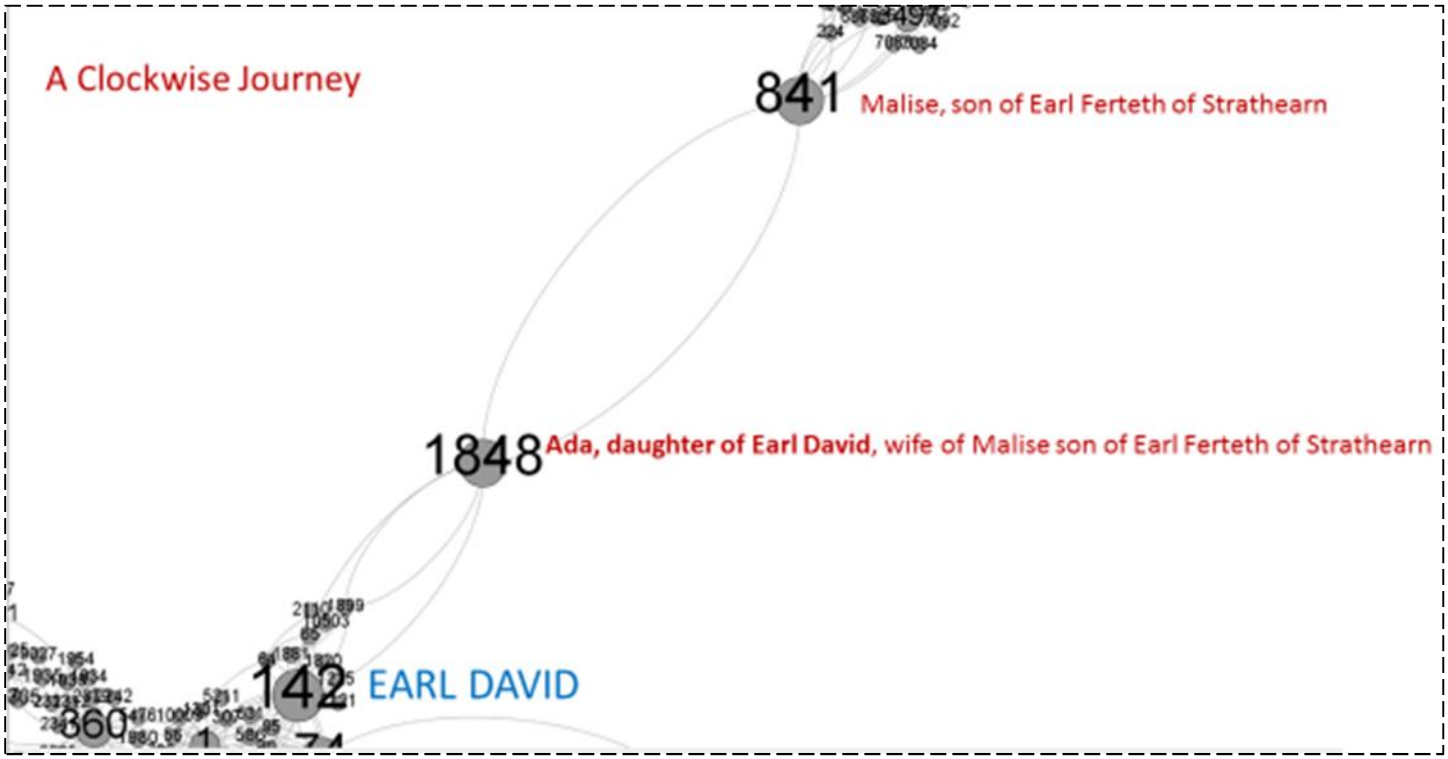
Figure 2.5. Core elite group



[5] Old dataset

Figure 2.6 illustrates the link between the royal grouping and the Strathearn comital grouping by means of Ada, illegitimate daughter of David earl of Huntingdon (d. 1219), the younger brother of King Malcolm (Mael Coluim) IV (1153-65) and King William I (1165-1214). Ada's marriage to Malise (Mael Ísu) son of Earl Ferteth and brother of Earl Gilbert of Strathearn tied the two families together.

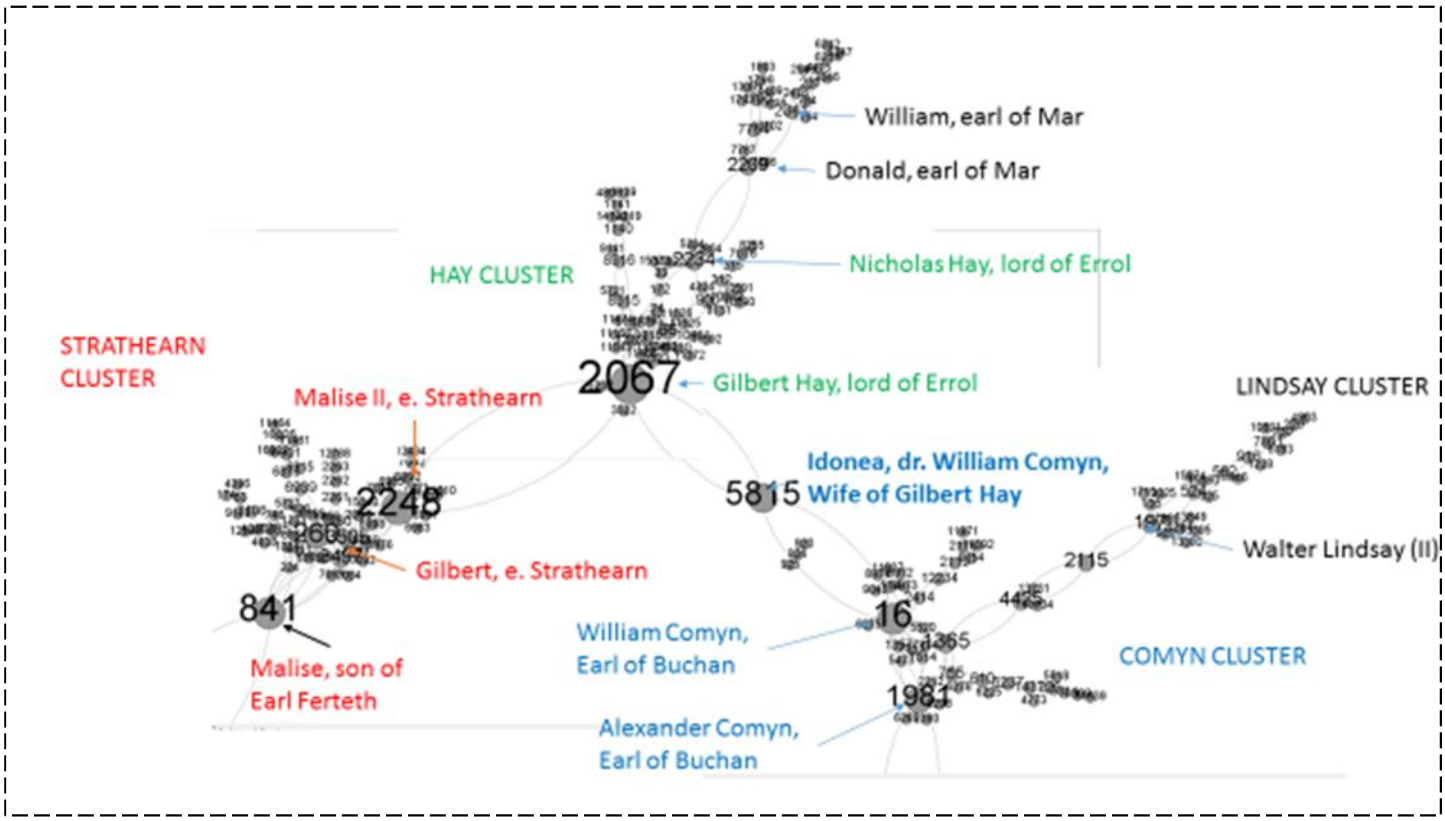
Figure 2.6. Connecting the royal and Strathearn groupings



The size of the nodes and the Person ID numbers is adjusted based on a concept called 'betweenness centrality' in social network theory. This concept was first developed by sociologist Linton Freeman in 1977. This is a mathematical calculation intended to represent the relative importance of individuals in the network, based on their position within the network (as opposed to, for example, how many other agents they are connected with). Actors with high betweenness centrality are seen as vital components in maintaining the integrity of the network; their importance lies in connecting up other disparate individuals and groups. Mathematically, this number is calculated by determining how many times an actor sits on the shortest path between two other actors (or nodes). Actors with high betweenness

potentially are very influential in that they can control the flow of information or power between other individuals and groups (Prell 2012, 103-4). These notions seem to work well with what we know about the dynamics of medieval family and kinship groups, particularly in the sense that marriages were brokered between two families for strategic reasons, in forming alliances and friendships, healing past rifts and feuds, gaining land, power, wealth, or political influence. This is one type of network where we can witness the vital role of women in forming the bridges linking up these family groups. The importance of women as actors with agency in these sociopolitical dynamics has recently been emphasised by medieval historians. While it is important to remember that our knowledge of marriages is incomplete, there is still clearly some validity in the relative importance based on betweenness visible in Figure 2.7. The individuals linking up the families in the core 'circle', such as Malise II, earl of Strathearn, Gilbert Hay, lord of Errol, and William Comyn, earl of Buchan, is represented in the size of their nodes. The key role of William Comyn's daughter, Idonea, in linking up that family with the Hay family is also reflected. The Mar and Lindsay families, by contrast, while still important, have less betweenness centrality because they are tangential to the core circle.

Figure 2.7. Strathearn, Hay, Comyn, Lindsay groupings



In Figure 2.8, the key role of women in linking up family groupings is even more evident. It is interesting here that Ela countess of Fife has a higher betweenness centrality than her husband Earl Duncan II of Fife (d.1204), a person to whom we will return. That earl's brother, Adam, is also important, because his marriage to Orable, daughter of Ness, widow of Robert de Quincy and mother of Saher de Quincy earl of Winchester, creates the link between the Fife and Quincy houses. Examination of the importance of individuals according to this regime and their places in the network should flag up areas of potential profitable enquiry by the historian. Roger de Quincy is linked through his daughter Elizabeth to the Comyn earl of Buchan and through his wife Helen with the house of Galloway. Countess Ela of Fife also links up the Fife family with the royal family (Figure 2.9). The royals are connected with the comital house of Dunbar by means of an illegitimate daughter of King William, Ada countess of Dunbar. Alan Durward and his family are also linked to the royal family by means of an illegitimate daughter, this time of Alexander II.

Figure 2.8. De Quincy, Fife, and Galloway groupings

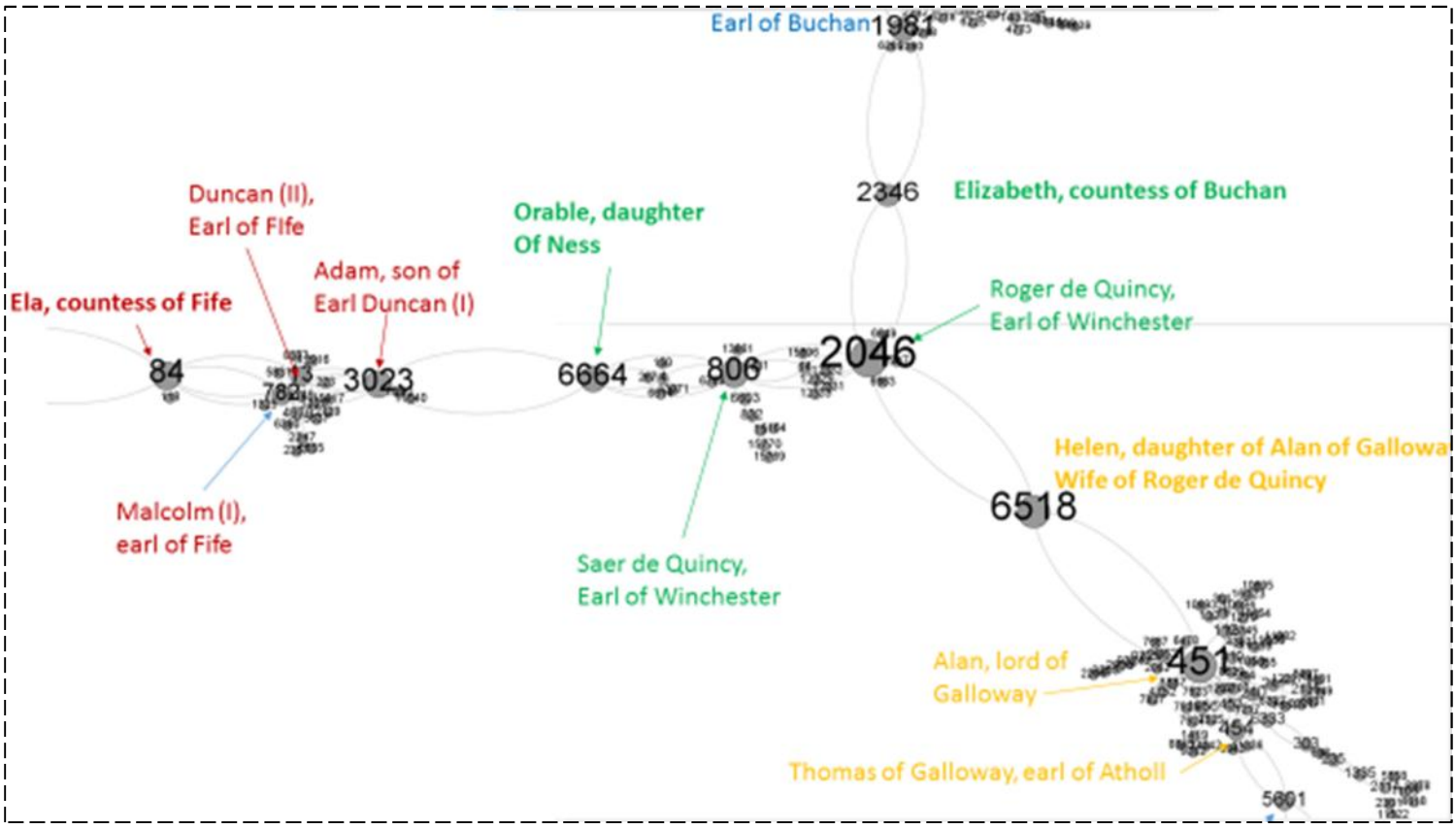


Figure 2.9. Royal family and Dunbar grouping

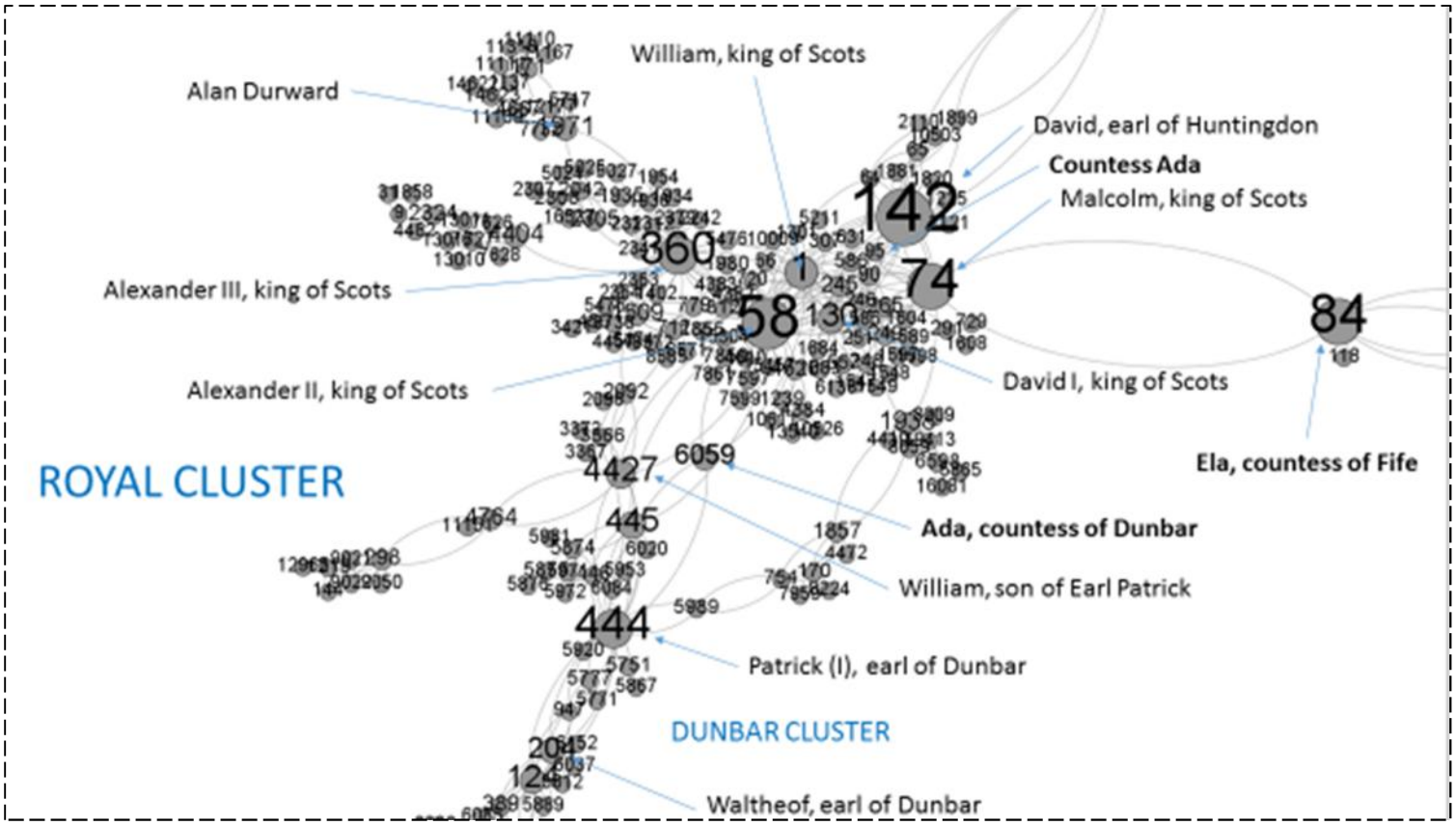


Table 2.2, below, gives the top thirty individuals in the family relationship sociogram according to their betweenness centrality.[6] Seven of these thirty are women (highlighted in light blue). This reflects their importance in connecting distinct family groupings, and any potential study of the social role of women in forging alliances should begin with these women. The remaining 23 men are indicative of the top families in this elite circle, and their betweenness often further reflects the ways in which individual actors within family groupings are linked up. Individuals from (Scottish) comital families are given in dark blue, making up twelve, or just over one third, of the top 30. They represent the comital kinship groups of Strathearn, Fife, Buchan, and Dunbar, with Mar, Angus, Atholl, Menteith, Lennox, Carrick and Ross being noticeably absent. Five individuals are from the royal family (in purple), with David earl of Huntingdon being the most central in terms of betweenness. The families of Hay, de Quincy, and Galloway are among the remaining.

[6] New dataset

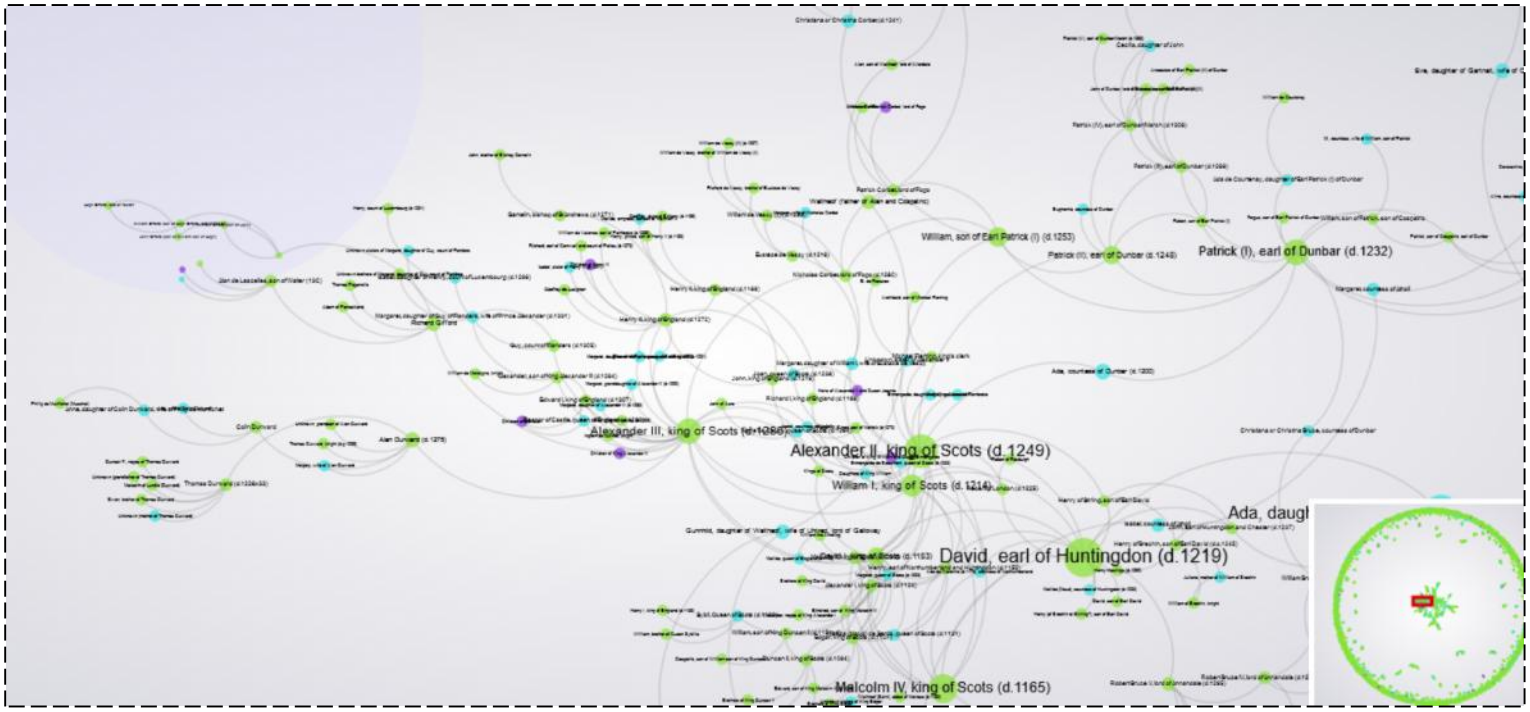
Table 2.2. Top 30 people in family relationships sociogram, by betweenness

Id	Name	Gender	Betweenness Centrality
2067	Gilbert Hay (I), lord of Errol (d.1263) (son of David)	M	69778.39649
2248	Malise (II), earl of Strathearn (d.1271)	M	55702.77745
142	David, earl of Huntingdon (d.1219)	M	54994.28946
16	William Comyn, earl of Buchan (d.1233)	M	52837.68221
1848	Ada, daughter of Earl David, wife of Malise of Strathearn	F	50112.63935
841	Malise, son of Ferteth earl of Strathearn (d.a.1214)	M	50086.80602
2046	Roger de Quincy, earl of Winchester (d.1264)	M	49534.59398
5815	Idonea, daughter of William Comyn, wife of Gilbert Hay	F	47810.51554
58	Alexander II, king of Scots (d.1249)	M	43981.18103
451	Alan, lord of Galloway (d.1234)	M	38706.45178
6518	Helen, daughter of Alan of Galloway, wife of Roger de Quincy	F	36380.88512
806	Saer de Quincy, earl of Winchester (d.1219)	M	34881.62732
74	Malcolm IV, king of Scots (d.1165)	M	34311.72077
84	Ela, countess of Fife	F	33954.48446
3023	Adam of Kilconquhar, brother of Earl Duncan (father of Duncan)	M	32156.05589
6664	Orable, daughter of Ness son of William	F	31585.3416
260	Gilbert or Gilla Brigte, earl of Strathearn (d.1223)	M	30646.06867
1981	Alexander Comyn, earl of Buchan (d.1289)	M	30292.26349
444	Patrick (I), earl of Dunbar (d.1232)	M	28533.59844
360	Alexander III, king of Scots (d.1286)	M	27886.83267
2346	Elizabeth, countess of Buchan	F	26335.1422
1	William I, king of Scots (d.1214)	M	21559.72018
1365	Margery, countess of Buchan (d.c.1244)	F	18432.11007
782	Malcolm (I), earl of Fife (d.1229)	M	18042.24223
13	Duncan (II), earl of Fife (d.1204)	M	18042.24223
443	Cospatric, earl of Dunbar (d.1138)	M	17228
4427	William, son of Earl Patrick (I) (d.1253)	M	16360.62631
3497	Fergus, son of Gilbert, earl of Strathearn (d.c.1247)	M	15747.98534
4425	William Lindsay (IV), son of Walter (III) (d.c.1247)	M	15036

Of course, the strength in the family relationships sociograms, and sociograms of all kinds, lies in the ability to visualize things in a broader and novel way compared to what was possible beforehand. The SNA visualizations on the PoMS website (http://db.poms.ac.uk/sna/all/) have all the nodes colour-coded according to sex/gender and labelled with the full display name of the individual. This makes it possible for users to explore the sociograms without needing to resort to a cumbersome list of Person

ID numbers, but it also makes the graphs more crowded. This also means the displays of relationship groupings do not reveal the patterns as clearly as the Gephi sociograms we have been using up to now (which employ the 'Force Atlas 2' design format). The following uses the 'Yifan Hu' design format in Gephi[7]:

Figure 2.10. Royal family grouping, Yifan Hu.



Figures 2.11 and 2.12 below reveal the extent to which families and individuals were interconnected. Alan, lord of Galloway (d. 1234) is the most central person in this segment of the elite core group. To his left and down, we see the Moreville family and their connections. To the right and down, we see the family of the earls of Atholl. Above and to the left of Alan we see the Galloway family itself and its collateral branch, the earls of Carrick. Also linked to this group are the descendants of Waltheof, lord of Allerdale, and through them, the de Mowbray family. Hugh Abernethy, a relative of Alan of Galloway, links this group in with the Abernethy and Douglas families.

[7] New dataset

Figure 2.11. Close-up on segment of inner main segment.

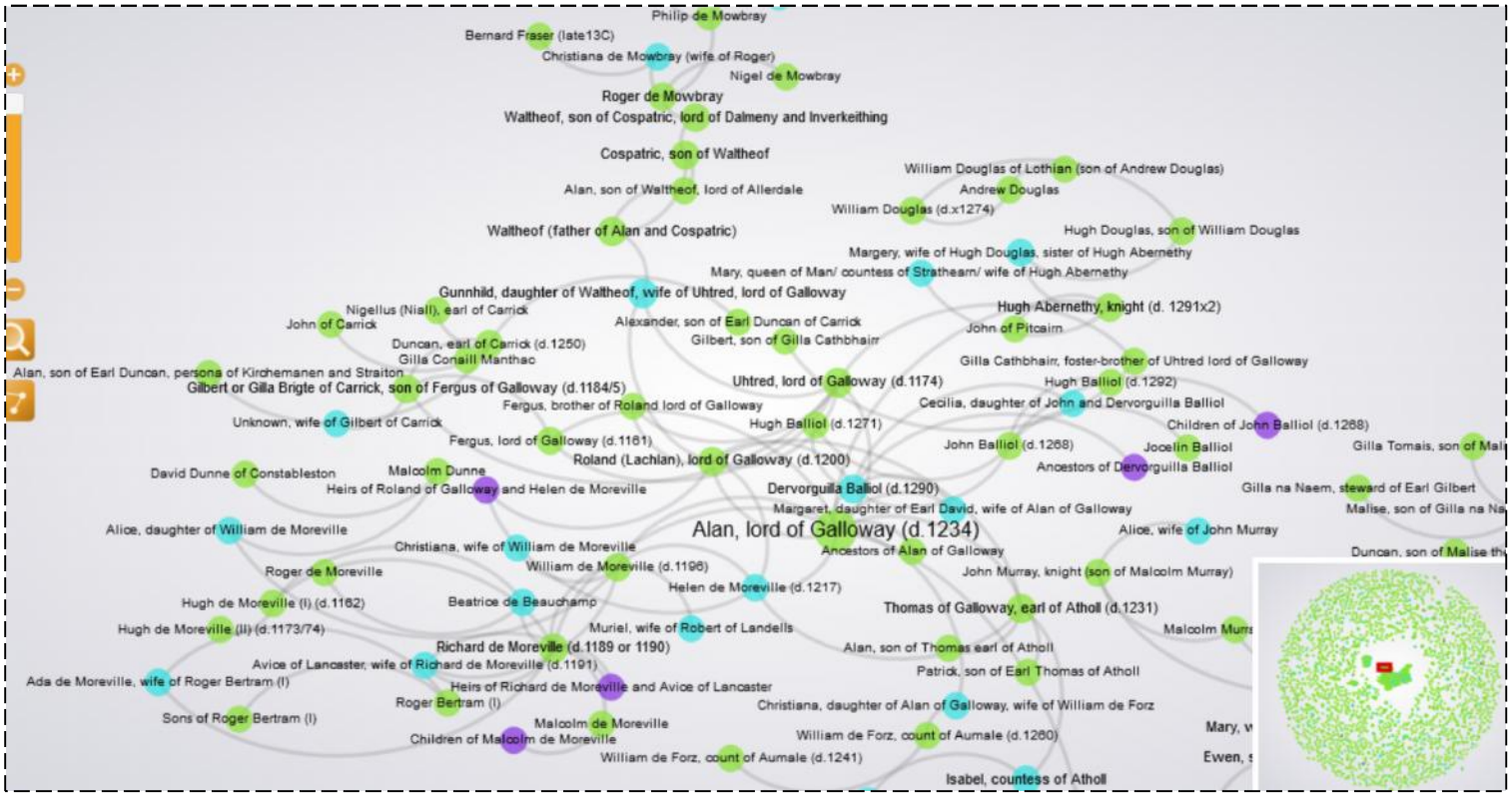
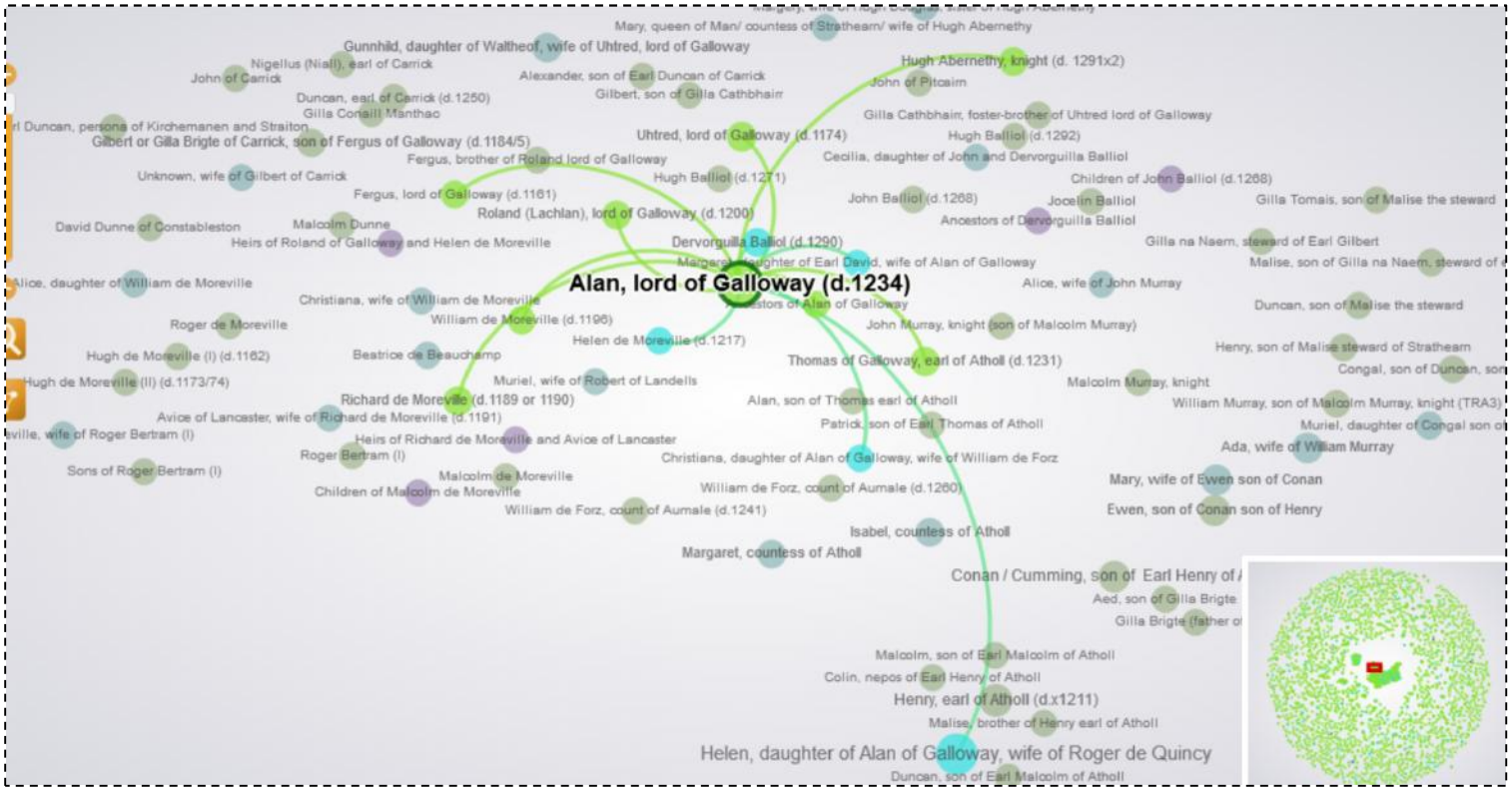


Figure 2.12. Close-up, with direct connections of Alan, lord of Galloway, highlighted.



We are going to use these Yifan Hu sociogram close-ups to examine some of the groupings which are not in the core linked-up elite area, but which still represent important players in the Scottish kingdom. Figures 2.13 and 2.14 give two different layouts of an important network that developed around Bishop Robert of St Andrews (d. 1159). It should be noted that two of the familial relationship types are 'ancestor' (antecessor, which can also be translated as predecessor or forebear), and 'successor'. These are often used by lay families to refer to their 'blood' kindred, but were also used by churchmen such as bishops. So not all the relationships referred to by churchmen were 'real' family relationships. However, churchmen often wrote about their predecessors and peers using the metaphor of family, so it is perhaps not too far off the mark. In any event, this grouping reveals the importance of siblings, nephews, and in all probability, illegitimate children, to networks around bishops.

Figure 2.13. Robert, bishop of St Andrews, with direct links highlighted.

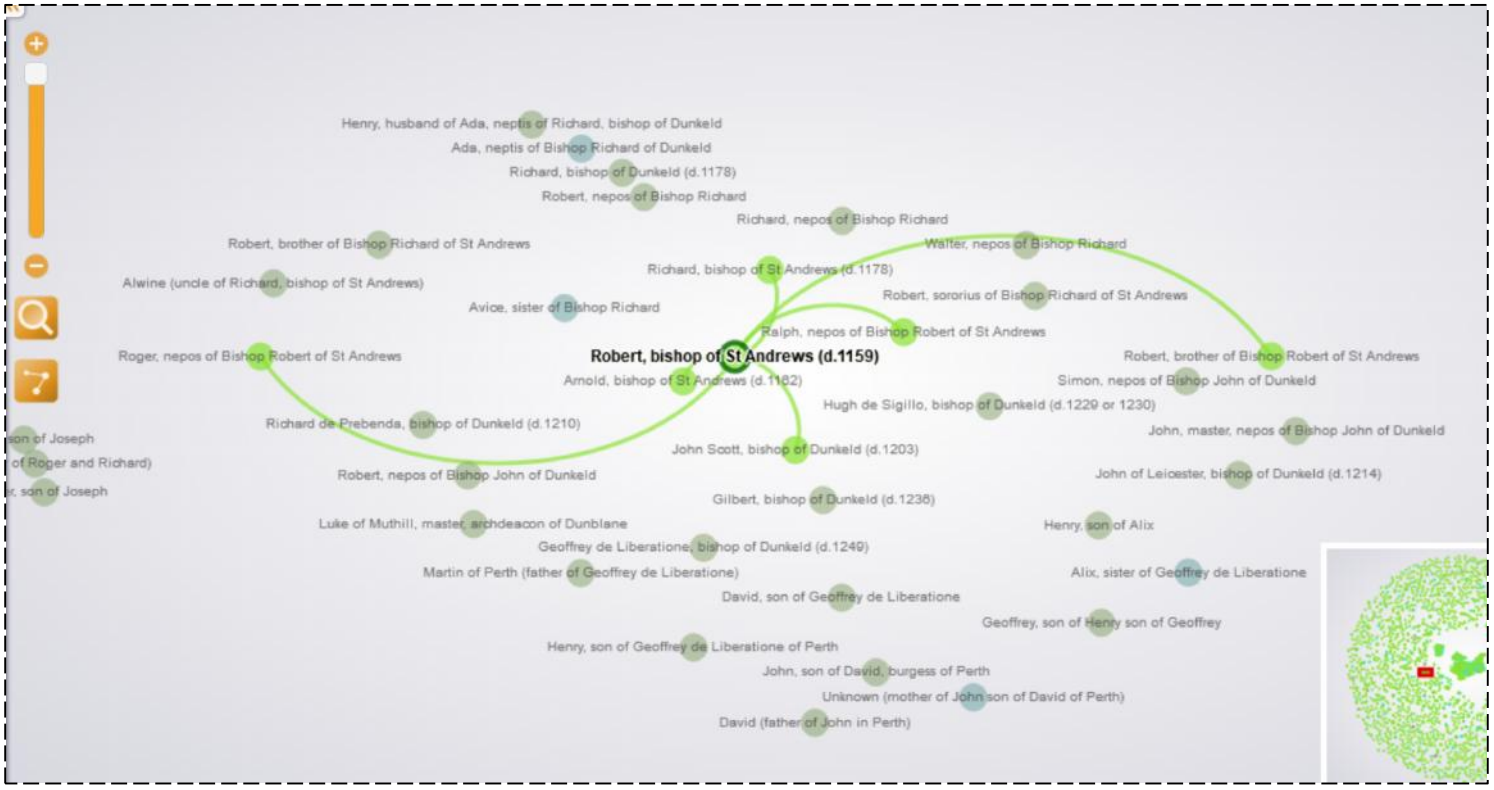
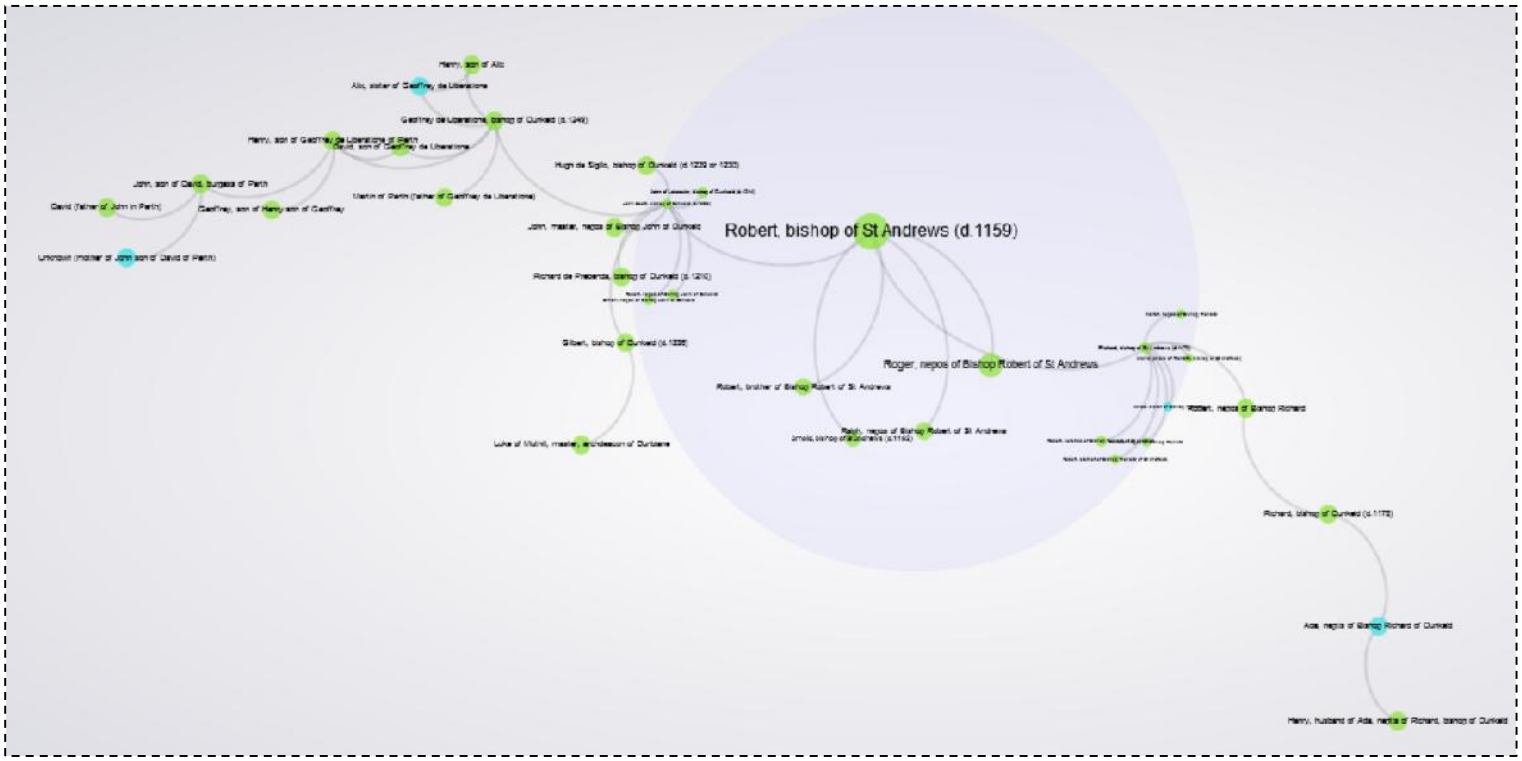


Figure 2.14. Network of Bishop Robert of St Andrews (d. 1159).



Figures 2.15 and 2.16 below show the largest interconnected group of nodes outwith the main core component in the family relationships sociogram. This reveals the prolific comital family of Lennox, who were connected by marriage to the Stewarts, their neighbours to the south in Renfrewshire. The Stewarts in turn were connected through Walter son of Alan (I)'s wife, Eschina, to the Avenel family, landholders in the border region. It is possible to visualize other family groupings who were not linked up (at least in our surviving Scottish evidence) with the core group, including the Melvilles (Figure 2.17), the Grahams (Figure 2.18), and the Murrays (Figure 2.19). The outside penumbra consists of many many groups of two and three individuals, such as fathers and sons, as demonstrated by the close-up view in Figure 2.20.

Figure 2.15. Lennox/ Stewart/ Avenel group, top half

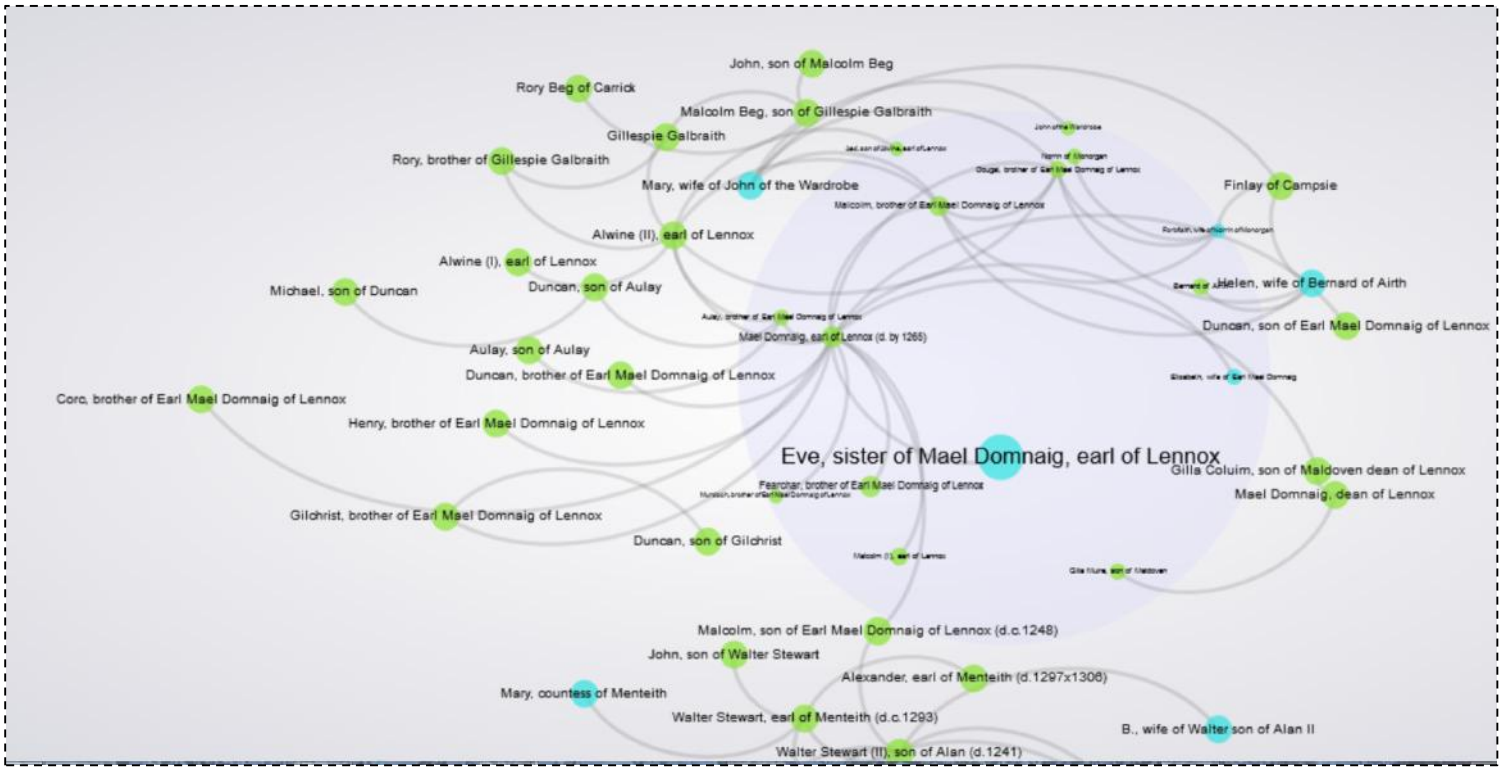


Figure 2.16. Lennox/ Stewart/ Avenel group, bottom half

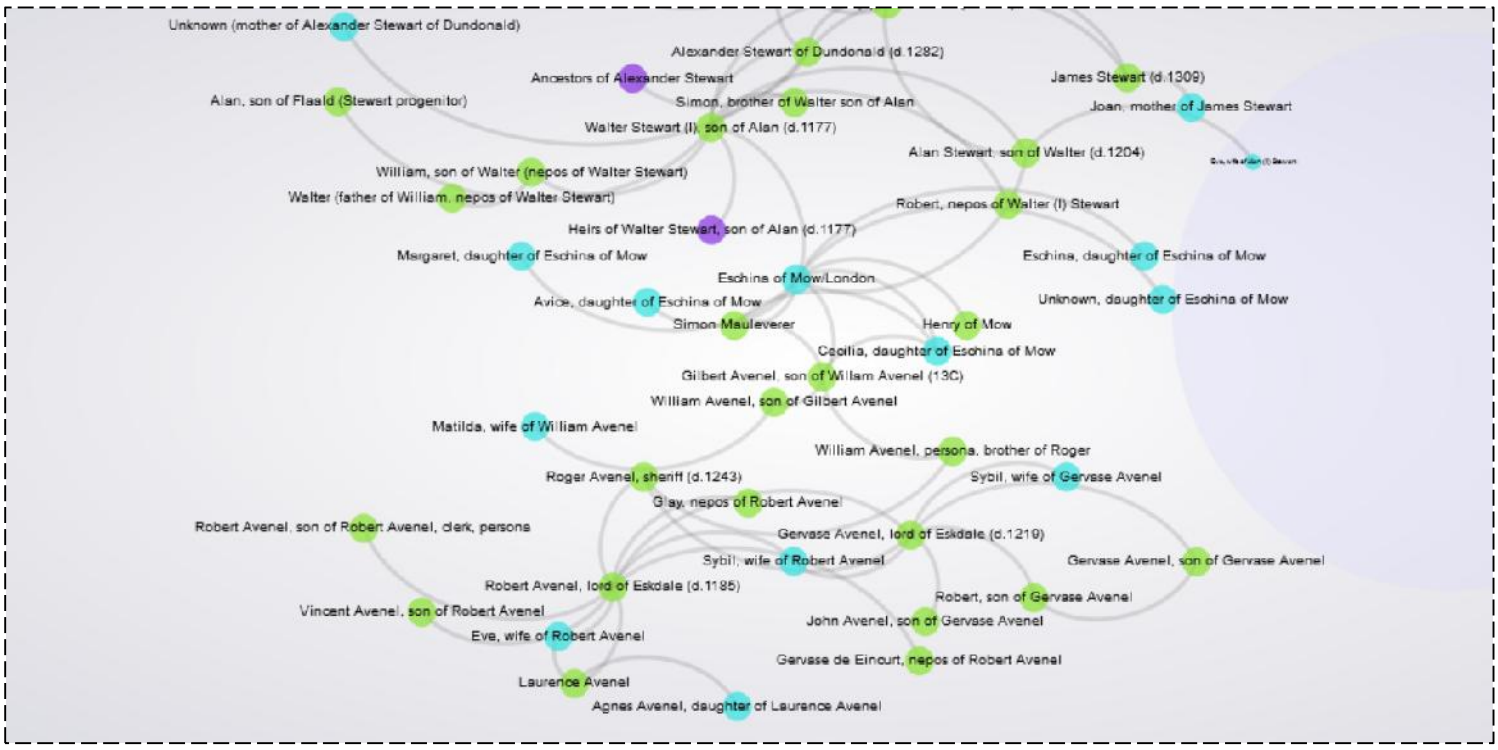


Figure 2.17. Melville family grouping

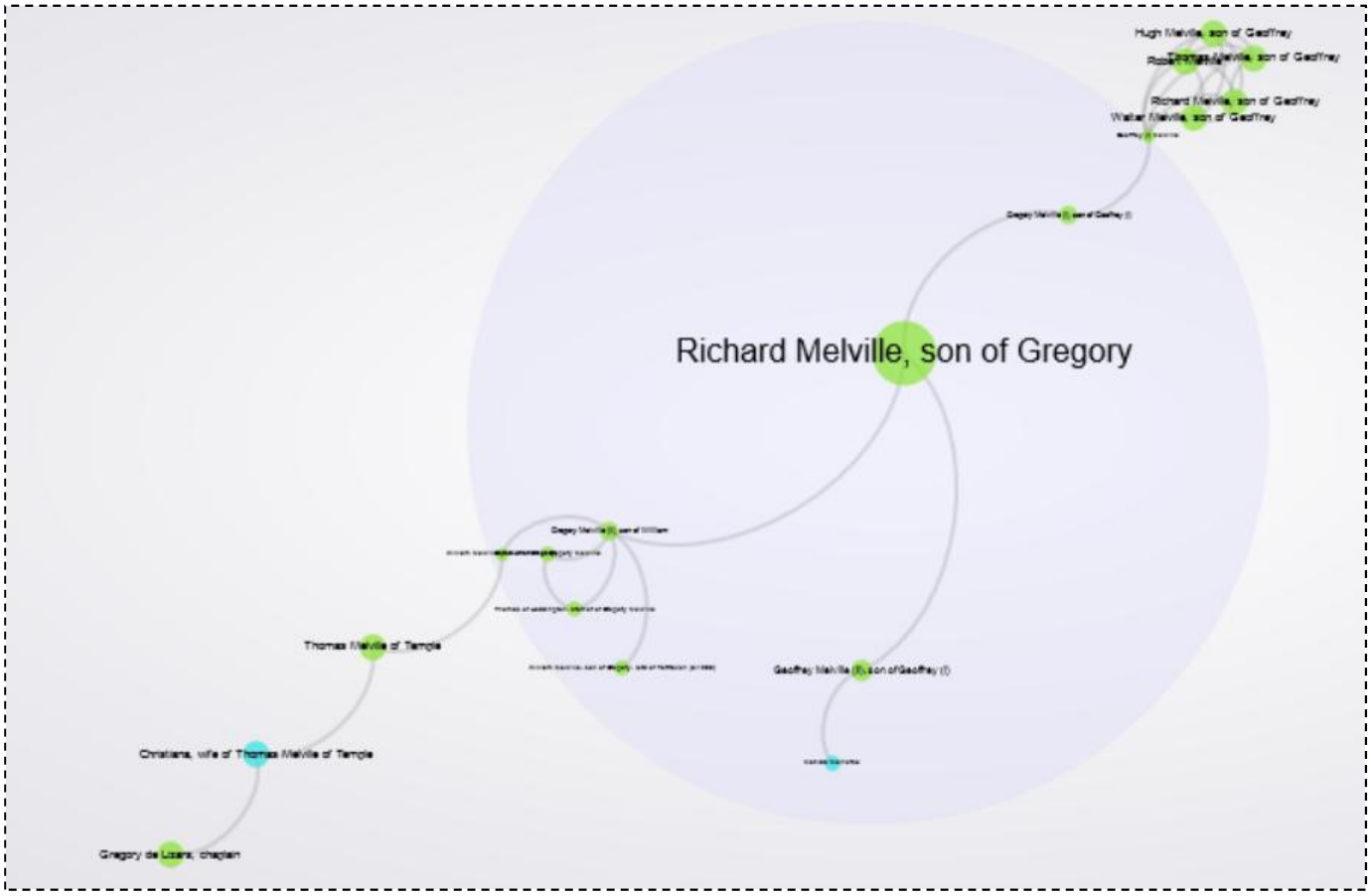


Figure 2.18. Graham family grouping

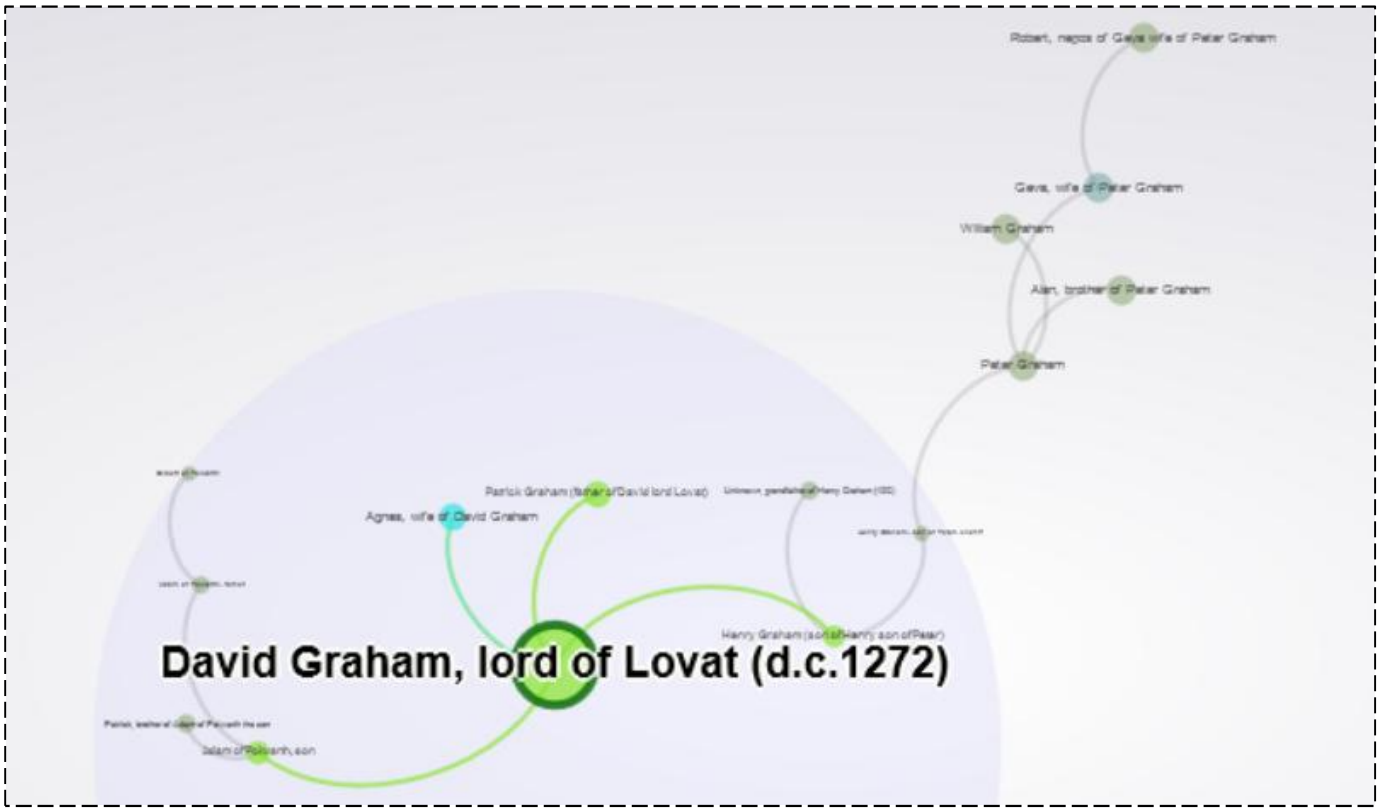


Figure 2.19 Murray family grouping

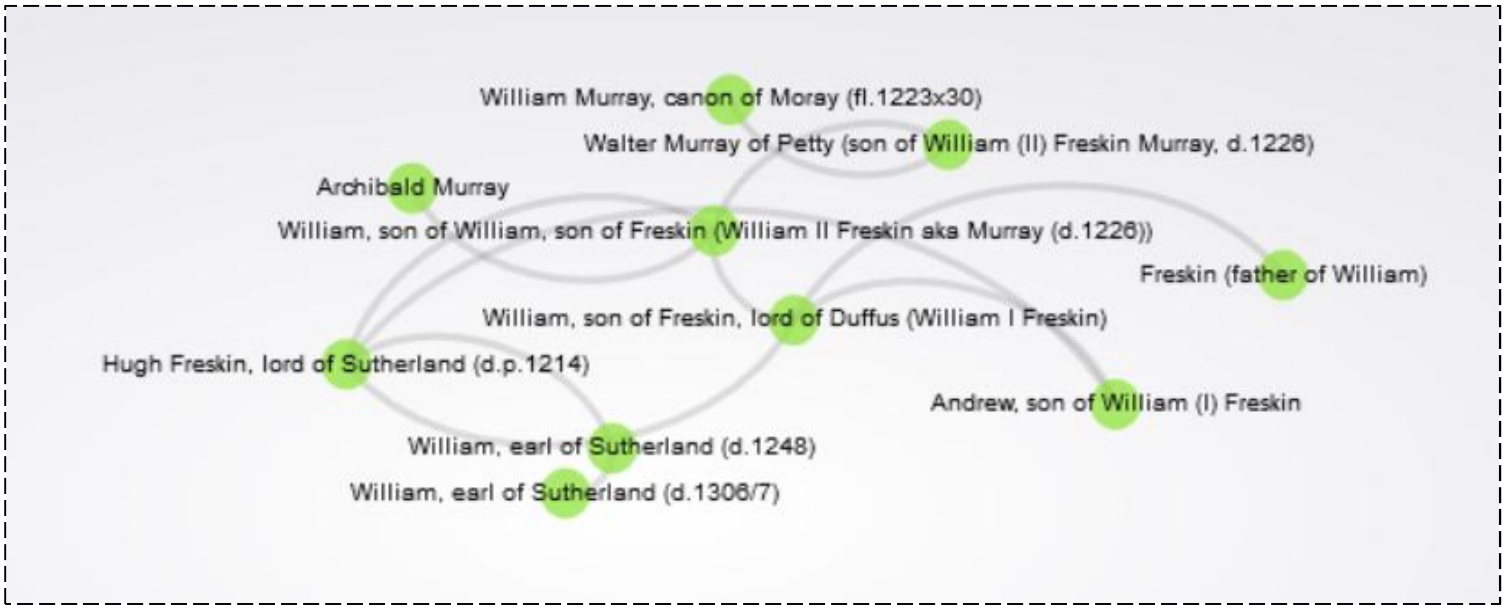
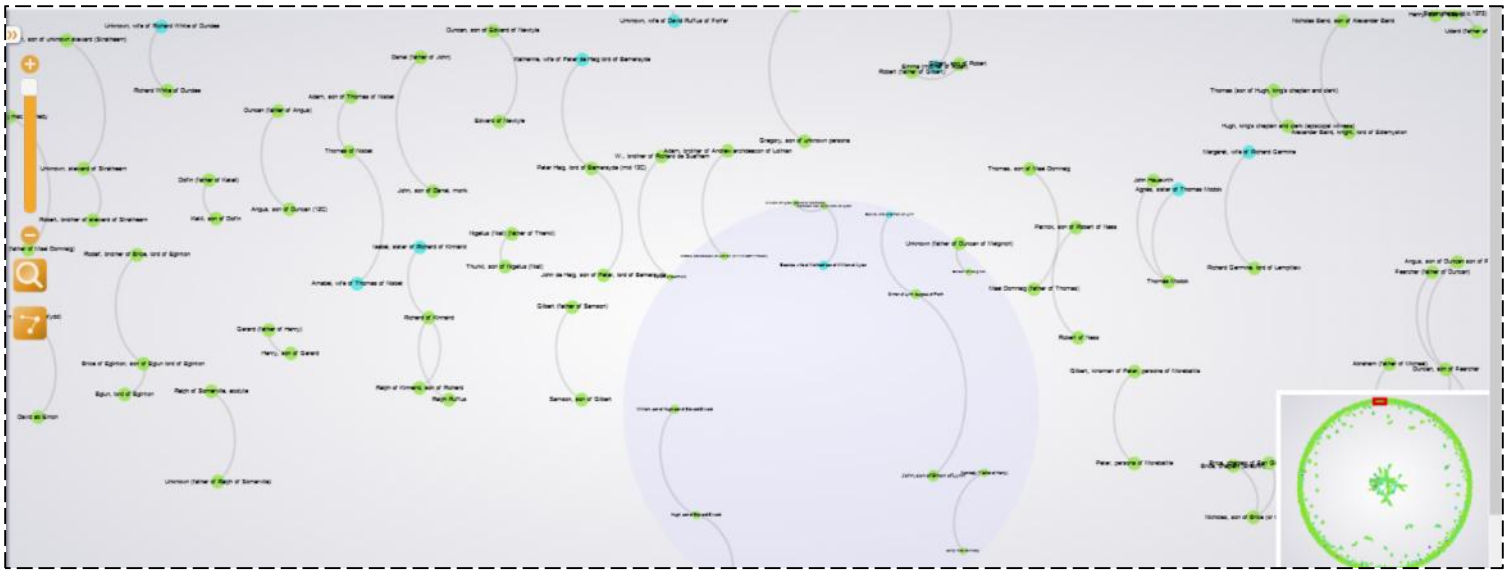


Figure 2.20. Close-up of the outer edge of family relationships sociogram



Part Two: Employment relationships

There are 81 distinct employment relationship types in the PoMS database, for the pre-1286 phase, reflecting explicit statements of employment made in the medieval sources (see Table 2.3). An example of this would be when a king refers to an individual as ‘my clerk’, ‘my physician’, ‘my baker’, etc., in one of his charters.

Table 2.3. Employment relationship factoid types

Advocate/attorney
Ambassador/envoy
Archdeacon
Armour-bearer/Esquire
Auditor
Auditor contradictarum
Baillie
Baker
Brewer
Butler (*pincerna*)
Canon
Chamberlain
Chancellor
Chaplain
Chaplain (king's)
Chaplain (papal)
Clerk
Commissary
Confessor
Constable
Cook
Counsellor
Crossbowman
Deacon
Dean
Deputy
Deputy-executor
Dispenser
Doorward
Executor
Expensarius
Falconer
Familiars/domestics

Fermer
Forester
Grieve
Groom
Guardian (*custos*)
Horn-blower
Janitor
Judex
Judge-delegate
Justice
Justiciar
Legate (papal)
Mair
Marischal
Master
Merchant
Messenger (*nuncius*)
Miller
Miner
Notary
Official
Official (minister)
Pantler
Penitentiary
Physician (*medicus*)
Precentor/Chanter
Priest
Procurator
Puer (servant)
Rannaire
Receiver
Reeve
Scribe
Scribe (papal)
Servant (*famulus*)
Serviens (servant/sergeant)
Shepherd
Sheriff
Smith
Squire
Steward
Sub-deacon (papal)
Sub-delegate
Tailor

Treasurer
Vicar
Vice-Chancellor
Vicegerent

Figure 2.21. Overview of Gephi sociogram of employment relationships

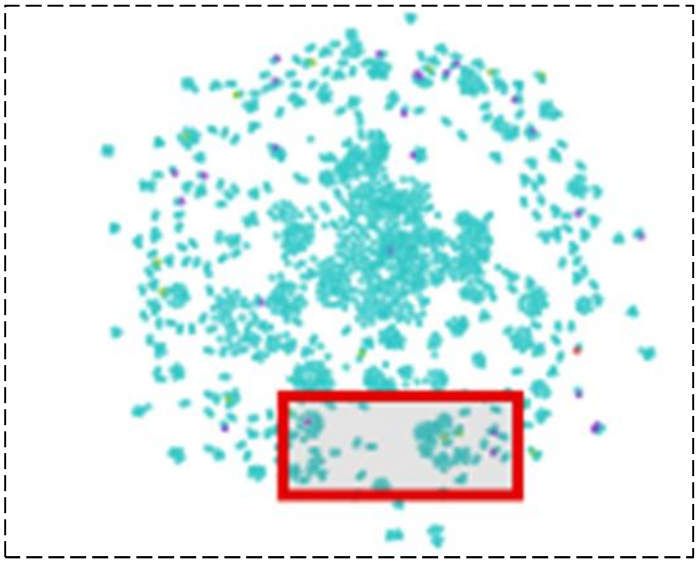


Figure 2.22. Employment relationships sociogram

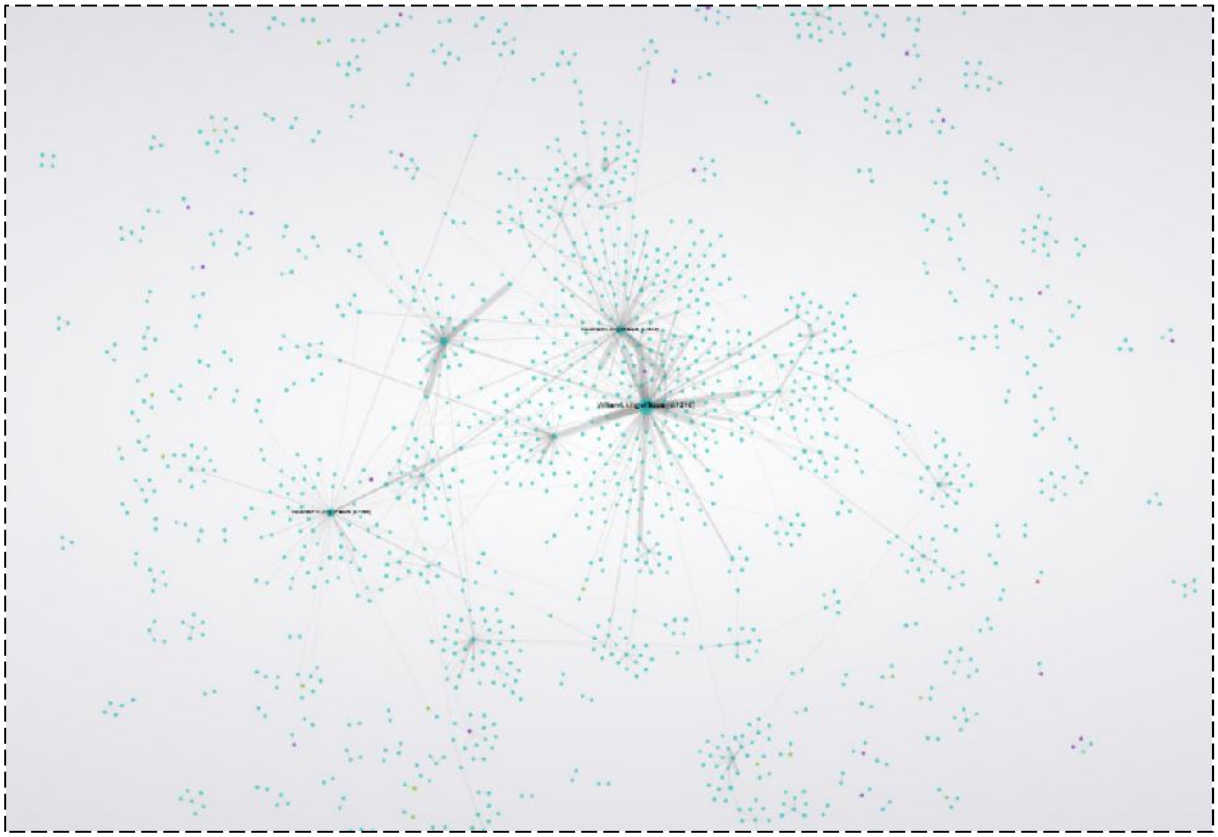


Figure 2.23. Gephi sociogram, with edges enhanced to demonstrate network structure

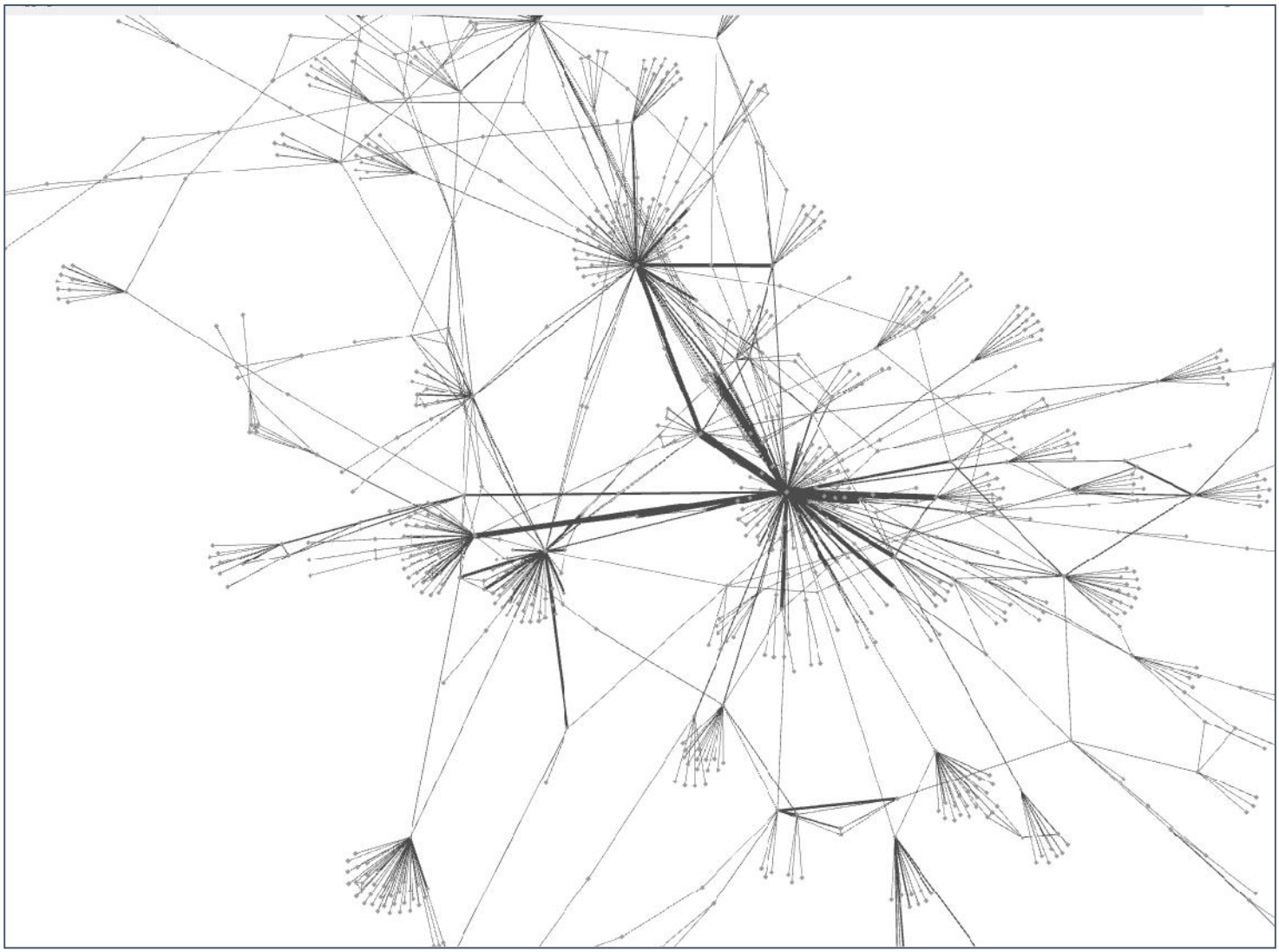


Figure 2.21 gives an overview of all the employment relationships in the Gephi sociogram, where male actors are coloured blue, female actors are green, and institutional actors are purple. As Figures 2.22 and 2.23 make clear, the employment relationships sociogram reveals a number of key 'employers' with their 'employees' connected around them. Key actors are connected in various ways, meaning that most of the actors are connected in some way to the core group. This is because a person can be an 'employee' in one context and an 'employer' in another. For example, figure 2.24 shows the employment connections of Walter of St Albans, bishop of Glasgow (d. 1232). Walter is connected to King William (1165-1214) because he was for many years a chaplain of that king; arrayed around Walter are his own 'employees' as bishop – his own clerks, chaplains, stewards, and so forth. King William (see Figure 2.25) was connected to a number of other key actors in this manner, including William Malveisin, bishop of St Andrews (1202-38), Florence, bishop of Glasgow (d. 1210), William del

Bois, chancellor (d. 1232), Richard de Prebenda, bishop of Dunkeld (d. 1210), and Matthew, bishop of Aberdeen (d. 1199). In this way, King William is the central uniting figure of this sociogram, and it is King William who has the highest betweenness centrality and the highest eigenvector centrality in this sociogram (see Tables 2.4 and 2.5). Eigenvector centrality is a calculation that reflects the importance of an actor based not only on how many other actors to whom that actor is connected, but also by considering the actors to whom they are connected. It aims to give a sense of whether one's connections are themselves influential, central figures, or merely lesser, peripheral figures (Predd 2012). Table 2.4 lists the top ten actors in this sociogram based on eigenvector centrality. There are more than one way of calculating eigenvector centrality; Gephi favours a method which gives the most central person a value of 1 (perhaps better thought of as 100%) and expresses the relative eigenvector centrality of the other actors as a proportion or percentage of that number.

Figure 2.24. Employment connections of Walter of St Albans, bishop of Glasgow (d.1232)

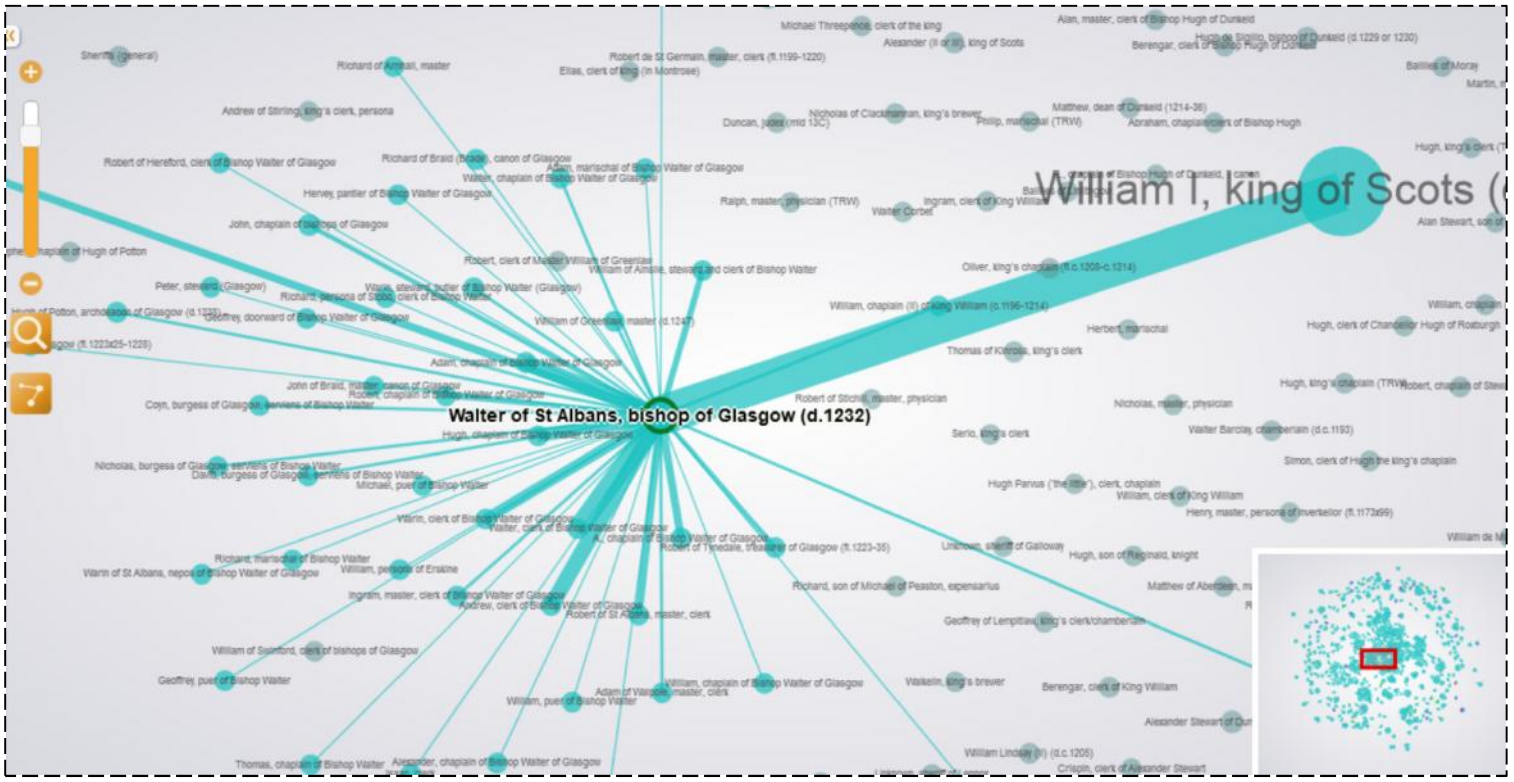


Figure 2.25. Employment connections of King William I (1165-1214)

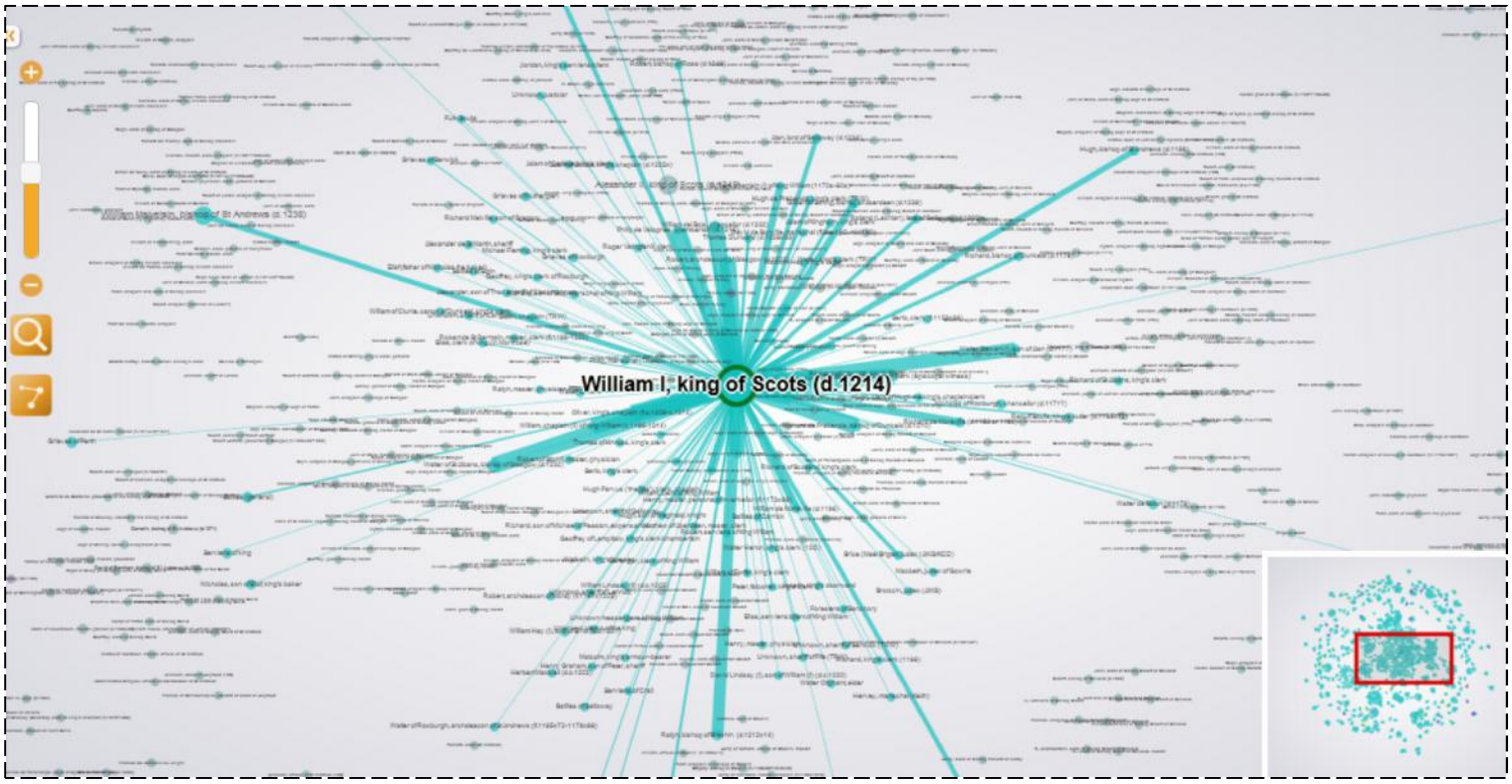


Figure 2.26. Employment connections of Alexander II, king of Scots (d. 1249)

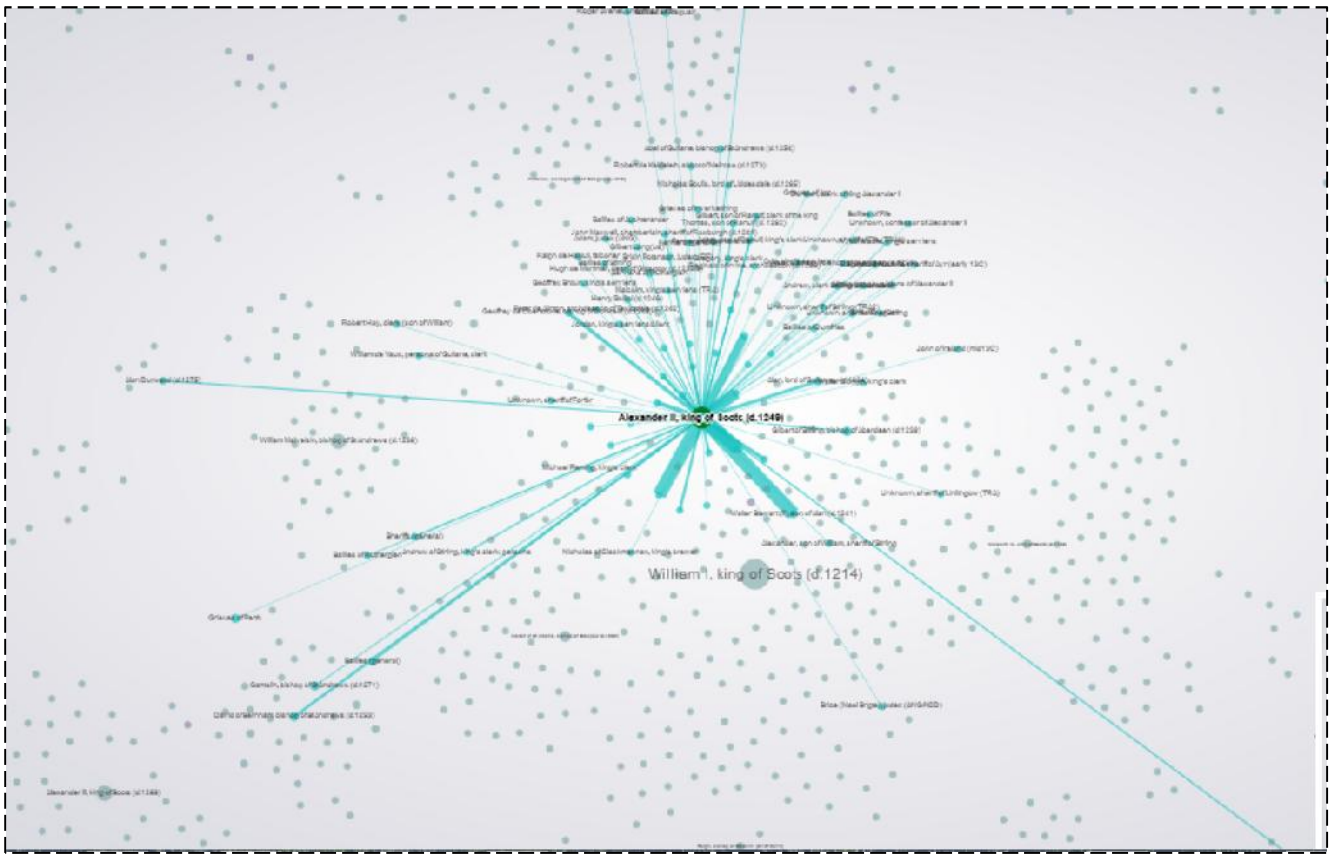
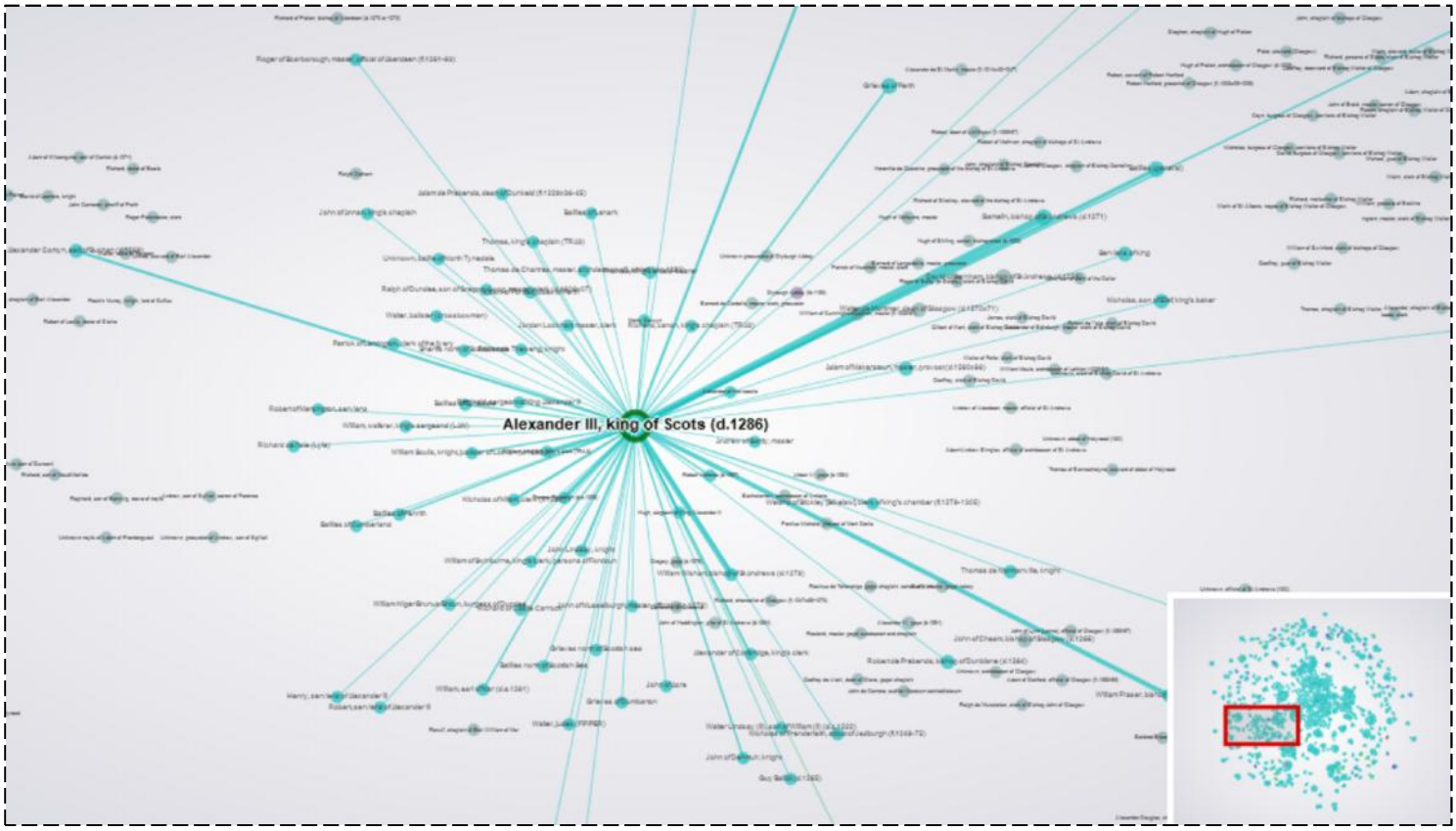


Figure 2.27. Employment connections of Alexander III, king of Scots (d. 1286)



William, king of Scots (d. 1214) is the person with the highest centrality in terms of three types of centrality: eigenvector, betweenness, and degree. Degree, the most basic form of centrality, is simply a calculation of all the actors with whom there is a direct tie. The eigenvector table gives an indication of the importance of King William in this graph; his son Alexander II (see Figure 2.26)'s centrality is less than 54% that of his father. This should be considered alongside the chronological significance of William; not only was his reign long (49 years), but it also occupied a central position in our time period allowing for many connections to actors who continued to be active long after his death. There is also a particular spot that William's reign plays in the documentary record, which will explore in greater depth in a later chapter. Nevertheless, kings play an important role here. Their employees are more likely to be mentioned as such in charters, but they were also among the only employees who would then go out and fulfil important roles themselves as 'employers'. The degree table demonstrates that King William was connected to 130 actors in employment relationship factoids, while Alexander II was linked to 92, and his own son Alexander III was linked to 72. While bishops are clearly the other main power players in this particular study, the most significant of these, William Malveisin, bishop of St

Andrews (d. 1238), was connected to 58 actors and had an eigenvector centrality of about a third of King William's (see Figure 2.28) . All of the top ten by degree were either kings or bishops. However, the eigenvector table shows that other actors were significant in this network, despite having fewer connections. William del Bois (d.1232) was a long-serving royal clerk and chancellor; however, unlike many others on his career path, he was never made a bishop (see Figure 2.29). Thus he had a degree of only 16: he was connected to 16 individuals, as compared to 47 for his contemporary Walter of St Albans, bishop of Glasgow. Yet in terms of eigenvector centrality, William is one notch above Walter in the league tables. This is because the people to whom he was connected were themselves more important figures in the network. These included King William, King Alexander II, and Bishop William Malveisin, Gilbert of Stirling, bishop of Aberdeen, numbers 1, 2, 3, and 7 in the eigenvector list, respectively.

Table 2.4. Top 10 Actors, by Eigenvector Centrality

Id	Name	Gender	Degree	Closeness Centrality	Betweenness Centrality	Eigenvector Centrality
1	William I, king of Scots (d.1214)	M	130	2.983903421	337787.259	1
58	Alexander II, king of Scots (d.1249)	M	92	3.671026157	131945.3364	0.537622721
40	William Malveisin, bishop of St Andrews (d.1238)	M	58	3.461770624	117671.5903	0.329647149
360	Alexander III, king of Scots (d.1286)	M	72	3.88028169	123538.1579	0.294567364
42	William del Bois, chancellor (d.1232)	M	16	3.456740443	16207.97688	0.232958497
858	Walter of St Albans, bishop of Glasgow (d.1232)	M	47	3.825955734	54197.38863	0.222394286
1204	Gilbert of Stirling, bishop of Aberdeen (d.1239)	M	12	3.563380282	32072.60488	0.179660244
432	David of Bernham, bishop of St Andrews (d.1253)	M	24	3.740442656	27004.21203	0.156485537
451	Alan, lord of Galloway (d.1234)	M	13	3.61167002	14017.04227	0.152953126

Table 2.5. Top 10 Actors, by Betweenness Centrality

Id	Name	Gender	Degree	Closeness Centrality	Betweenness Centrality	Eigenvector Centrality
1	William I, king of Scots (d.1214)	M	130	2.983903421	337787.259	1
58	Alexander II, king of Scots (d.1249)	M	92	3.671026157	131945.3364	0.537622721
360	Alexander III, king of Scots (d.1286)	M	72	3.88028169	123538.1579	0.294567364
40	William Malveisin, bishop of St Andrews (d.1238)	M	58	3.461770624	117671.5903	0.329647149
858	Walter of St Albans, bishop of Glasgow (d.1232)	M	47	3.825955734	54197.38863	0.222394286
260	Gilbert or Gilla Brigte, earl of Strathearn (d.1223)	M	15	3.873239437	41476.5	0.112558044
788	Andrew Murray, bishop of Moray (d.1242)	M	40	4.354124748	40126.0394	0.118634521
74	Malcolm IV, king of Scots (d.1165)	M	25	4.658953722	32223.24237	0.090796138
1204	Gilbert of Stirling, bishop of Aberdeen (d.1239)	M	12	3.563380282	32072.60488	0.179660244

Table 2.6 Top actors by degree

Id	Name	Gender	Degree
1	William I, king of Scots (d.1214)	M	130
58	Alexander II, king of Scots (d.1249)	M	92
360	Alexander III, king of Scots (d.1286)	M	72
40	William Malveisin, bishop of St Andrews (d.1238)	M	58
858	Walter of St Albans, bishop of Glasgow (d.1232)	M	47
788	Andrew Murray, bishop of Moray (d.1242)	M	40
74	Malcolm IV, king of Scots (d.1165)	M	25
432	David of Bernham, bishop of St Andrews (d.1253)	M	24
2	Matthew, bishop of Aberdeen (d.1199)	M	22
448	Florence, bishop-elect of Glasgow (d.1210)	M	17

It is noteworthy while half of the actors are on all three lists (Kings William, Alexander II, Alexander III, Bishop William Malveisin, Bishop Walter of St Albans), there is considerable variation in the other half. Andrew Murray, bishop of Moray (d. 1242) had and impressive 40 employment connections, but he is way down at number 28 in the eigenvector list, with 11.8% compared to King William's 100%. He is still quite important in terms of betweenness centrality: he was not connected by employment with top players, but this did not prevent him from occupying a place of potential influence in the

overall graph structure. Gilbert or Gilla Brigte, earl of Strathearn (d.1223) had a degree of only 15 but appears as number six in betweenness centrality (see Figure 2.30). This is because of his connections with King William and Bishop Matthew of Aberdeen.

Figure 2.28. Employment connections of William Malveisin, bp. St Andrews (d. 1238)

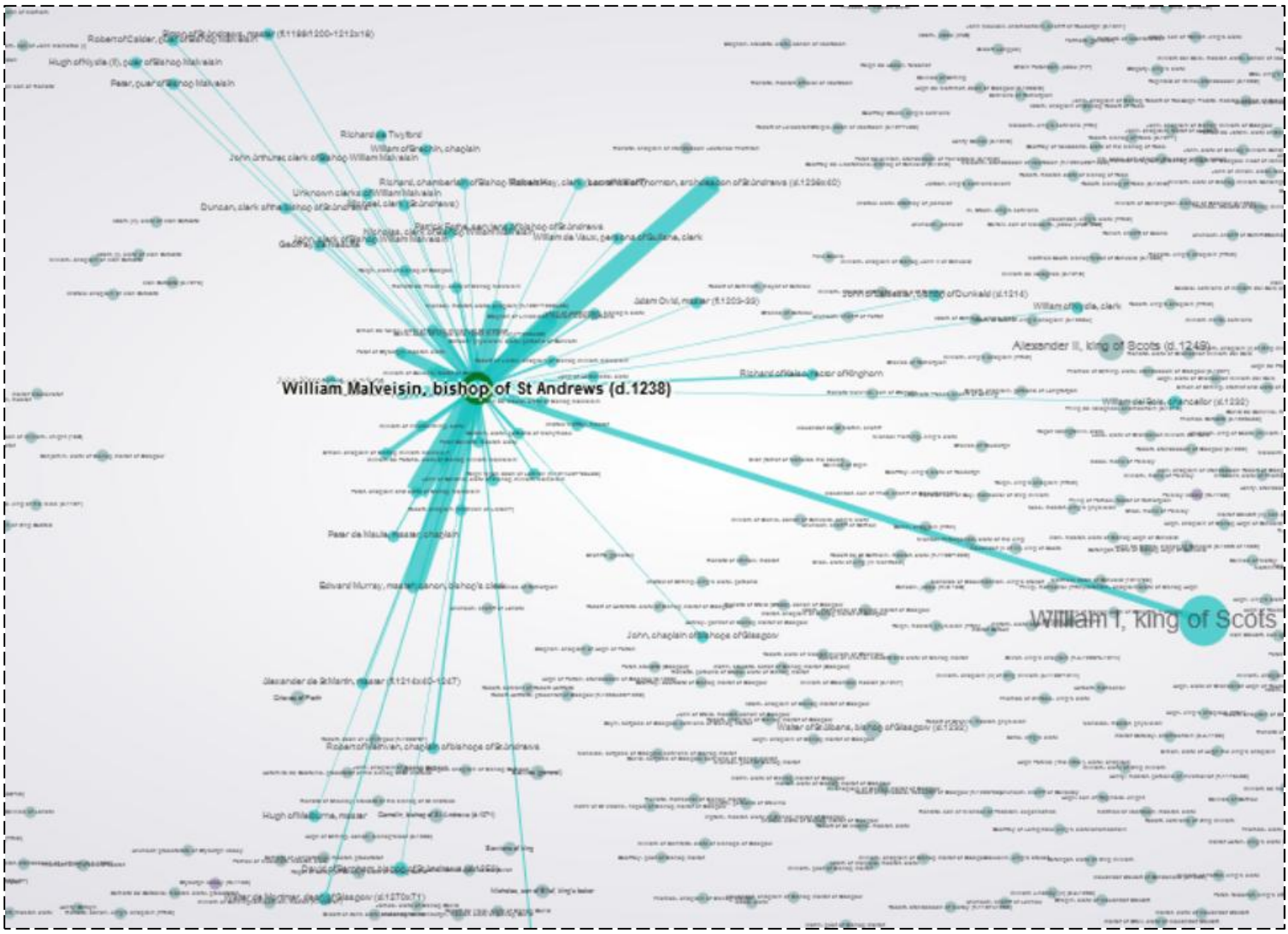


Figure 2.29. Employment connections of William del Bois, chancellor (d. 1232)

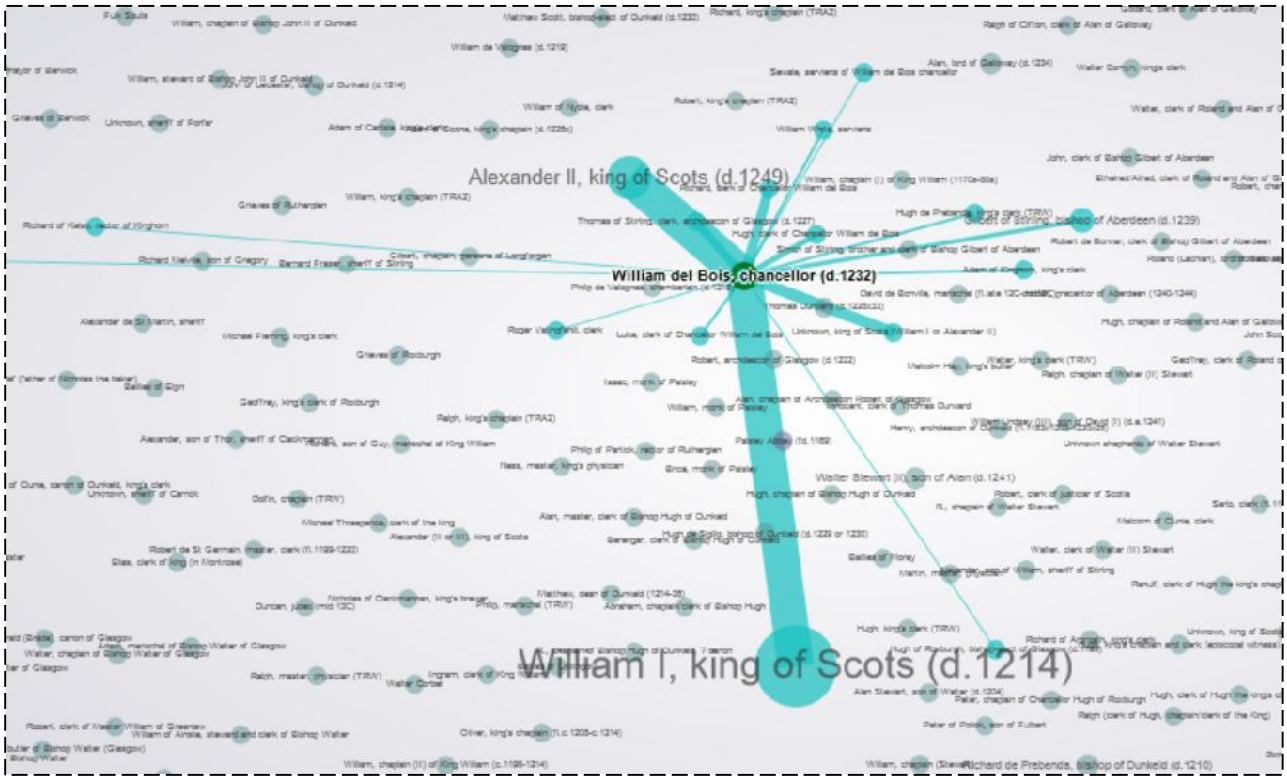
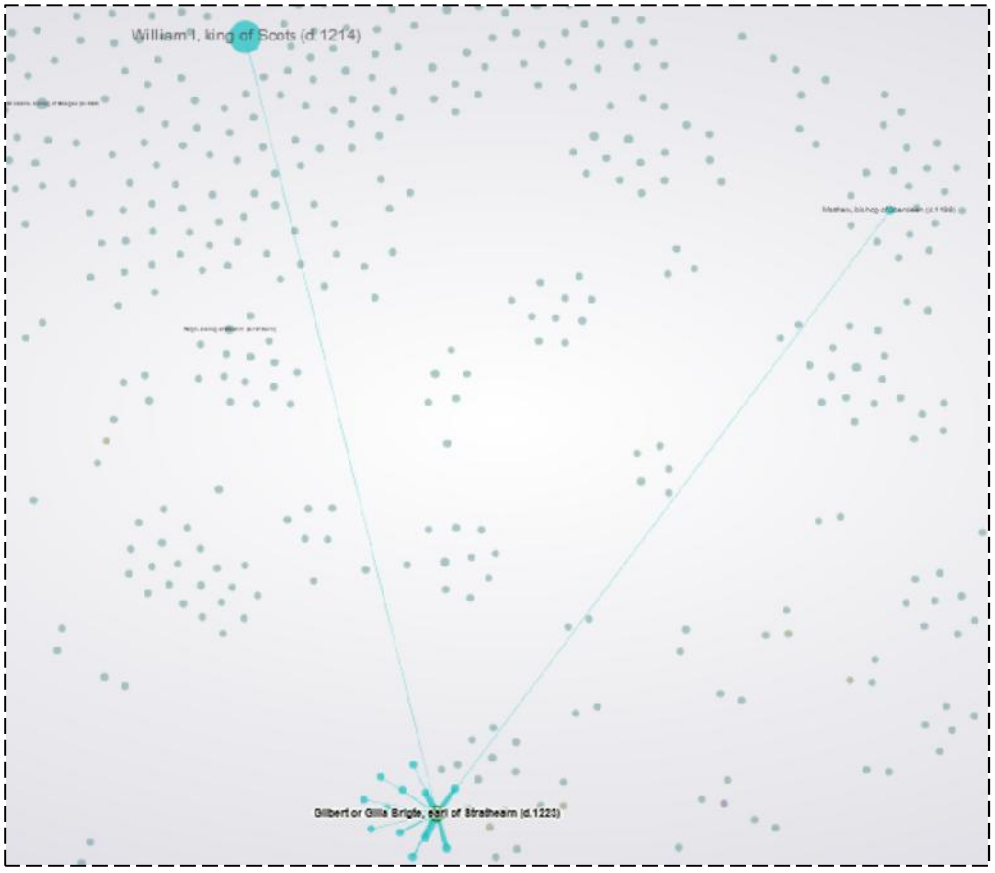
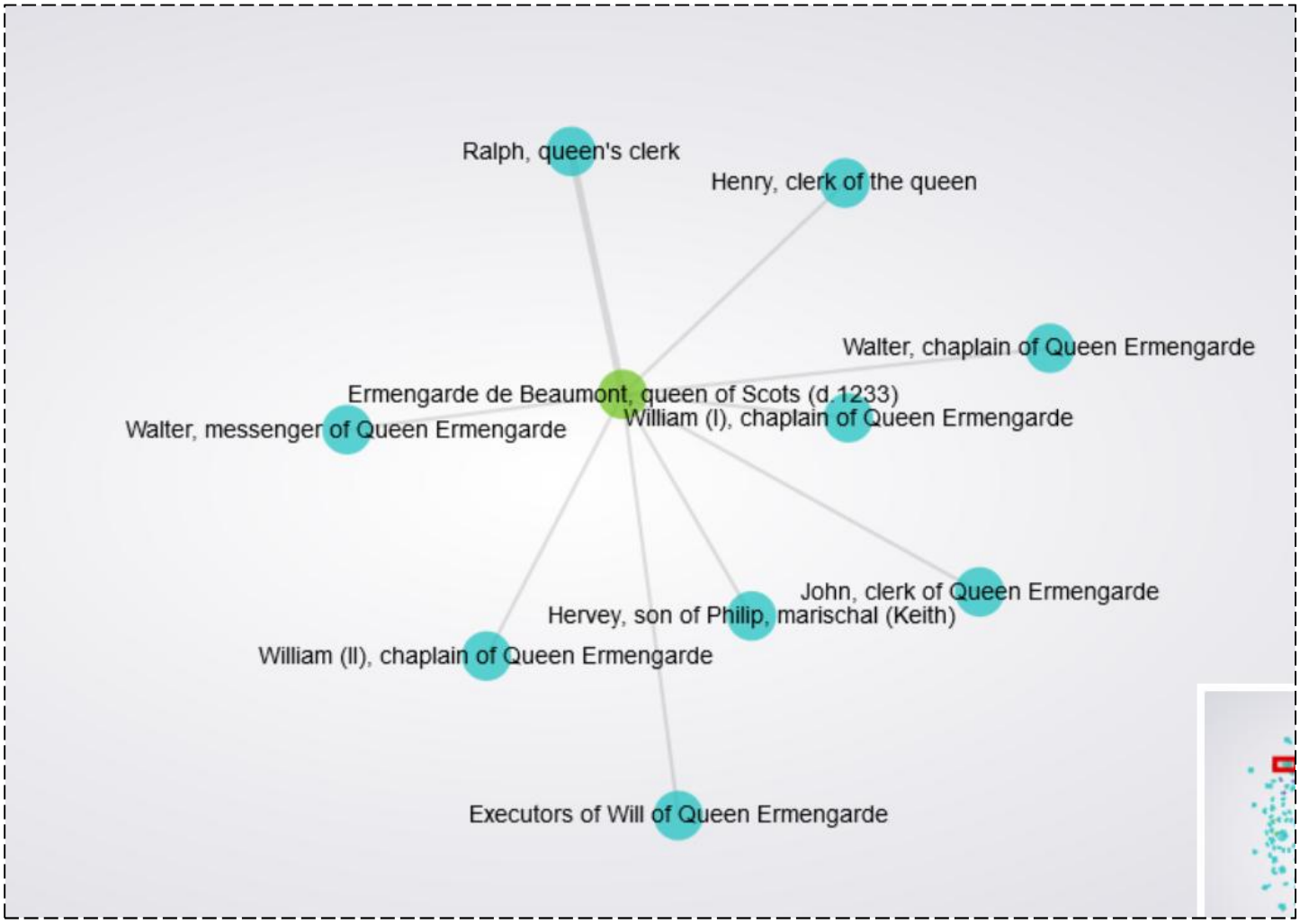


Figure 2.30. Employment connections of Gilbert, earl of Strathearn (d. 1223)



It is also important to remember that just because people are not connected in the context of employment relationships does not mean they may not have been connected in other ways. A good example is the disconnected (for the main core segment) group of people around Ermengarde de Beaumont, queen of Scots (d. 1233). Ermengarde's employees are shown in Figure 2.31. While she would obviously be connected through family relationship to her husband, King Alexander II, the two individuals are not connected in this sociogram.

Figure 2.31. Employment connections of Ermengarde, queen of Scots (d. 1233)



Part Three: Tenurial and lordship relationships

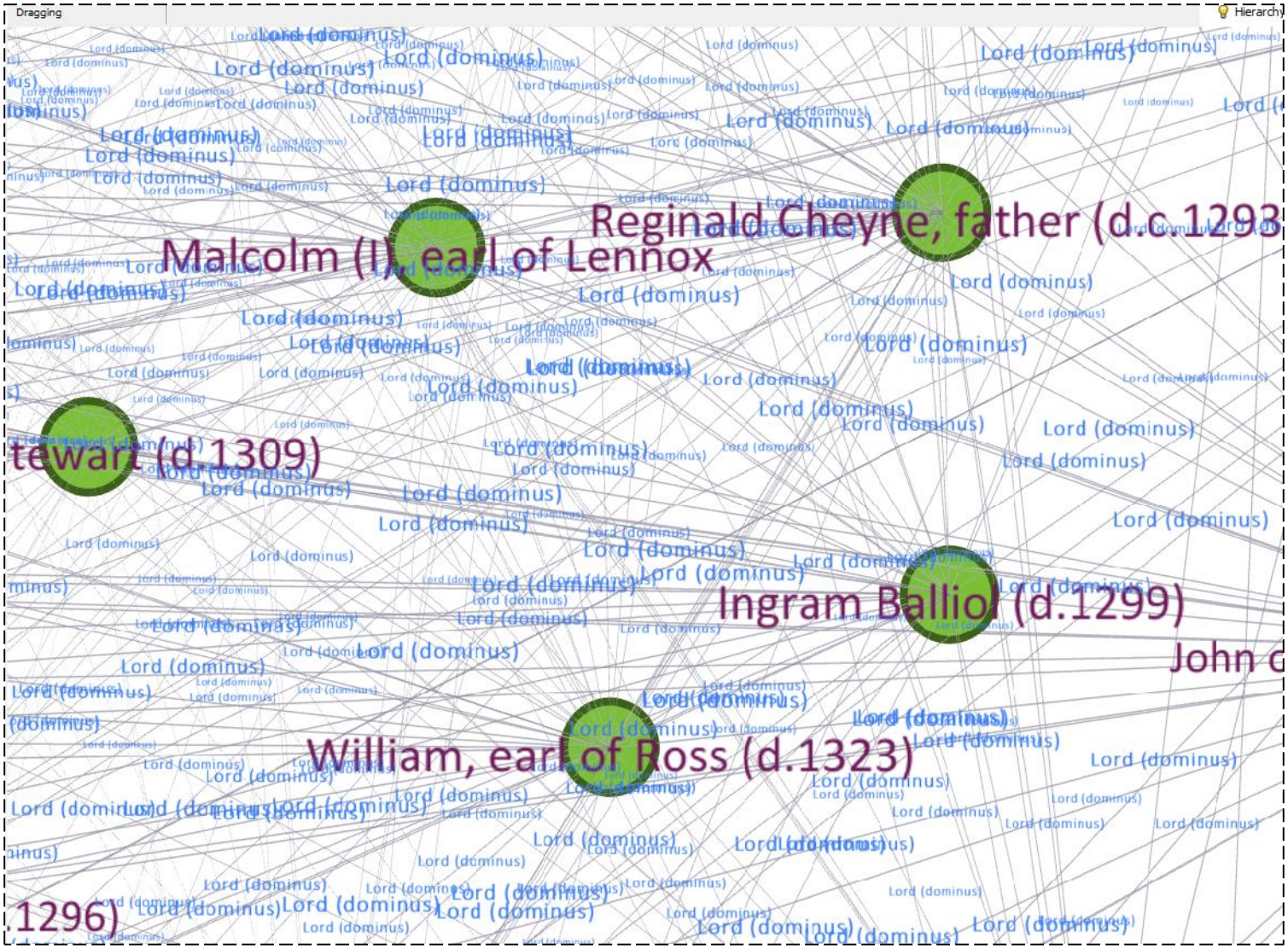
There are 36 types of tenurial and lordship relationships in the pre-1286 PoMS database. It must be remembered that these only reflect explicit statements of lordship (etc.) in the documents, and do not include social relationships of this type which historians might infer from transactions in charters.

Table 2.7. Types of tenurial and lordship relationships

Archbishop
Assignee
Baron
Bishop
Burgess
Confraternity (monastic)
Cottar
Daughter church
Dependant (Cell)
Earl
Feudator
Fidelis (sworn man)
Franklin
Friend (f.) (*amica*)
Friend (m.) (*amicus*)
King
Knight (*miles*)
Lady (*domina*)
Liege Man (*homo ligius*)
Lord (*dominus*)
Man (*homo*)
Metropolitan
Monk
Mother church
Parishioner
Patron
Predecessor
Religious house (*Domus*)
Serf/Neyf
Socius (companion/associate)
Suffragan
Tenant
Thane
Vassal (*vassallus*/*cliens*)
Vavassor (undertenant)
Woman (*femina*)

The following Gephi sociogram shows a dense network of lordship relations in the late thirteenth century. References to lordship were more frequent in the later part of our time period. This illustration shows that 'Lord (dominus)' was the most commonly used tenurial and lordship relationship type.

Figure 2.32. Dense web of lordship relationships in late thirteenth century



Strictly defined lordship relationships were not the only kind of bond tying together laymen. The following sociogram shows the various types of relationship between people connected to the baron Philip de Mowbray, including 'Socius (companion/associate)' and 'Friend (m.) (amicus)'.

Figure 2.32. Associates of Philip de Mowbray

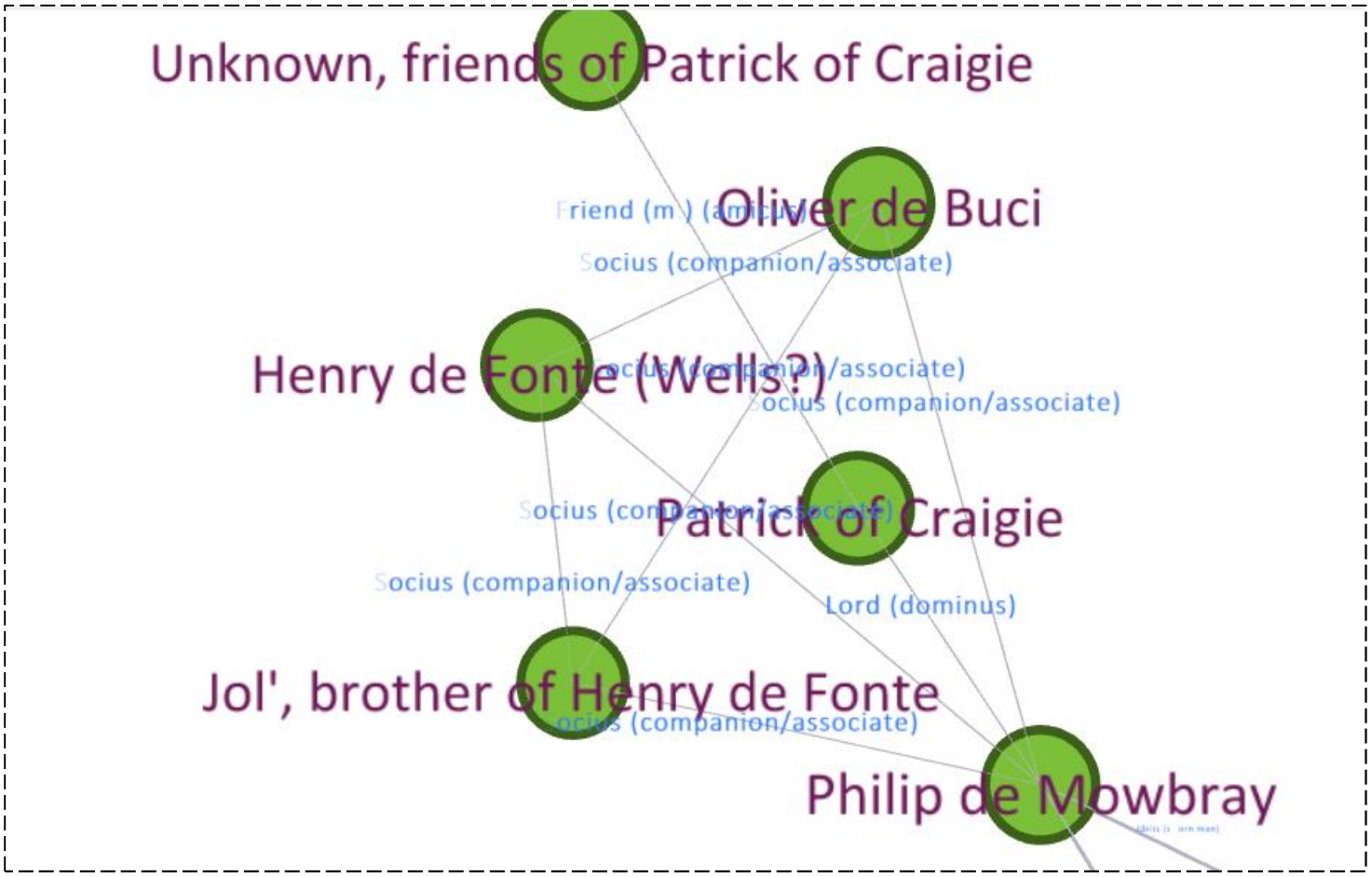
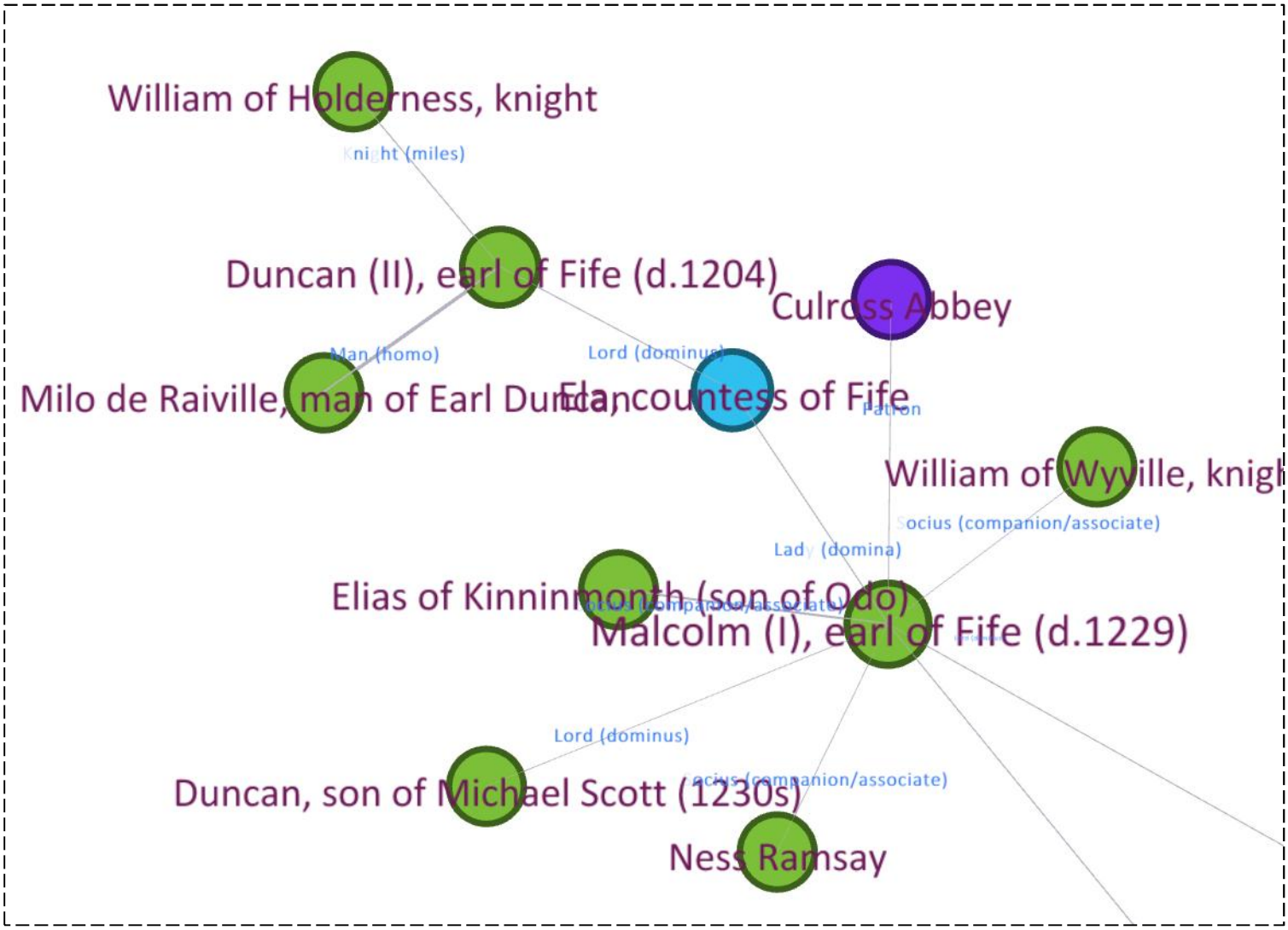


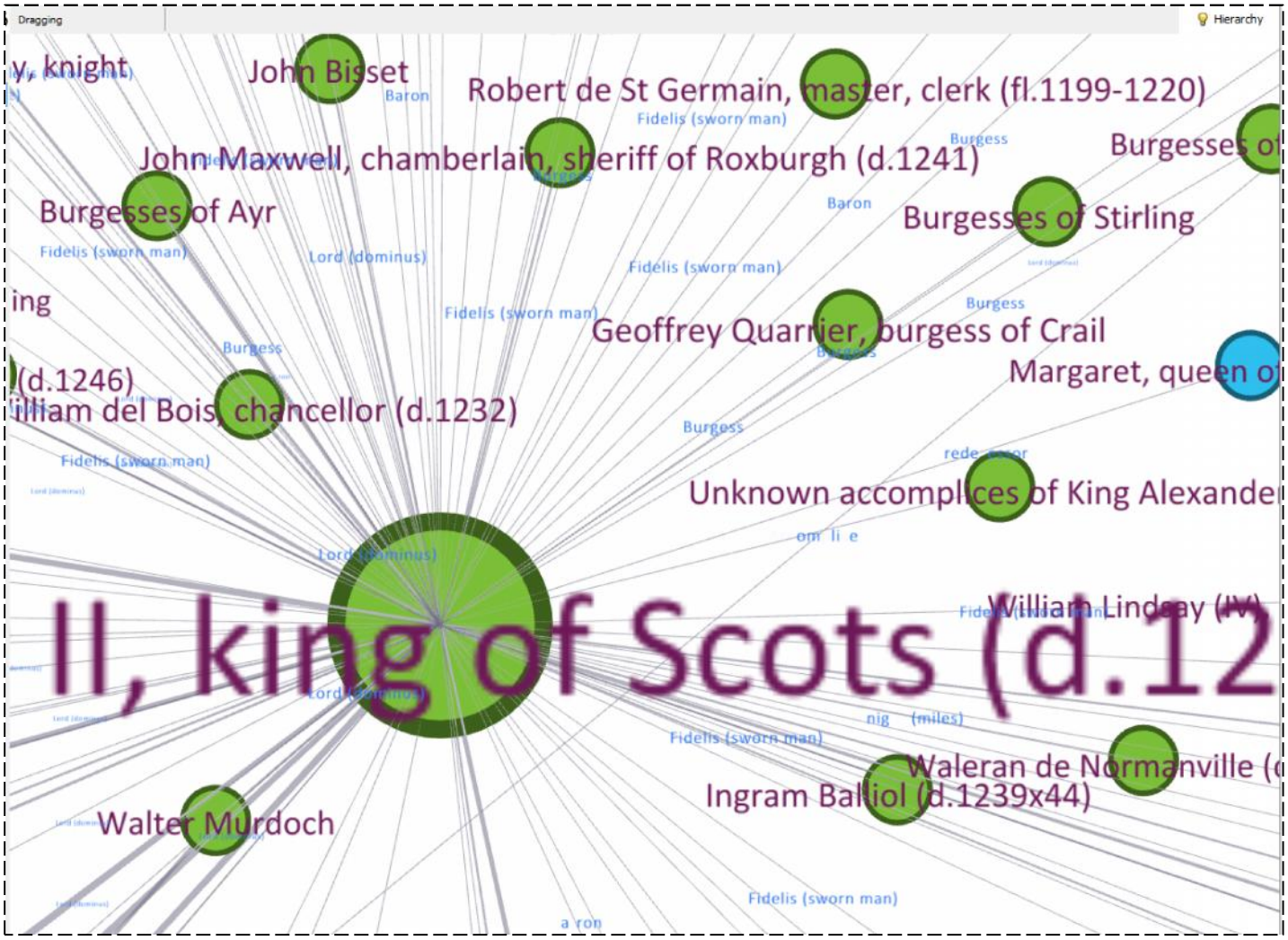
Figure 2.33 illustrates the variety of forms of social relationship which could tie the earls of Fife to those around them. William of Holderness was described as the 'knight (miles)' of Duncan (II), earl of Fife (d. 1204), while Milo de Raiville was described as his 'man (homo)'. Malcolm (I), earl of Fife (d. 1229) was the 'patron' of Culross Abbey, and the 'lord (dominus)' of Duncan, son of Michael Scott, while Ness Ramsay and William of Wyville were each termed his 'Socius (companion/ associate)'.

Figure 2.33. Social relationships of the earls of Fife.



The following sociogram (Figure 2.34) illustrates some more lordship and tenurial relationship types. A number of individuals are described as ‘Fidelis (sworn man)’ of King Alexander III, while others are termed his barons, burgesses, or knights.

Figure 2.34. Tenurial and lordship relationships of Alexander III.



The following table lists the twenty individuals with the highest degree centrality in the Tenurial and Lordship Relationships network as calculated in Gephi.[8] Most of the individuals were active in the mid-to-late thirteenth century, and King Alexander III (1249-86) has the highest Eigenvector centrality in this study. Nevertheless, his predecessors King Alexander II (1214-49) and King William I (1165-1214) were linked to more individuals, with 123 and 120 such ties as compared to Alexander III's 83. Figures 2.35 and 2.36 show the whole structure of the sociogram in Gephi, as visible on the PoMS website (http://db.poms.ac.uk/sna/all/26/), where the nodes representing men are green, women are blue, and purple are institutions. Much as we have seen with the other relationship sociograms, there is a core segment distributed largely around the central figures of kings, with a number of smaller groupings, including dyads and triads, around the periphery.

Table 2.8. Centrality of individuals in Tenurial and Lordship Relationships sociogram

Id	Name	Gender	Degree	Eigenvector Centrality	Betweenness Centrality
58	Alexander II, king of Scots (d.1249)	M	123	0.190762158	141326.1875
1	William I, king of Scots (d.1214)	M	120	0.118732852	92373.73261
360	Alexander III, king of Scots (d.1286)	M	83	1	38878.98893
446	Patrick (III), earl of Dunbar (d.1289)	M	48	0.956759267	6607.446999
1981	Alexander Comyn, earl of Buchan (d.1289)	M	48	0.966728379	13514.92442
2110	William of Brechin, knight	M	48	0.924043923	6184.445831
2050	Malise (III), earl of Strathearn (d.in or a.1317)	M	47	0.954903238	8082.075771
2176	John Comyn, lord of Badenoch (d.1302)	M	45	0.953215672	913.0757706
1171	William Murray, son of Malcolm Murray, knight (TRA3)	M	44	0.952397331	187.0757706
1938	Robert Bruce V, lord of Annandale (d.1295)	M	44	0.922569043	11286.04668
1955	William Sinclair (d.1299x1303)	M	44	0.952397331	187.0757706
2138	William Soulis, knight, justiciar of Lothian (d.1292/3)	M	44	0.952397331	187.0757706
2209	Donald, earl of Mar (d.1297x1305)	M	44	0.952397331	187.0757706
2257	Alexander Balliol of Cavers (d.c.1311)	M	44	0.952397331	187.0757706
2310	Duncan (III), earl of Fife (d.1289)	M	44	0.952397331	187.0757706
6598	Robert Bruce VI, earl of Carrick (d.1304)	M	44	0.952397331	187.0757706
3428	Angus, son of Donald of the Isles, lord of Islay (d. ca 1293)	M	42	0.921274371	10479.73996
130	David I, king of Scots (d.1153)	M	41	0.056511232	21699.98134
1935	Alexander, son of King Alexander III (d.1284)	M	41	0.913221751	805.530355
2323	Alexander of Argyll	M	41	0.913666434	183.9958769

[8] New dataset

Figure 2.35. Overview of sociogram in Gephi

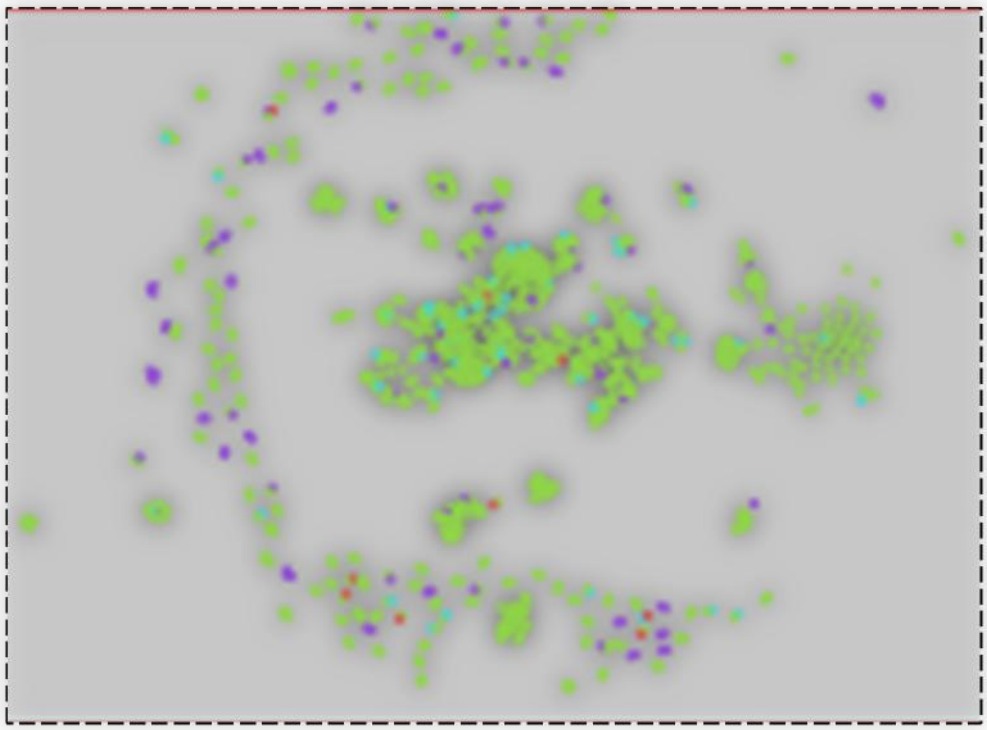


Figure 2.35. Tenurial and Lordship Relationships sociogram, Gephi.

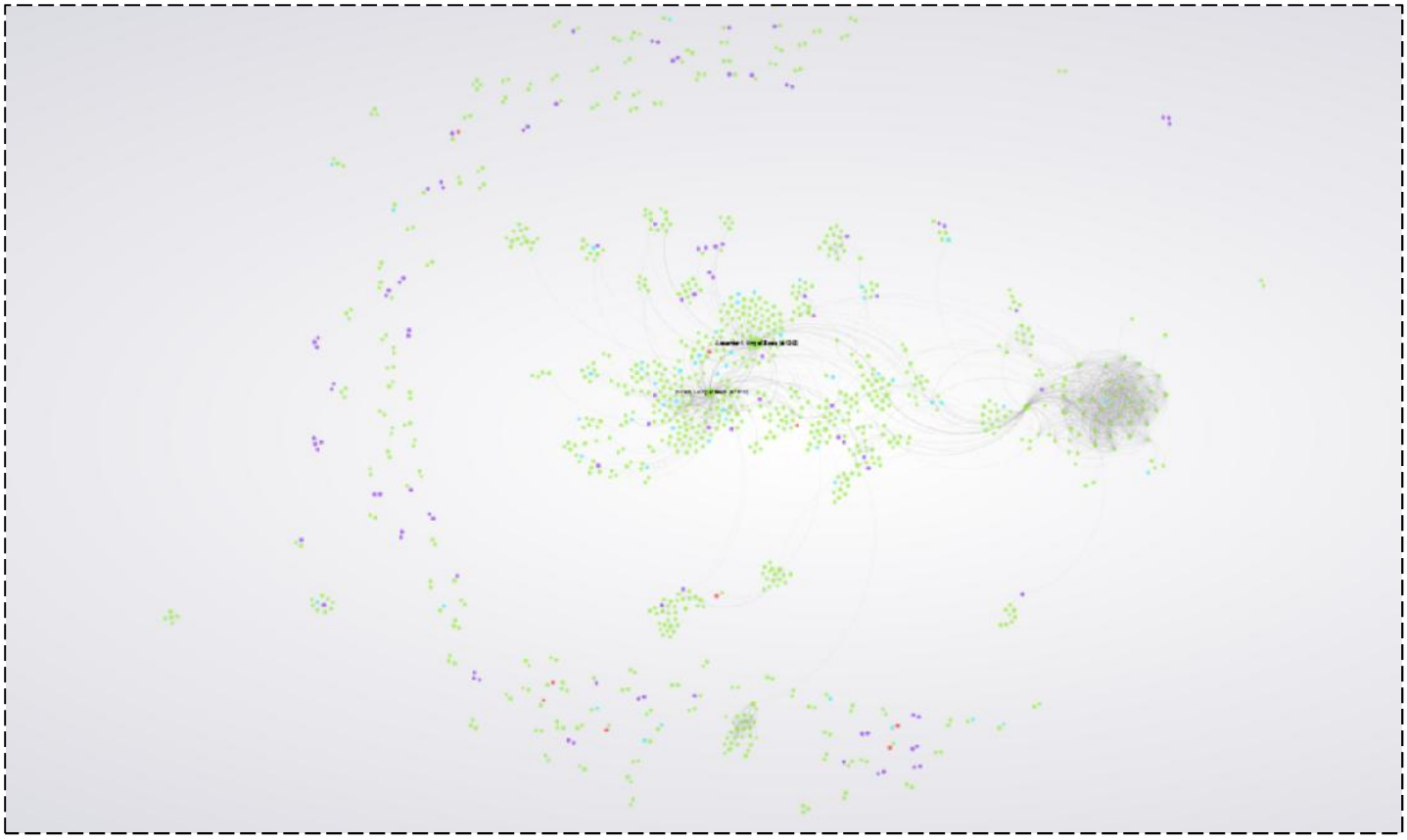


Figure 2.36. Tenurial and lordship relationships of William I, king of Scots (d. 1214)

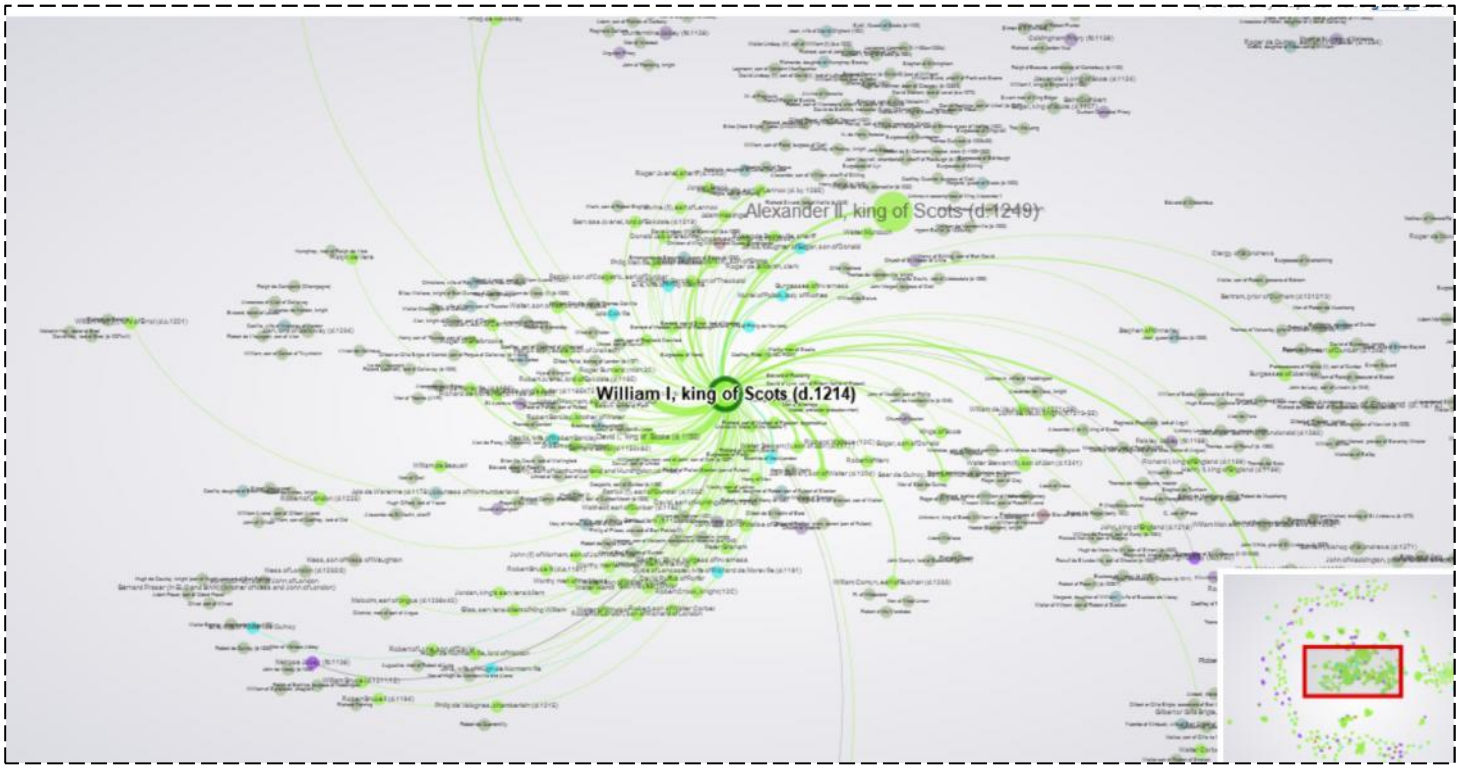


Figure 2.37. Tenurial and lordship relationships of Alexander II, king of Scots (d. 1249)

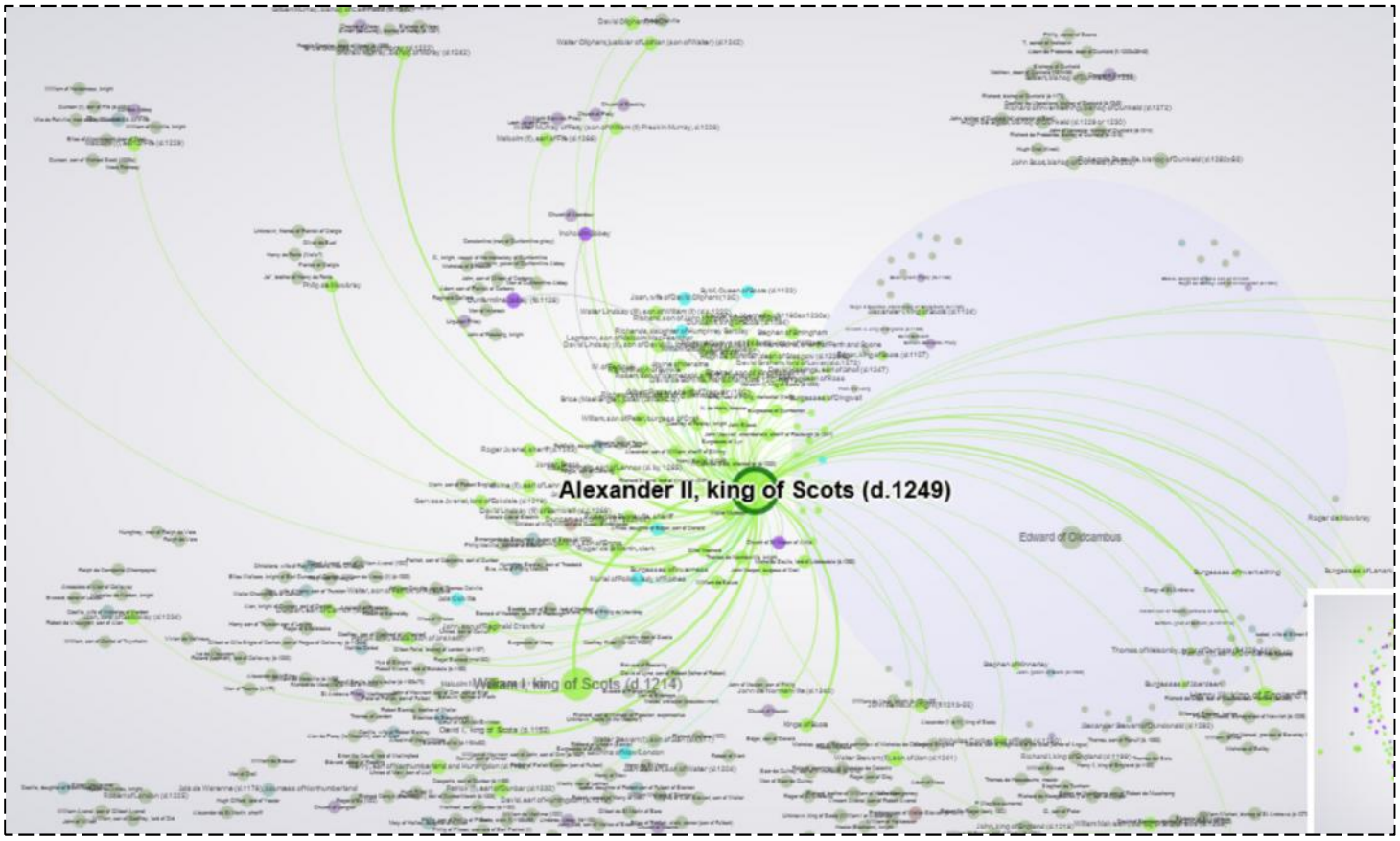
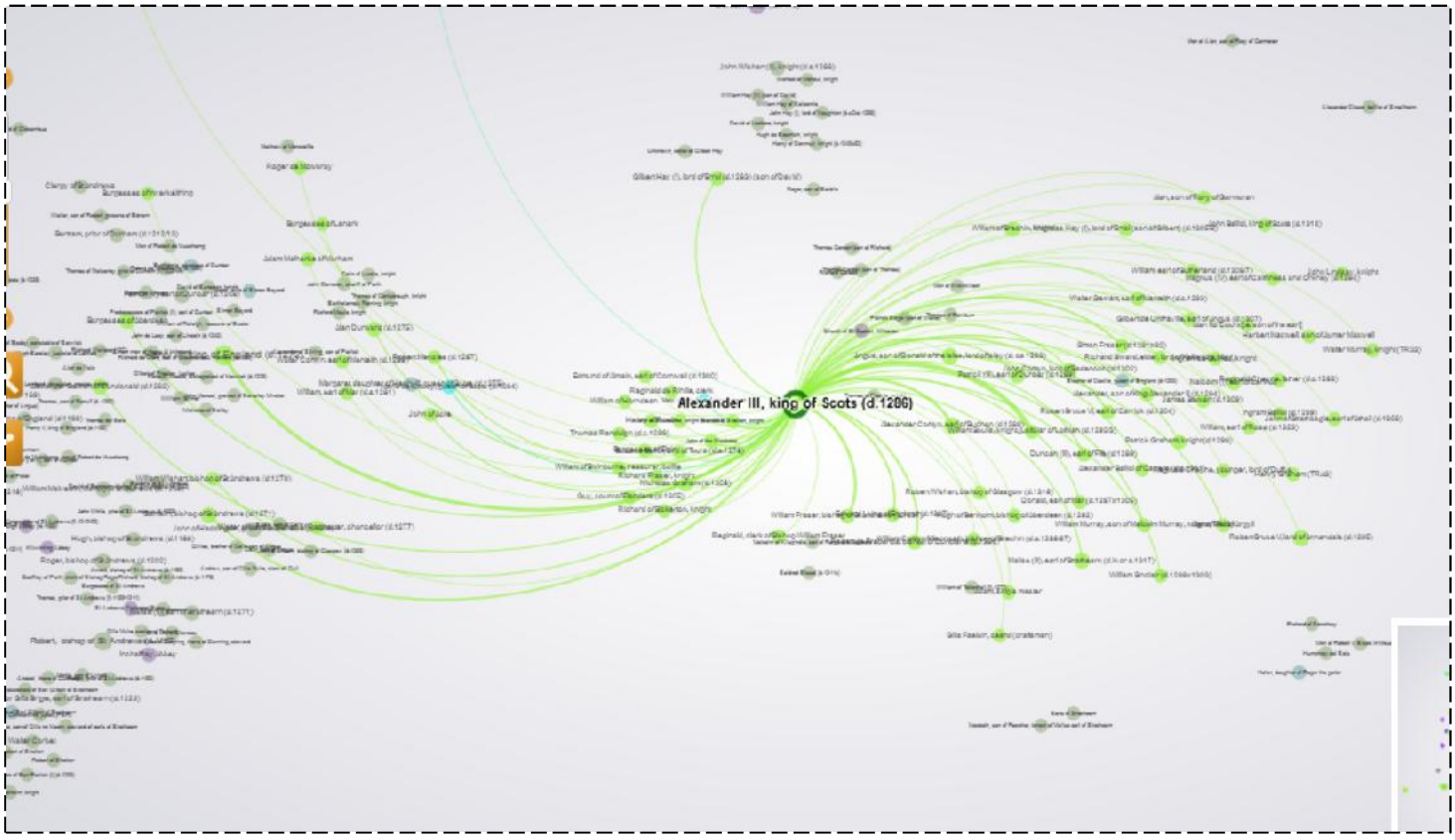


Figure 2.38. Tenurial and lordship relationships of Alexander III, king of Scots (d. 1286)



Unfortunately, there is an error in this study which means that multiple lordship connections between King Alexander III and his barons represented in a single document, such as H4/42/5 (see Figure 2.39) show up in the social network analysis as not only links between these individual barons and the king, but also between all of the barons themselves. This seems to have skewed the centrality figures reported in Table 2.8, and with these documents removed it is possible that other persons from across the chronological period might appear as more central in the study. These barons are represented in the very densely interconnected constellation of nodes to the right of Alexander III in Figure 2.38, which is easily identifiable as a kind of 'swarm' in Figure 2.35. The ego-networks of two other central figures from this time period, Alexander Comyn, earl of Buchan, and Patrick (III), earl of Dunbar, are also given in Figures 2.40 and 2.41 below, respectively. The same group of barons is also easily identifiable in both of these. As there is no way of easily remedying this error, the results for individuals in the reign of Alexander III need to be taken with a big grain of salt, particularly any mathematical calculations of centrality. However, these problems do not exist for the earlier period, and most of the sociogram accurately reflects the lordship and tenurial relationships of the individuals.

Figure 2.39. Alexander III and his barons, 1284 (H4/42/5)

Relationship: Lords (dominus) of various named barons (Tenurial & lordship relationship)

RELATIONSHIP	Lord (dominus)
SUBJECT	Alexander, son of King Alexander III (d.1284)
SUBJECT	Alexander III, king of Scots (d.1286)
FROM SOURCE	4/42/5 (*Foedera*, I, II, 638)
FIRM DATE	5 February 1284
DATING NOTES	5th day of February, AD 1283, regnal year 35

Associated People (40):

Listing items 1 to 40, page 1 of 1

ROLE	NAME
subject (relationship)	Alexander, son of King Alexander III (d.1284)
subject (relationship)	Alexander III, king of Scots (d.1286)
object (relationship)	Alexander Comyn, earl of Buchan (d.1289)
object (relationship)	Patrick (III), earl of Dunbar (d.1289)
object (relationship)	Malise (III), earl of Strathearn (d.in or a.1317)
object (relationship)	Malcolm (I), earl of Lennox
object (relationship)	Robert Bruce V, lord of Annandale (d.1295)
object (relationship)	Donald, earl of Mar (d.1297×1305)
object (relationship)	Gilbert de Umfraville, earl of Angus (d.1307)
object (relationship)	Walter Stewart, earl of Menteith (d.c.1293)
object (relationship)	William, earl of Ross (d.1323)
object (relationship)	William, earl of Sutherland (d.1306/7)
object (relationship)	Magnus (IV), earl of Caithness and Orkney (d.1284)
object (relationship)	Duncan (III), earl of Fife (d.1289)
object (relationship)	John of Strathbogie, earl of Atholl (d.1306)
object (relationship)	Robert Bruce VI, earl of Carrick (d.1304)
object (relationship)	James Stewart (d.1309)
object (relationship)	John Balliol, king of Scots (d.1314)
object (relationship)	John Comyn, lord of Badenoch (d.1302)
object (relationship)	William Soulis, knight, justiciar of Lothian (d.1292/3)
object (relationship)	Ingram de Guines, knight
object (relationship)	William Murray, son of Malcolm Murray, knight (TRA3)
object (relationship)	Walter Murray, knight (TRA3)
object (relationship)	Alexander Balliol of Cavers (d.c.1311)
object (relationship)	Reginald Cheyne, father (d.c.1293)
object (relationship)	William Sinclair (d.1299×1303)
object (relationship)	Richard Siward, elder, lord of Kellie (d.a.1311)
object (relationship)	William of Brechin, knight
object (relationship)	Nicholas Hay (I), lord of Errol (son of Gilbert) (d.1305/6)
object (relationship)	Henry Graham (TRA3)
object (relationship)	Ingram Balliol (d.1299)
object (relationship)	Alan fitz Count [i.e. son of the earl]
object (relationship)	Reginald Cheyne, younger, lord of Duffus
object (relationship)	John Lindsay, knight
object (relationship)	Patrick Graham, knight (d.1296)
object (relationship)	Herbert Maxwell, son of Aymer Maxwell
object (relationship)	Simon Fraser (d.1291×92)
object (relationship)	Alexander of Argyll
object (relationship)	Angus, son of Donald of the Isles, lord of Islay (d. ca 1293)
object (relationship)	Alan, son of Rory of Garmoran

Figure 2.40. Tenurial and lordship of Alexander Comyn, earl of Buchan (d. 1289)

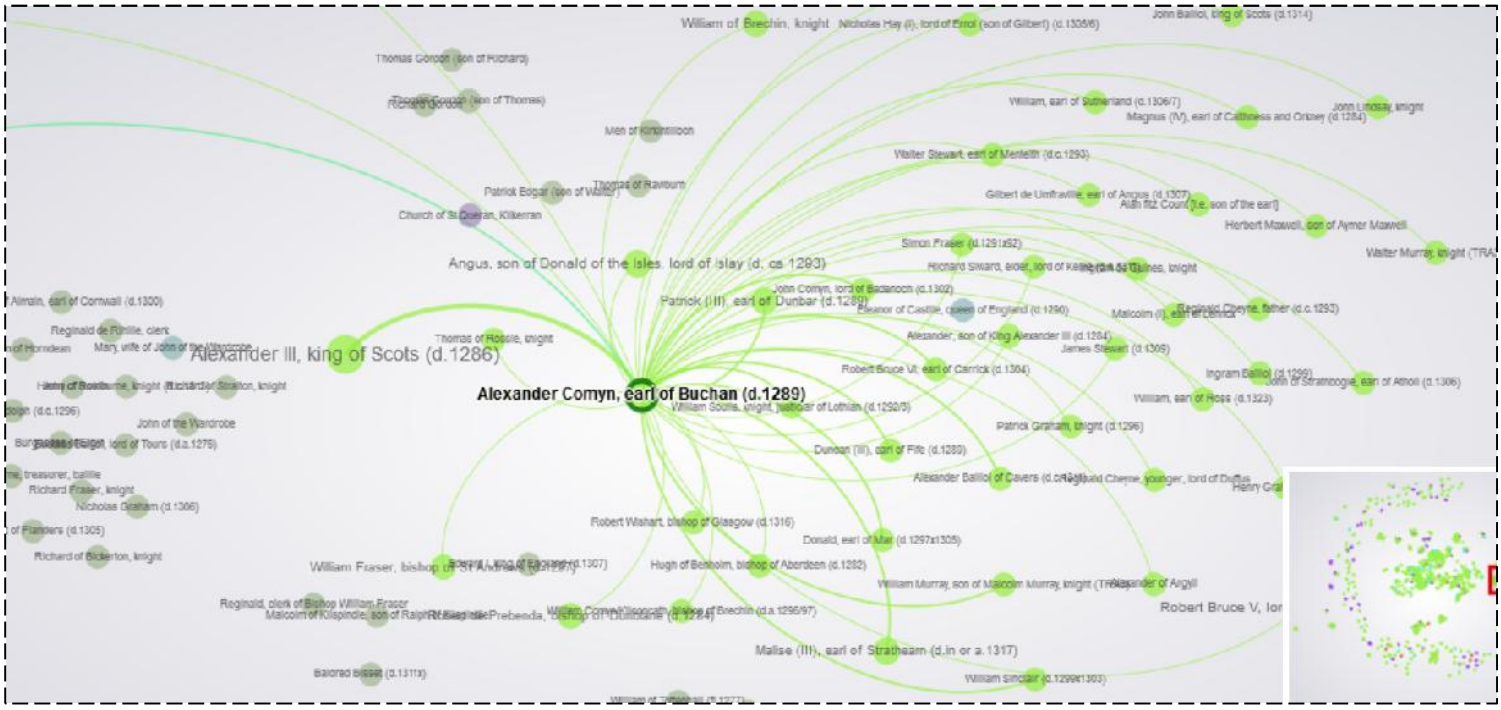
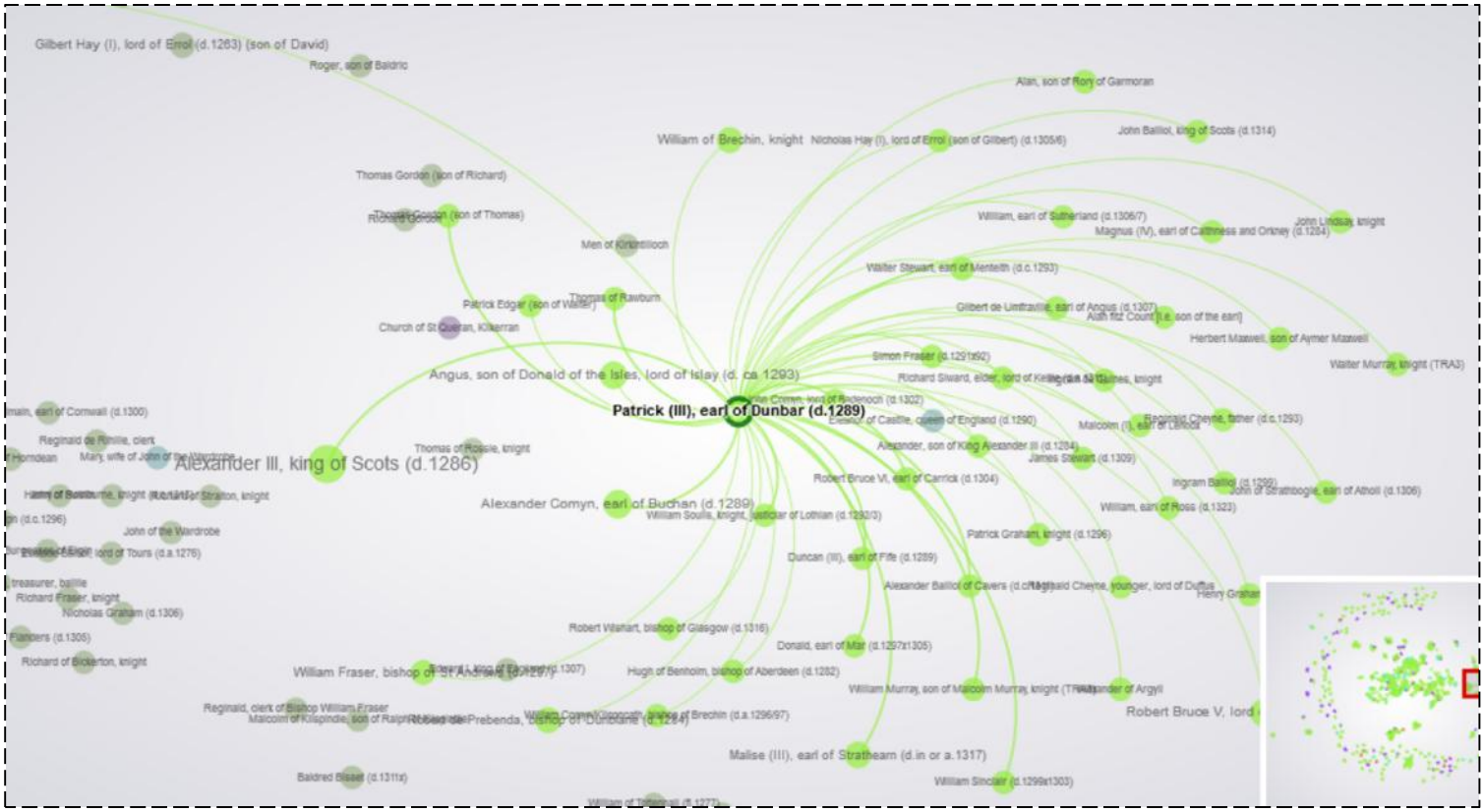


Figure 2.41. Tenurial and lordship of Patrick (III), earl of Dunbar



While our evidence of tenurial and lordship relationships explicitly mentioned is far from complete, Figures 2.42 through 2.45 are indicative of broader trends in the social relationships of the great landholders, including religious institutions. Figure 2.42 illustrates lordship relationships of Dunfermline Abbey, for example with a vassal knight with the first initial ‘G’, and various ‘men of’ the abbey, including one Constantine. We also see its mother-house relationship with its dependent priory, Urquhart, and tenurial links, especially on its lands in Lothian, Carberry and Smeaton. Similar relationships can be seen in Figure 2.43 for the bishops of Aberdeen. For the earls, we are more likely to see the relationships connecting them to their household officers. Figure 2.44 shows the tenurial and lordship ties of Gilbert or Gilla Brigte, earl of Strathearn, as patron of Inchaffray abbey, as husband (and lord) of Ysenda of Kinbuck, as well as ties to a local judge, thane, and others.

Figure 2.42. Tenurial and lordship relationships of Dunfermline Abbey

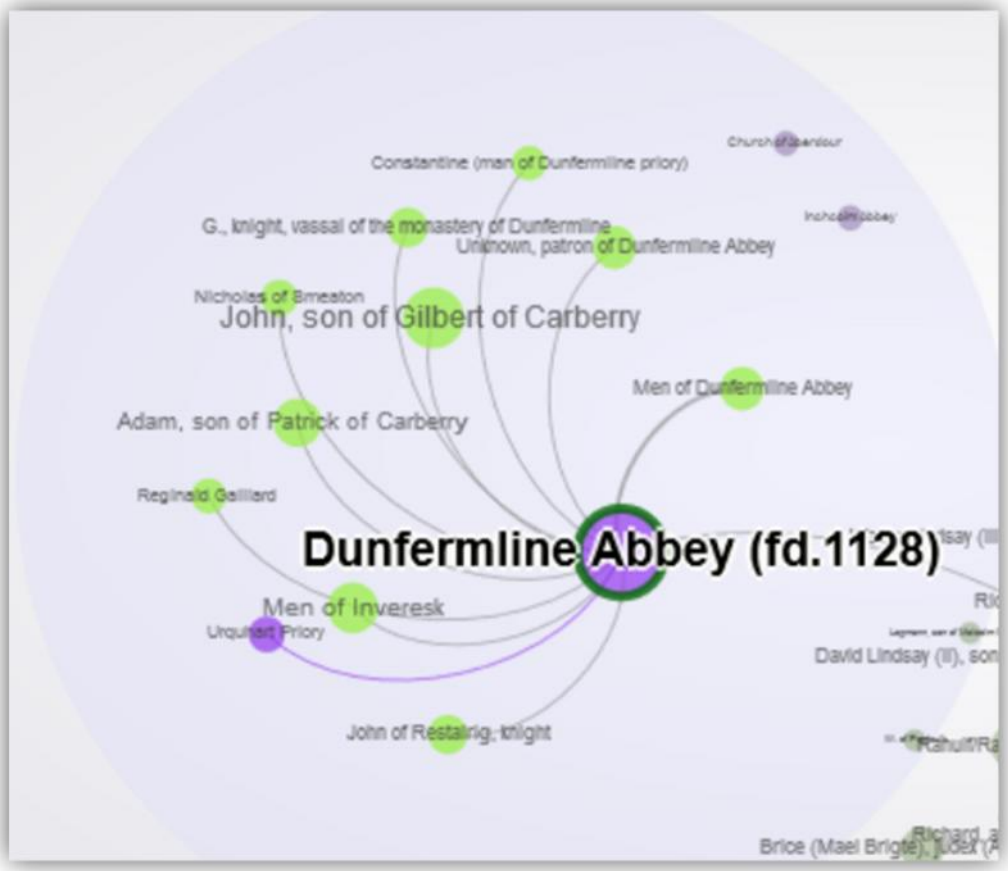


Figure 2.43. Tenurial and lordship relationships of some bishops of Aberdeen

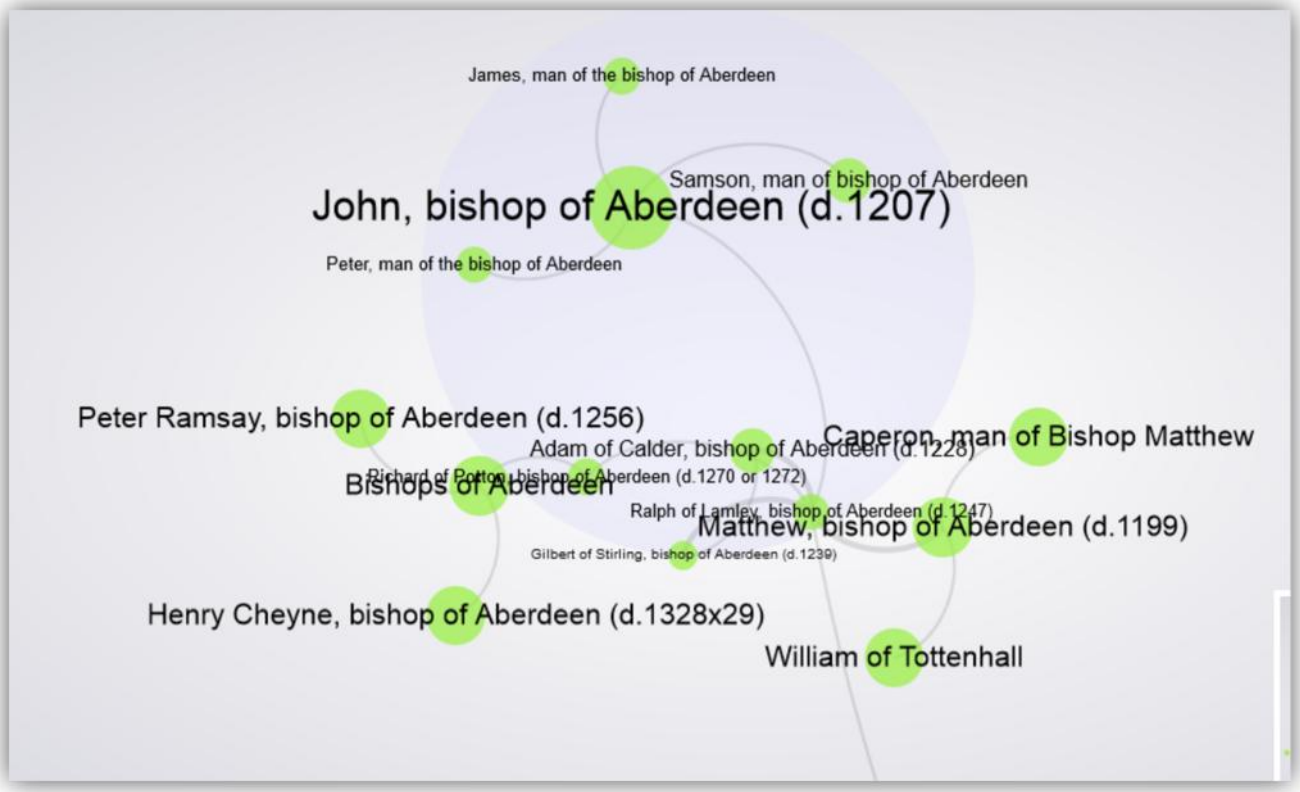
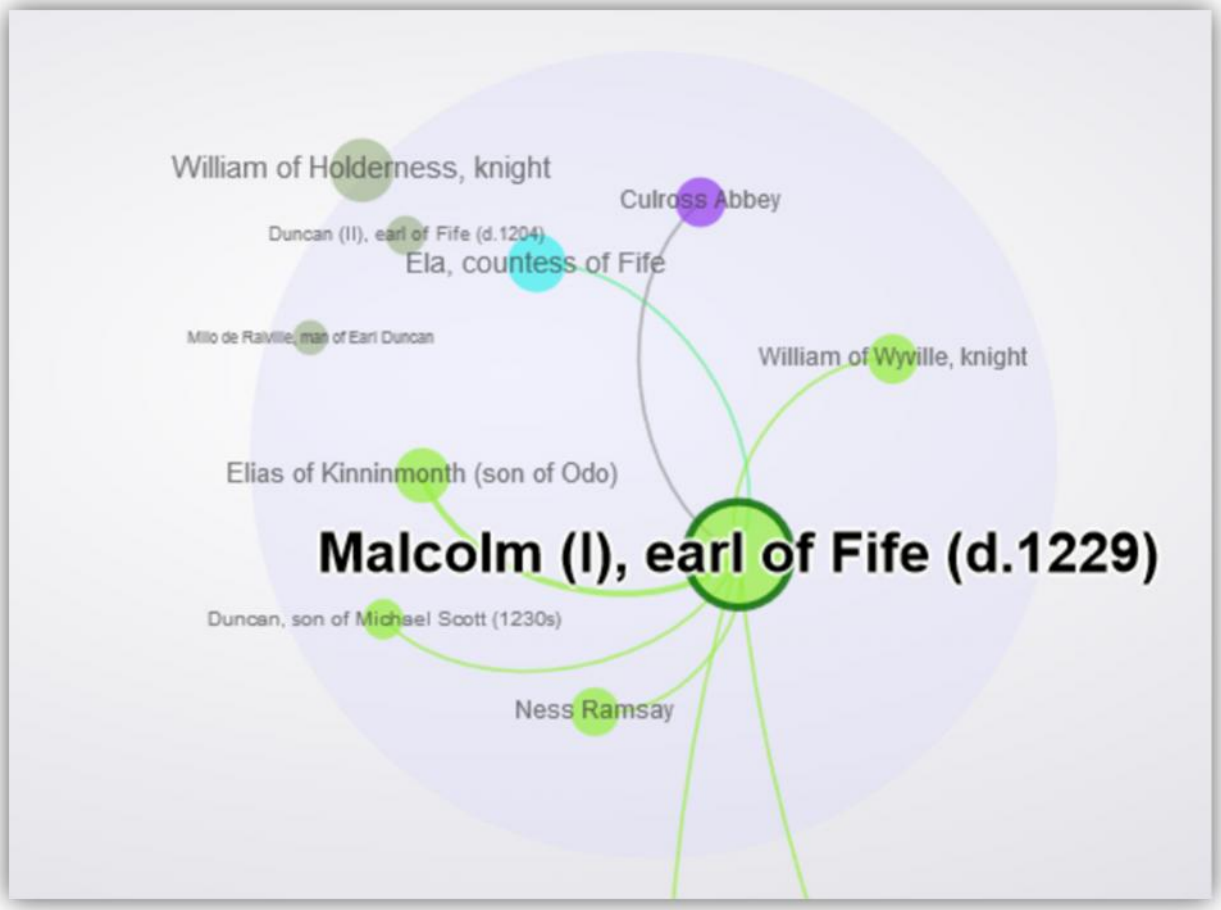


Figure 2.44. Tenurial and lordship relationships of Gilbert earl of Strathearn (d. 1223)

Figure 2.45. Tenurial and lordship relationships of Malcolm (I), earl of Fife (d. 1229)



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3 NETWORKS OF GRANTORS & BENEFICIARIES

The three categories of relationship networks examined in chapter two reflected explicitly made statements in the medieval sources about connections between individuals. The following chapters examine social networks produced from other sorts of connections between medieval persons. Chapter three examines the links between grantors and beneficiaries of charters. Most of the documents in the database record gifts, confirmations, sales, and so forth, of land or other property from one person or institution to another. The enactment of these transactions set in train long-standing relationships. The anthropological and sociological literature on gift-giving and the social relationships engendered in gift-giving is vast. It is not the job of social network analysis to speculate on the exact nature of these relationships, rather to allow us access to these networks in ways which were hitherto impossible. While chapter two's analyses were based on the factoid type 'relationship' in the PoMS database, chapter three's case study is based around the factoid type 'transaction'. The study incorporated only transactions from the following document types: charter, charter/brieve, notification, agreement and settlement, because these for the most part contain evidence about dispositive transactions, like gift-giving. The parameters of the study are as follows:

Table 3.1. Grantor and beneficiary study parameters

Number of documents	4063
Number of transactions	5351
Number of people/ institutions	2225
Average transactions per person	2.4

There are 5351 transactions drawn from 4063 documents involving 2225 persons and institutions, allowing for an average of 2.4 transactions per person (Table 3.1). The vast majority – over 98% – of these documents relevant to the study were charters (Table 3.2). About 55% of the documents were charters issued by or in the name of aristocrats and other laymen, while about a quarter were royal and about a fifth were ecclesiastical, in the sense that they were issued by bishops, abbots, and so forth (Table. 3.3). Together, gifts, concessions and quitclaims made up nearly 60% of all transactions, when confirmations and renewals are added to this the number is over 90% (see Table 3.4).

Table 3.2. Breakdown of document types in study

Charters	3996	98.4%
Charter/ brieves	16	.4%
Notifications	13	.3%
Agreements	26	.6%
Settlements	12	.3%

Table 3.3. Breakdown of documents by H-number

H1/	Royal	1006	24.7%
H2/	Ecclesiastical	793	19.5%
H3/	Private	2225	54.8%
H4/	Agreements, etc.	39	1%

Table 3.4. Breakdown of transactions in study

Gifts and foundations[9]	2248	42%
Confirmations	1106	21%
Renewals	715	13%
Quitclaim & Resignation[10]	543	10%
Concessions[11]	304	6%
Grants of property (condedo)	131	2%
Sales	72	1%
Obligation	59	1%
Succession	57	1%
Other/ misc.	34	<1%
Institution & ordination of vicarage	31	<1%
Statement[12]	21	<1%
Inspection	16	<1%
Lease / wadset	14	<1%

[9] Plus one infeftment and one gift0agreement)
[10] And renunciations of claim
[11] Including concession (agreements) the following follow same pattern
[12] Plus acknowledgement and instruction

Figure 3.1. G&B People and Institutions, with gender

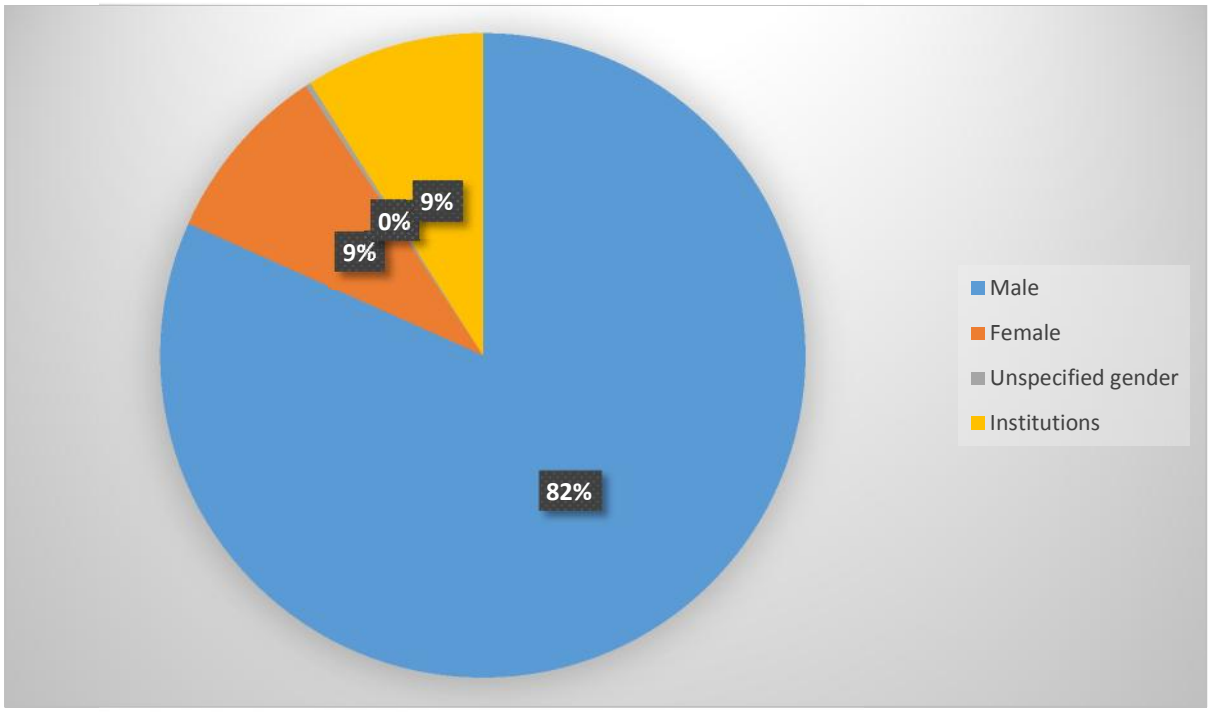
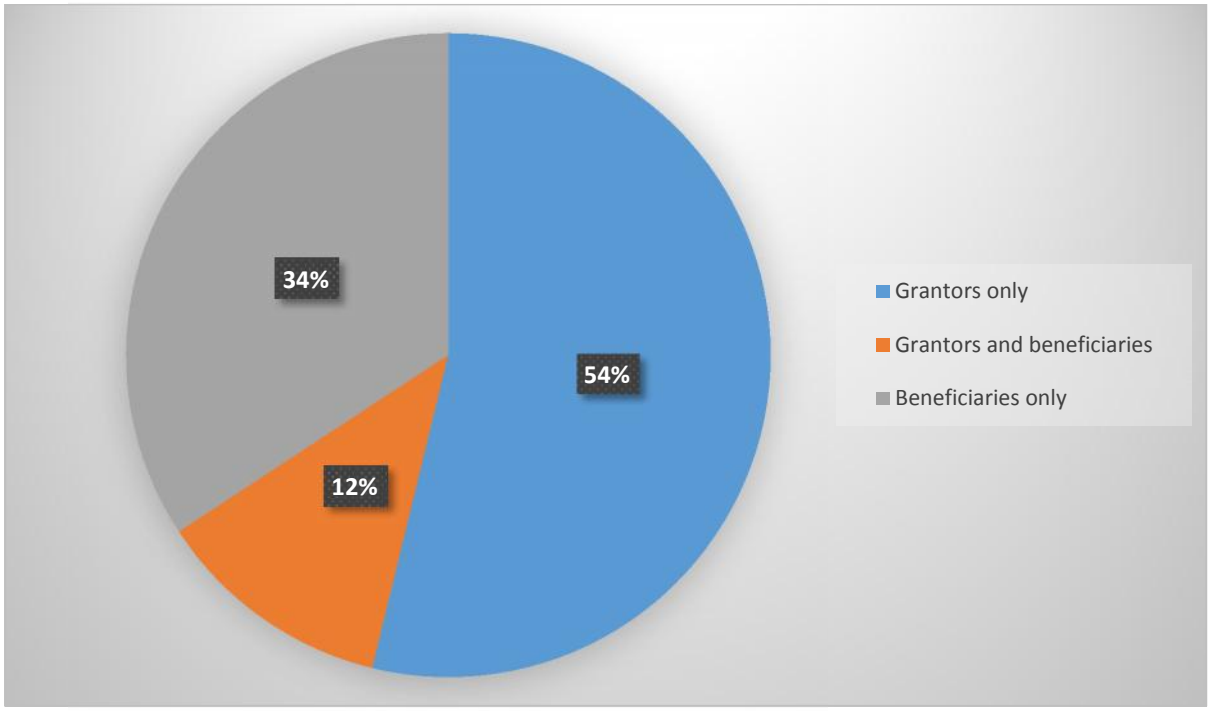


Figure 3.2. Grantors, beneficiaries, and both



There were 2225 individual actors in the study. Of these, 1818 (82%) were male, 201 (9%) were female, a mere 6 were actors of uncertain gender (usually generic heirs), and 200 (9%) were institutions (see Figure 3.1). Most actors were either grantors or beneficiaries (see Figure 3.2), but only 266 (12%) were both grantors and beneficiaries. Not surprisingly there were more grantors only (1197 actors) than beneficiaries only (762 actors). However, the vast majority of actors appear only once or twice. Of all grantors, 911 individuals – 62%- acted only once, and a further 279 actors – 19% - appeared only twice. Among grantors, only 80 agents acted more than five times – a mere 5.5%. This reflects something of the hierarchy of society in the Middle Ages. Of all beneficiaries, 732 (73%) appear only once, with a further 144 (14%) acting as beneficiary only twice. Only 66 (6.6%) of beneficiaries appear as such more than five times, and only 33 (3.3%) were beneficiaries more than ten times. These statistics explain why this network is not very dense – many grantors are connected to a single beneficiary, usually a religious house, while only the most active grantors are linked to a large number of beneficiaries.

The grantor-and-beneficiary studies are also directed networks, which means that each tie between two nodes has directionality, indicating whether a person was on the giving end or the receiving end of the transaction. As Table 3.5 highlights, it is useful to separate the overall degree number into 'in-degree', reflecting how many times that person was a beneficiary, and 'out-degree', reflecting how many times that person was a grantor. For example, King William had the highest out-degree, with 170 acts of granting, while he was only the beneficiary only once. The five most active grantors were all kings, while most of the other 'top grantors' were bishops, earls, and other lay magnates and church prelates.

Table 3.5. Top Grantors: out-degree of 10 and over

Id	Name	Gender	In-Degree	Out-degree	Degree	Betweenness Centrality
1	William I, king of Scots (d.1214)	M	1	170	171	374
58	Alexander II, king of Scots (d.1249)	M	1	156	157	326.1667
360	Alexander III, king of Scots (d.1286)	M	1	67	68	232
74	Malcolm IV, king of Scots (d.1165)	M	0	50	50	0
130	David I, king of Scots (d.1153)	M	0	37	37	0
788	Andrew Murray, bishop of Moray (d.1242)	M	7	36	43	1438.667
40	William Malveisin, bishop of St Andrews (d.1238)	M	6	28	34	10960.4
2087	Mael Domnaig, earl of Lennox (d. by 1265)	M	3	26	29	404
432	David of Bernham, bishop of St Andrews (d.125	M	0	22	22	0
90	Henry, earl of Northumberland and Huntingdon (d.1152)	M	0	21	21	0
2046	Roger de Quincy, earl of Winchester (d.1264)	M	2	18	20	4366.35
16	William Comyn, earl of Buchan (d.1233)	M	2	17	19	33.5
451	Alan, lord of Galloway (d.1234)	M	2	17	19	3620.667
817	Roger, bishop of St Andrews (d.1202)	M	3	17	20	111.8667
134	Richard, bishop of St Andrews (d.1178)	M	0	16	16	0
858	Walter of St Albans, bishop of Glasgow (d.1232)	M	13	16	29	4234.6
82	Kelso Abbey	I	186	15	201	25565
2220	Ralph of Lamley, bishop of Aberdeen (d.1247)	M	2	15	17	31.36667
3786	Henry of Norham, prior of St Andrews (fl.x1228-1236)	M	0	15	15	0
148	Robert, bishop of St Andrews (d.1159)	M	0	14	14	0
142	David, earl of Huntingdon (d.1219)	M	2	13	15	137
400	Alan Stewart, son of Walter (d.1204)	M	0	13	13	0
112	Richard de Moreville (d.1189 or 1190)	M	0	12	12	0
782	Malcolm (I), earl of Fife (d.1229)	M	5	12	17	3351.833
2081	John de Vaux, knight (fl.1213-55)	M	0	12	12	0
745	Jocelin, bishop of Glasgow (d.1199)	M	3	11	14	230
751	Bertram, prior of Durham (d.1212/13)	M	5	11	16	220.9333
1378	Walter Stewart (II), son of Alan (d.1241)	M	3	11	14	2622.383
1382	David of Quixwood	M	0	11	11	0
2248	Malise (II), earl of Strathearn (d.1271)	M	0	11	11	0
444	Patrick (I), earl of Dunbar (d.1232)	M	1	10	11	3
453	Roland (Lachlan), lord of Galloway (d.1200)	M	0	10	10	0
456	Gamelin, bishop of St Andrews (d.1271)	M	0	10	10	0
806	Saer de Quincy, earl of Winchester (d.1219)	M	0	10	10	0
1453	James Stewart (d.1309)	M	0	10	10	0
1981	Alexander Comyn, earl of Buchan (d.1289)	M	1	10	11	37
12934	William de Lizars, son of David, ld. Gorton	M	0	10	10	0

The corresponding Gephi visualization on the PoMS website is called Grantors and Beneficiaries, adjusted to grantors (http://db.poms.ac.uk/sna/all/46/). This means that the size of the nodes and name labels reflects the out-degree, or how many times the person acted as grantor. Figure 3.3 gives a good general sense of the structure of the network, with minor actors fanning out like rays around the major grantors and beneficiaries. Figure 3.4 gives a close-up of this sociogram, with the top grantors, Kings William I and Alexander II, clearly visible. The nodes in pink represent institutions, giving a clear sense of the importance of monasteries and other church institutions in this study. Figure 3.5 highlights the grantor-and-beneficiary links of the most prolific grantor, King William I, demonstrating the extent of his connections across the whole network.

Figure 3.3. Gephi sociogram, Grantors and Beneficiaries, adjusted to grantors.

Figure 3.4. Grantors and Beneficiaries, adjusted to grantors: close-up

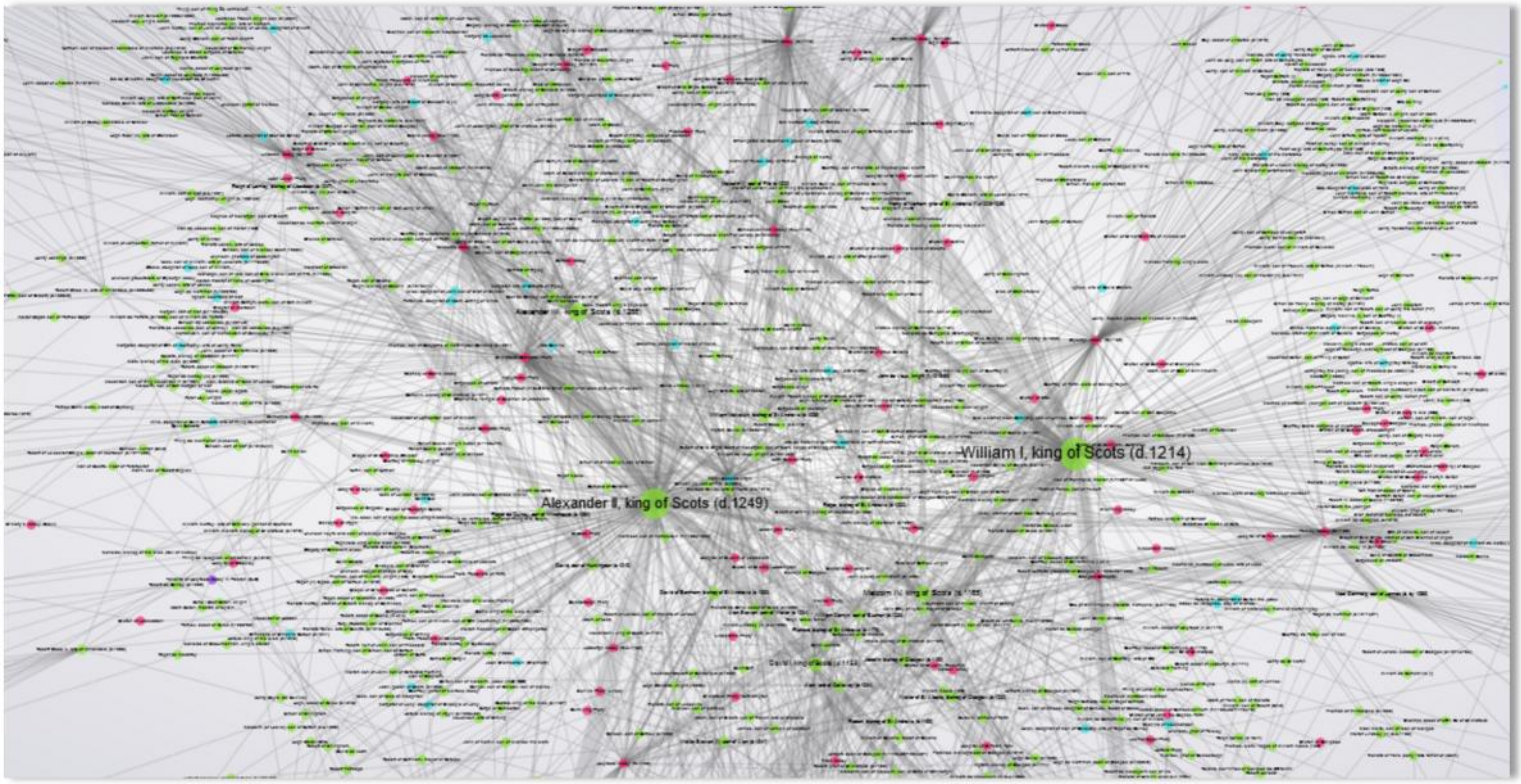
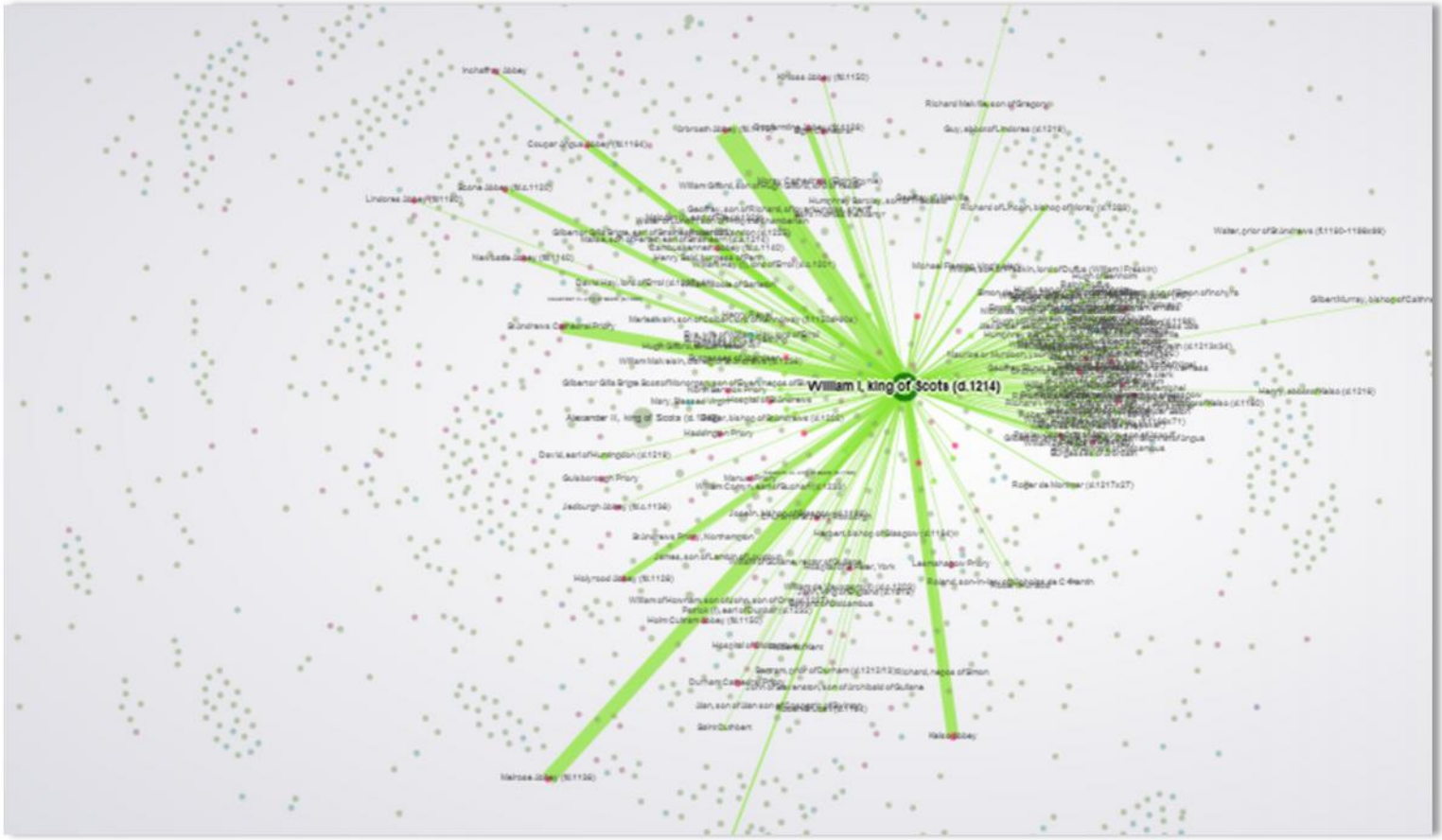


Figure 3.5. Grantor-beneficiary connections of William I, king of Scots (d. 1214)



The most commonly-attributed beneficiaries are listed in Table 3.6. Unsurprisingly, these are mostly monasteries, who benefited from the munificence of a wide range of individuals in society and were also better at recording and preserving written records of these gifts than other groups in society. The top institutions were Kelso, Melrose, Dryburgh and Arbroath abbeys, as well as Coldingham and St Andrews Cathedral priories. The Blessed Virgin Mary appears as the fourth most active beneficiary, with an in-degree of 135, because donors were keen to invoke her in terms of prayers for their souls that were a condition of these gifts. Similarly, Saint Cuthbert appears down the list, with an in-degree of 50, and Saints Kentigern, Aebbe, and Andrew are also listed in the table (saints are coloured in blue). The only laymen to appear in the list of top beneficiaries were Nicholas Hay, lord of Errol, and David Graham, lord of Lovat, both of whom were active in the mid-late thirteenth century.

Table 3.6. Top Beneficiaries: in-degree of 10 and over

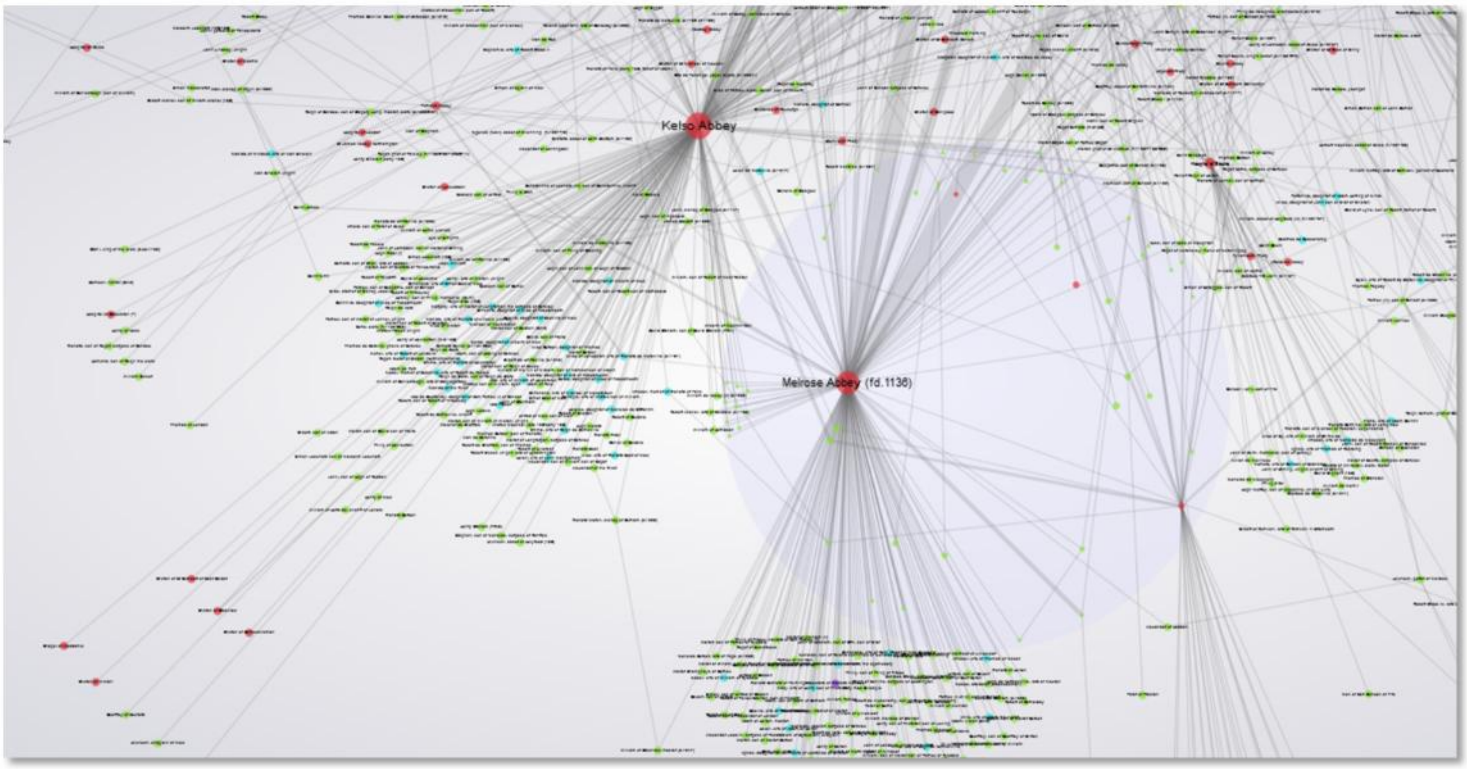
Id	Label	Gender	In-Degree	Out-Degree	Degree	Betweenness Centrality	Eigenvector Centrality
82	Kelso Abbey	I	186	15	201	25565	1
75	Melrose Abbey (fd.1136)	I	158	5	163	2592.666667	0.669233008
710	Mary, Blessed Virgin	F	135	0	135	0	0.65238806
128	Dryburgh Abbey (fd.1150)	I	119	1	120	566	0.565961348
77	Coldingham Priory (fd.1139)	I	116	2	118	781	0.416634373
41	Arbroath Abbey (fd.1178)	I	102	2	104	3600.166667	0.354449239
131	St Andrews Cathedral Priory	I	101	5	106	2089.833333	0.39324945
127	Newbattle Abbey (fd.1140)	I	85	1	86	67.5	0.300300059
278	Paisley Abbey (fd.1169)	I	84	0	84	0	0.350357275
7	Dunfermline Abbey (fd.1128)	I	71	5	76	2931.233333	0.253247872
1039	Lindores Abbey (fd1190)	I	69	1	70	267.8333333	0.27949786
216	Coupar Angus Abbey (fd.1164)	I	67	0	67	0	0.223060902
582	Saint Cuthbert	M	50	0	50	0	0.251136092
87	Holyrood Abbey (fd.1128)	I	49	0	49	0	0.237412622
29	Scone Abbey (fd.c.1120)	I	43	1	44	233.8333333	0.251662464
1115	Inchaffray Abbey	I	42	0	42	0	0.150221788
250	Cambuskenneth Abbey (fd.c.1140)	I	38	0	38	0	0.169563161
2254	Coldstream Priory	I	37	0	37	0	0.091859933
1194	Holm Cultram Abbey (fd.1150)	I	35	1	36	39	0.162234735
186	Glasgow Cathedral	I	35	0	35	0	0.221231837
189	Durham Cathedral Priory	I	33	8	41	13341.93333	0.32611186
208	Hospital of Soutra	I	33	0	33	0	0.194128881
914	Saint Kentigern	M	24	0	24	0	0.185028513
4506	Saint Abbe	F	22	0	22	0	0.061114506
1957	Balmerino Abbey (fd.1229)	I	21	0	21	0	0.151314557

1912	Inchcolm Abbey	I	19	0	19	0	0.071729875
667	North Berwick Priory	I	17	0	17	0	0.069536547
354	May Priory	I	16	2	18	93	0.046635142
138	Jedburgh Abbey (fd.c.1138)	I	16	0	16	0	0.047104657
858	Walter of St Albans, bishop of Glasgow (d.1232)	M	13	16	29	4234.6	0.291330398
1101	Kinloss Abbey (fd.1150)	I	13	0	13	0	0.051566116
4047	Monymusk Priory	I	12	0	12	0	0.065979769
2234	Nicholas Hay (I), lord of Errol (son of Gilbert) (d.1305/6)	M	11	1	12	8.5	0.026783341
2005	David Graham, lord of Lovat (d.c.1272)	M	10	1	11	1374.5	0.037094436
1457	Furness Abbey	I	10	0	10	0	0.053911859
247	Saint Andrew	M	10	0	10	0	0.04566638
1214	Hospital of St Peter, York	I	10	0	10	0	0.032996162
1647	St Bees Priory	I	10	0	10	0	0.027539642

The corresponding Gephi visualization on the PoMS website is called Grantors and Beneficiaries, adjusted to beneficiaries (http://db.poms.ac.uk/sna/all/41/). This means that the size of the nodes and name labels reflects the in-degree, or how many times the person acted as beneficiary. The key role of a few top beneficiaries as 'spokes in the wheel' can be seen from the overview of the Gephi sociogram in Figure 3.6, while the particular roles of Kelso and Melrose abbeys is visible in Figure 3.7.

Figure 3.6. Gephi sociogram, Grantors and Beneficiaries, adjusted to beneficiaries

Figure 3.7. Grantors and Beneficiaries, adjusted to beneficiaries: close-up



Illustrations of some of the connections of specific actors follow (Figures 3.8, 3.9, 3.10) and readers can explore these in greater detail online. The thickness of the edges reflects the number of transactions there were between two actors, and the colour of the edges reflects the gender of the other person or institution (alter rather than ego). The patterns of the connections of both the top grantors and top beneficiaries are remarkably similar, like rays emanating out (or in as it were) from the node of ego. This reflects the fact that in this kind of network, it is ego which ties the network together. Given only the evidence of granting and receiving, removing ego (for example, the monastery receiving the gifts) removes the raison d'être of the network and the network would cease to exist. In the real world, of course, there would be other sorts of social relationships and contexts linking together the spokes of the wheel, as it were; nevertheless, these sociograms illustrate starkly the potential for monasteries to act as focal points, one in which other social relationships were likely to be fostered.

Figure 3.8. Grantor-beneficiary connections of Kelso Abbey

Figure 3.9. Grantor-beneficiary connections of St Andrews Cathedral Priory

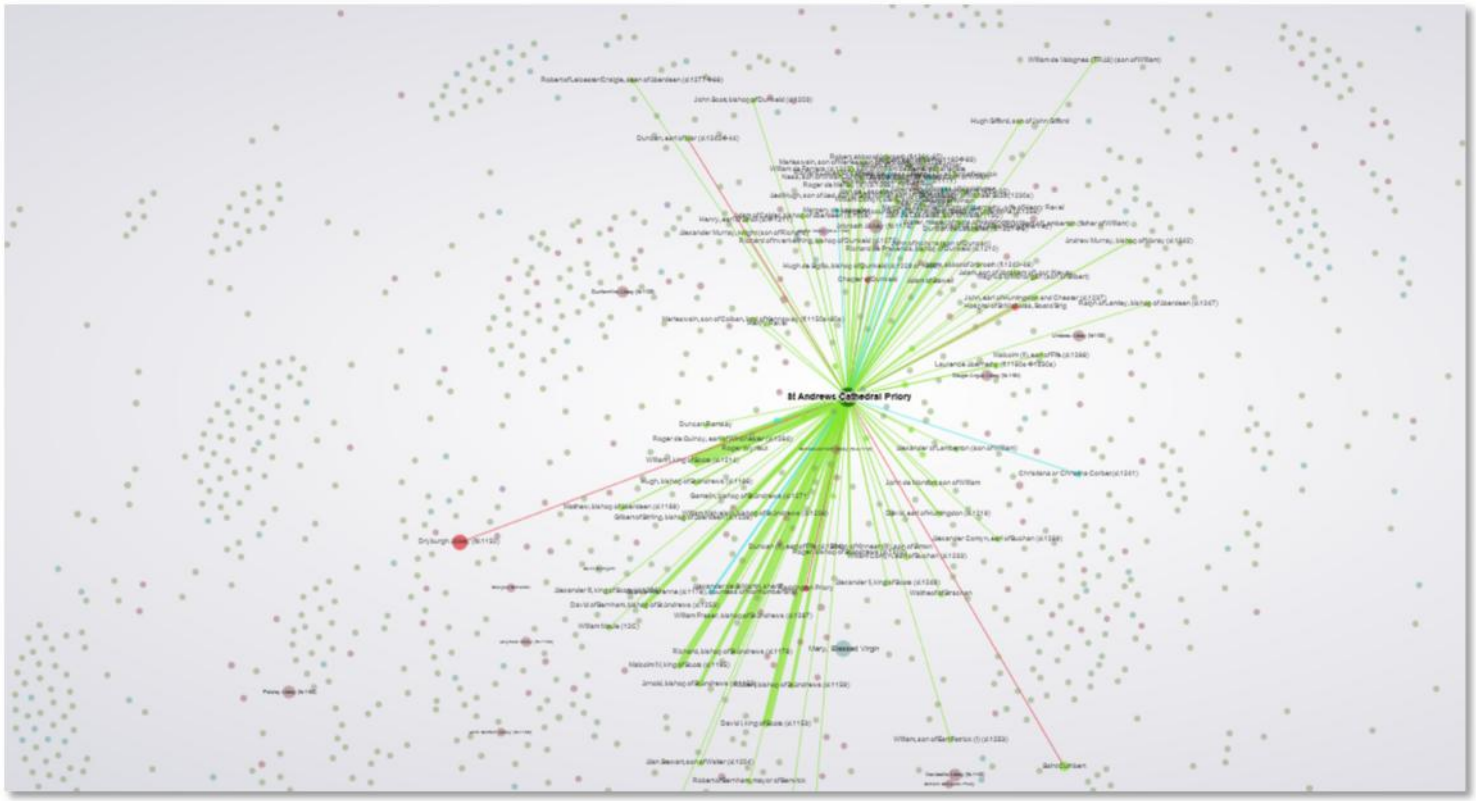
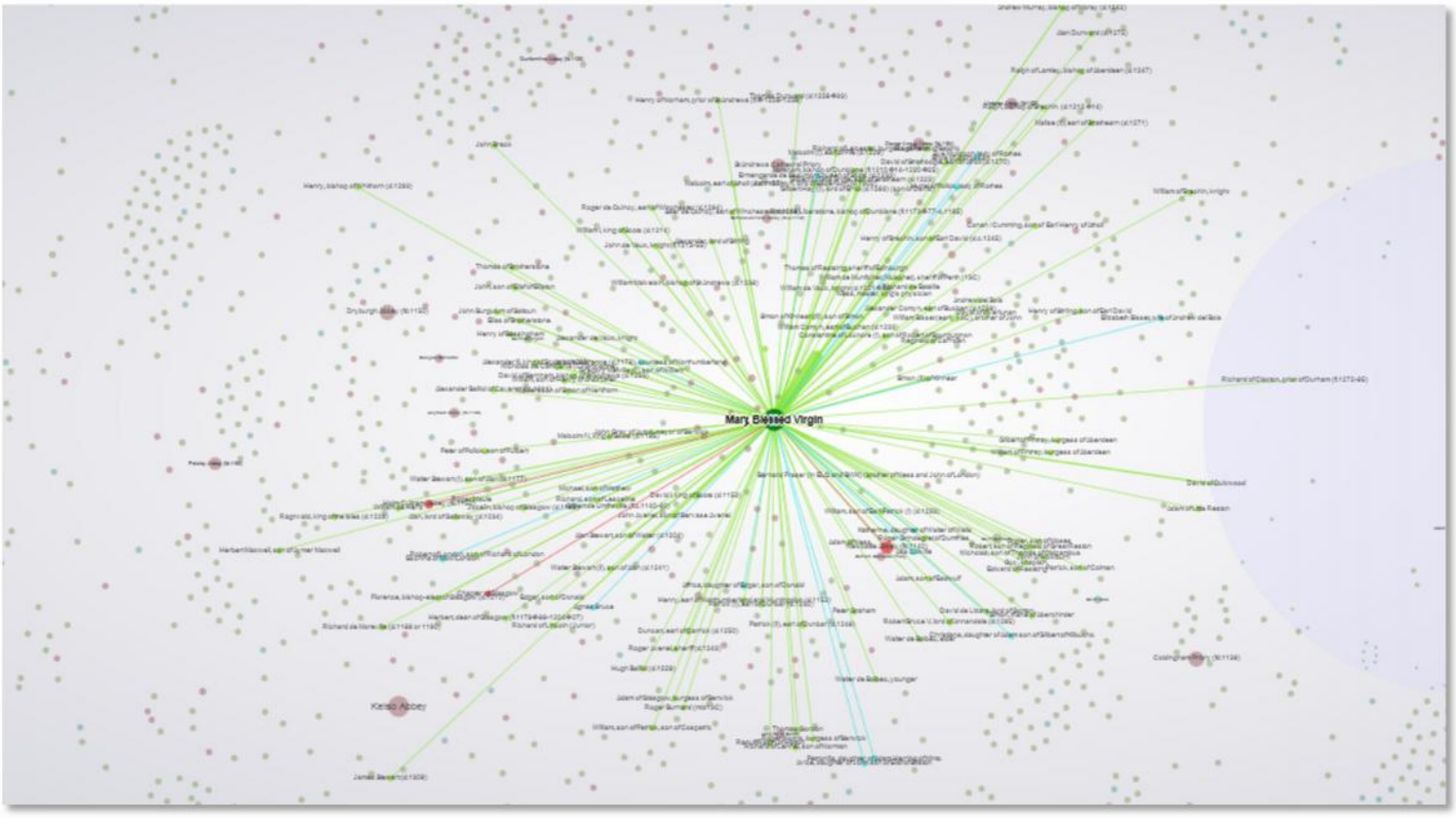


Figure 3.9. The Blessed Virgin Mary



The sociograms produced in the Gephi program allow for some additional features which the web-based visualizations are not able to represent. One of these is the directionality of the ties between actors. The directionality reflects the nature of the transaction, running from grantor to beneficiary. This close-up of Saint Cuthbert shows how the directionality is represented by means of arrows (figure 3.10). The edge-enhanced image of grantors and beneficiaries in Figure 3.11 demonstrates the directionality of transactions between kings and religious houses.

Figure 3.10. Saint Cuthbert as beneficiary, with arrows

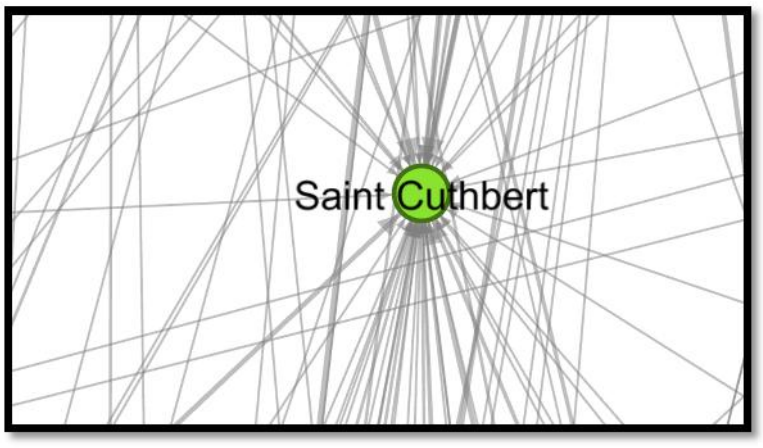
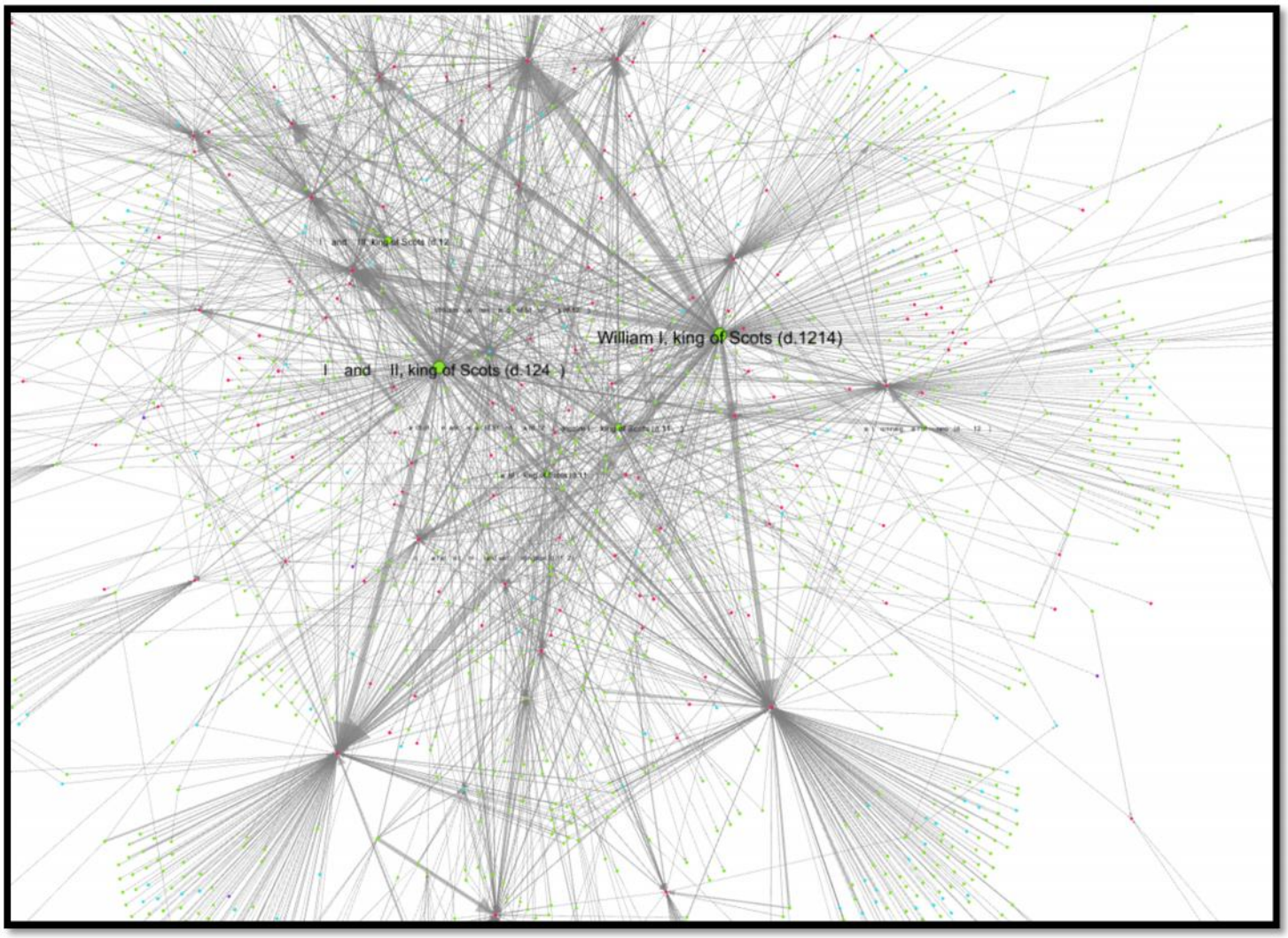


Figure 3.11. Edge-enhanced Gephi sociogram, with arrows



It also possible to use Gephi to examine the nature of each implied relationship between the grantor and beneficiary. This is reflected in the 'weight' of the edge or tie between two nodes. This weight is what determines the thickness of the edges in Figure 3.11 above. The number assigned to the weight is that of the number of transactions shared between Actor 1 and actor 2. Table 3.7 lays out these relationships with 15 or more transactions. These do not distinguish in terms of the directionality, or whether actor 1 or actor 2 were grantor or beneficiary. As it happens, based on the nature of the evidence, however, the following relationships are almost entirely those in which actor one was chiefly a grantor and actor two was chiefly a beneficiary. These implied relationships are subtly different from the tables we have already seen noting the most active grantors and beneficiaries in an unqualified sense. While Kelso Abbey was the top beneficiary in sheer numbers, it comes rather farther down this list, which gives us a sense of the closeness of the bonds formed by individuals and institutions.

Table 3.7. Most productive grantor-beneficiary relationships.

Actor 1	Actor 2	Number of connections
William I, king of Scots (d. 1214)	Arbroath Abbey	53
William I, king of Scots (d. 1214)	Melrose Abbey	30
Alexander II, king of Scots (d. 1249)	Melrose Abbey	27
William I, king of Scots (d. 1214)	St Andrews Cathedral Priory	26
Alexander II, king of Scots (d. 1249)	Arbroath Abbey	26
William I, king of Scots (d. 1214)	Kelso Abbey	24
Alexander II, king of Scots (d. 1249)	Blessed Virgin Mary	23
Gilbert or Gilla Brigte, earl of Strathearn (d. 1223)	Inchaffray Abbey	20
Richard, bishop of St Andrews (d. 1178)	St Andrews Cathedral Priory	18
Alexander II, king of Scots (d. 1249)	Scone Abbey	17
Alexander II, king of Scots (d. 1249)	Newbattle Abbey	17
David I, king of Scots (d. 1153)	St Andrews Cathedral Priory	16
David, earl of Huntingdon (d. 1219)	Lindores Abbey	16
David of Quixwood	Coldingham Priory	16
William I, king of Scots (d. 1214)	Dunfermline Abbey	15
William I, king of Scots (d. 1214)	Holyrood Abbey	15
William I, king of Scots (d. 1214)	Cambuskenneth Abbey	15
William Malveisin, bishop of St Andrews (d. 1238)	Arbroath Abbey	15

King William I appears seven times in this list of (implicit) relationships yielding fifteen or more transactions as a grantor or beneficiary, demonstrating his links with the abbeys of Arbroath, Melrose, Kelso, Dunfermline, Holyrood and Cambuskenneth. Similarly, his son King Alexander II appears five times, showing his close relationships with the Cistercian abbeys of Melrose and Newbattle, his devotion to the Blessed Virgin Mary, and links with Scone abbey. The most intense relationships between grantors and beneficiaries were those formed between the founder of a religious house and the monastery. Thus, there were 53 transactions between King William and Arbroath Abbey, 20 transactions between Gilbert earl of Strathearn and Inchaffray Abbey, and 16 between David earl of Huntingdon and Lindores Abbey. The sixteen connections between Coldingham Abbey and David of Quixwood are a reflection of the unique richness of that house's documentary archive.

Figure 3.12. Overview of G-B network in Gephi

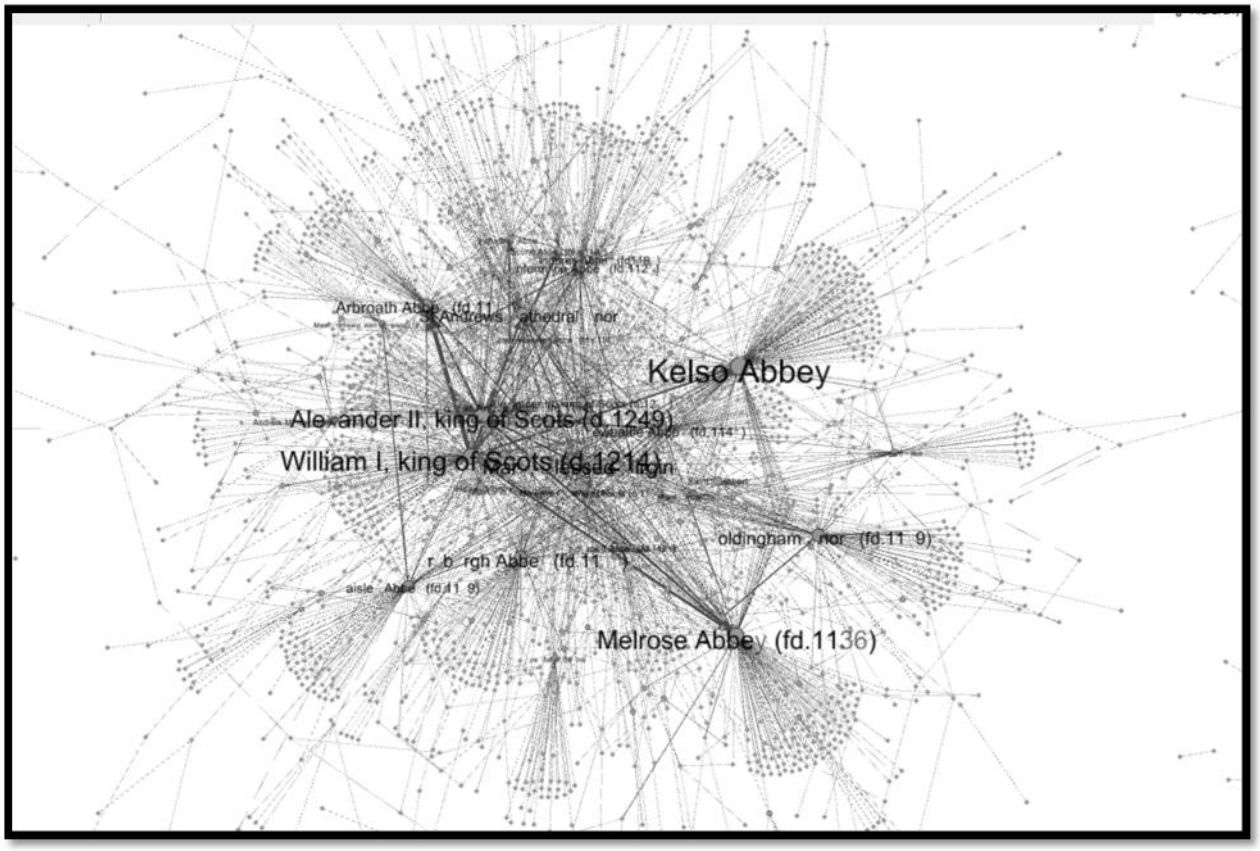


Figure 3.13. Edges representing five transactions or more

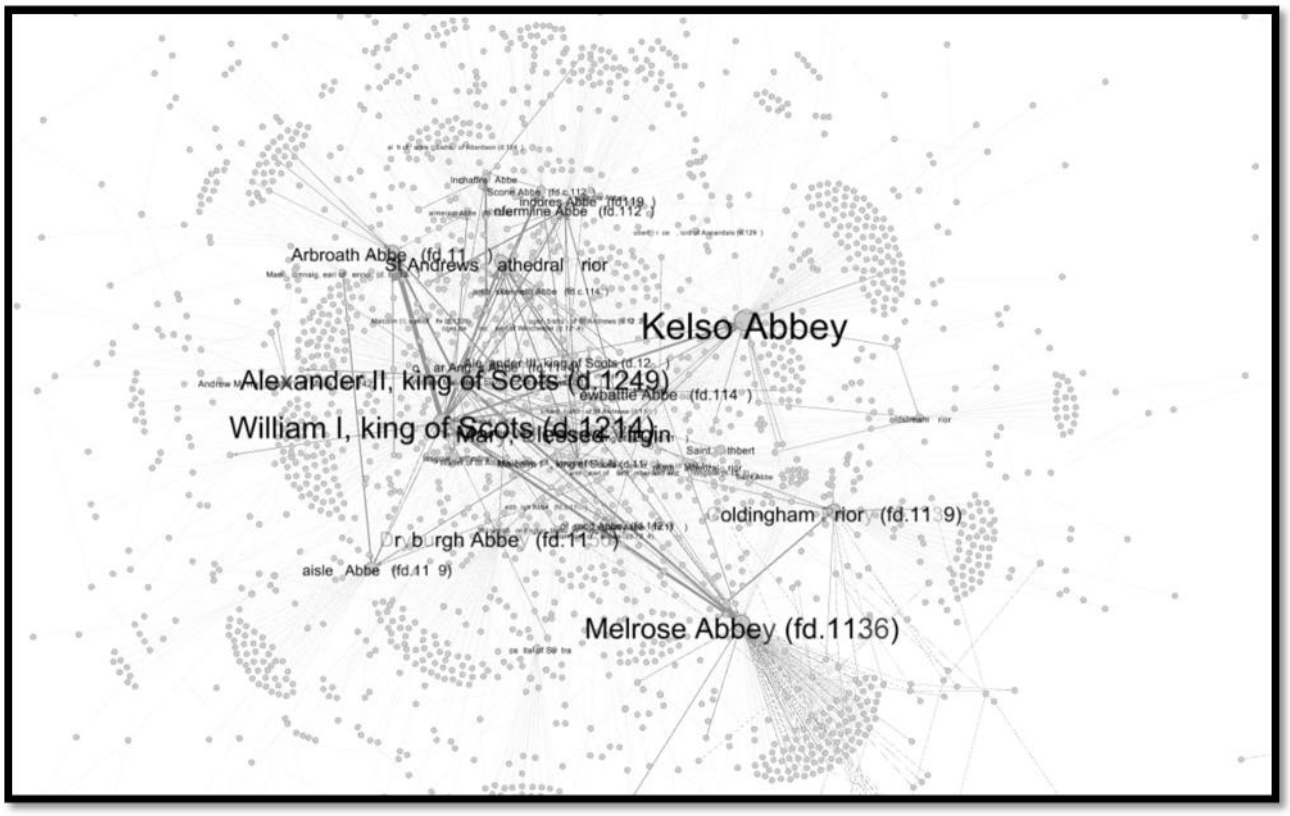


Figure 3.14. Edges representing ten transactions or more

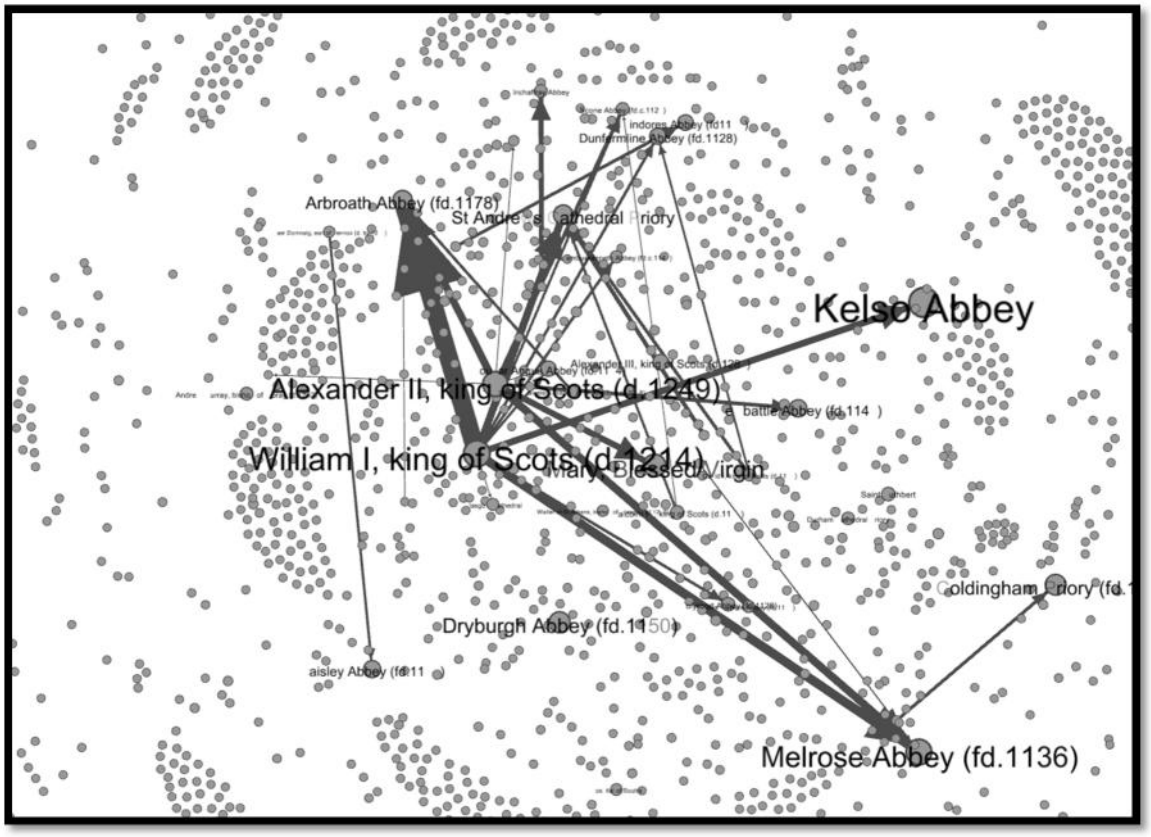


Figure 3.15. Edges representing fifteen transactions or more

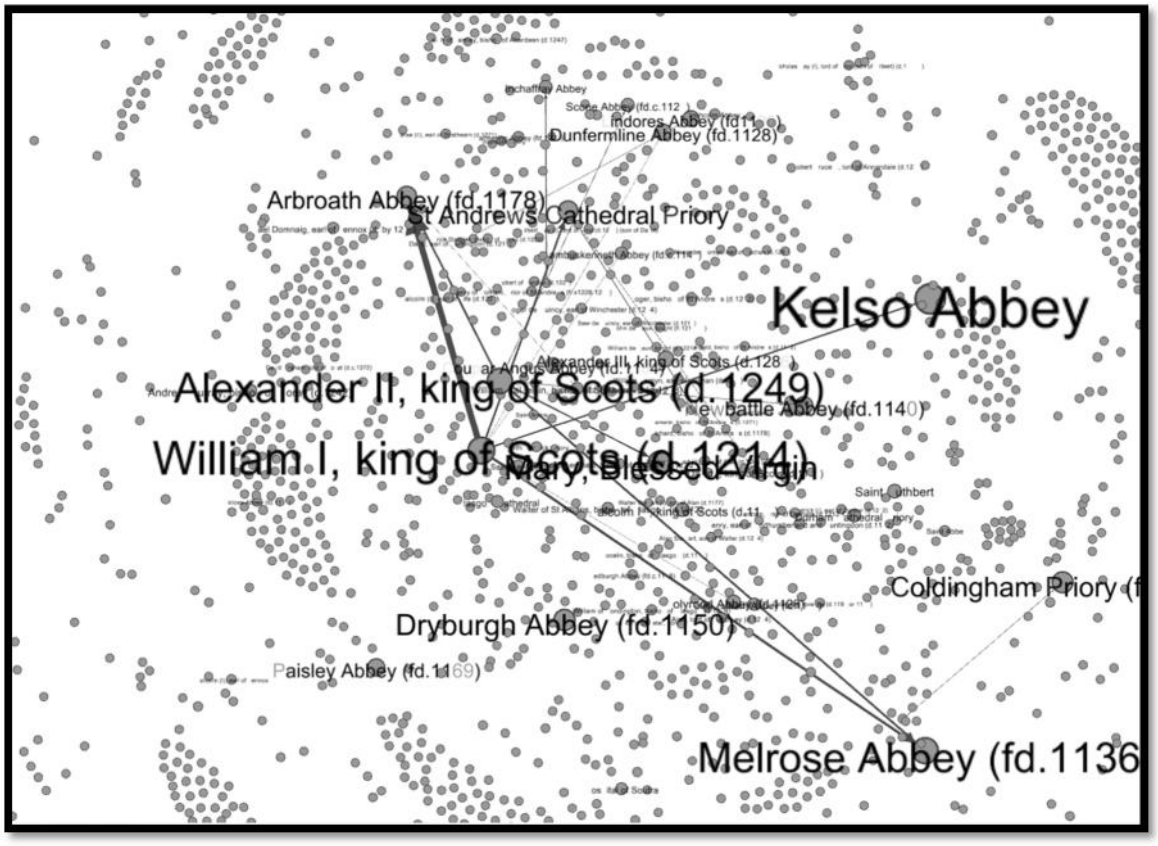


Figure 3.16. Edges representing twenty transactions or more

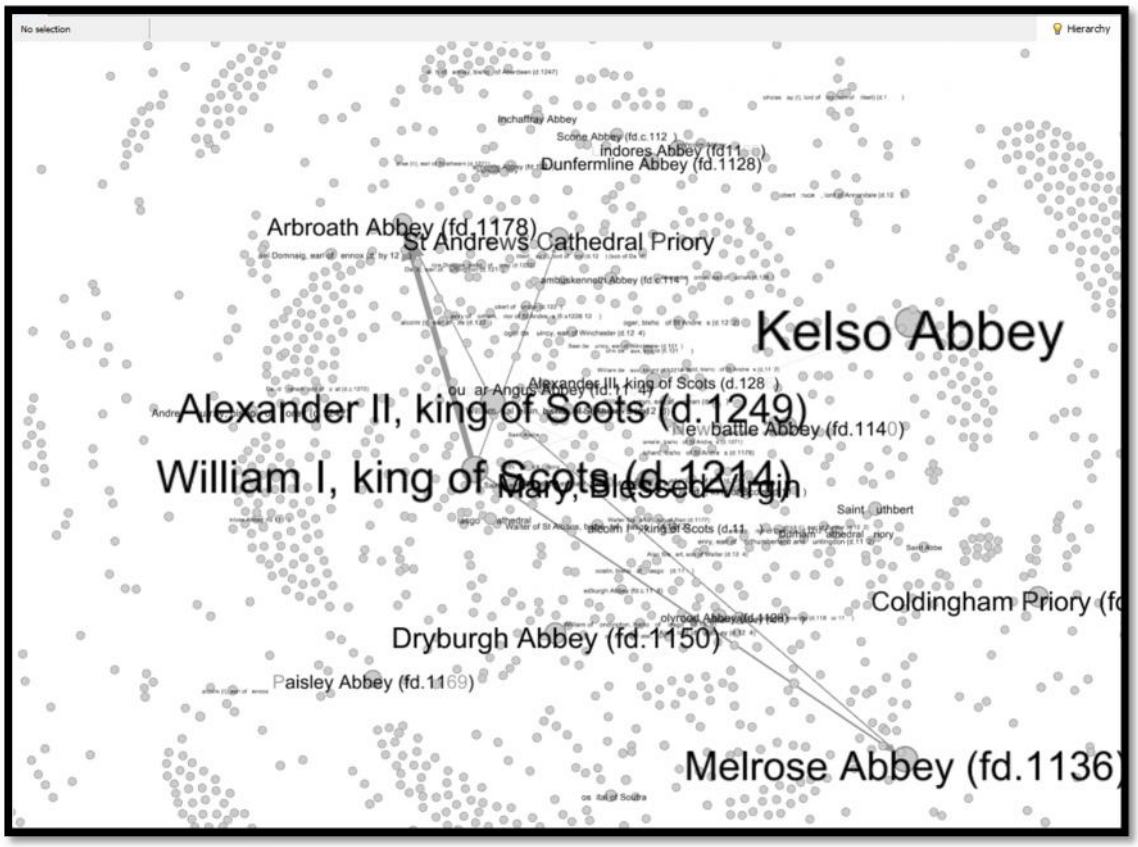


Figure 3.17. Edges representing twenty-five transactions or more

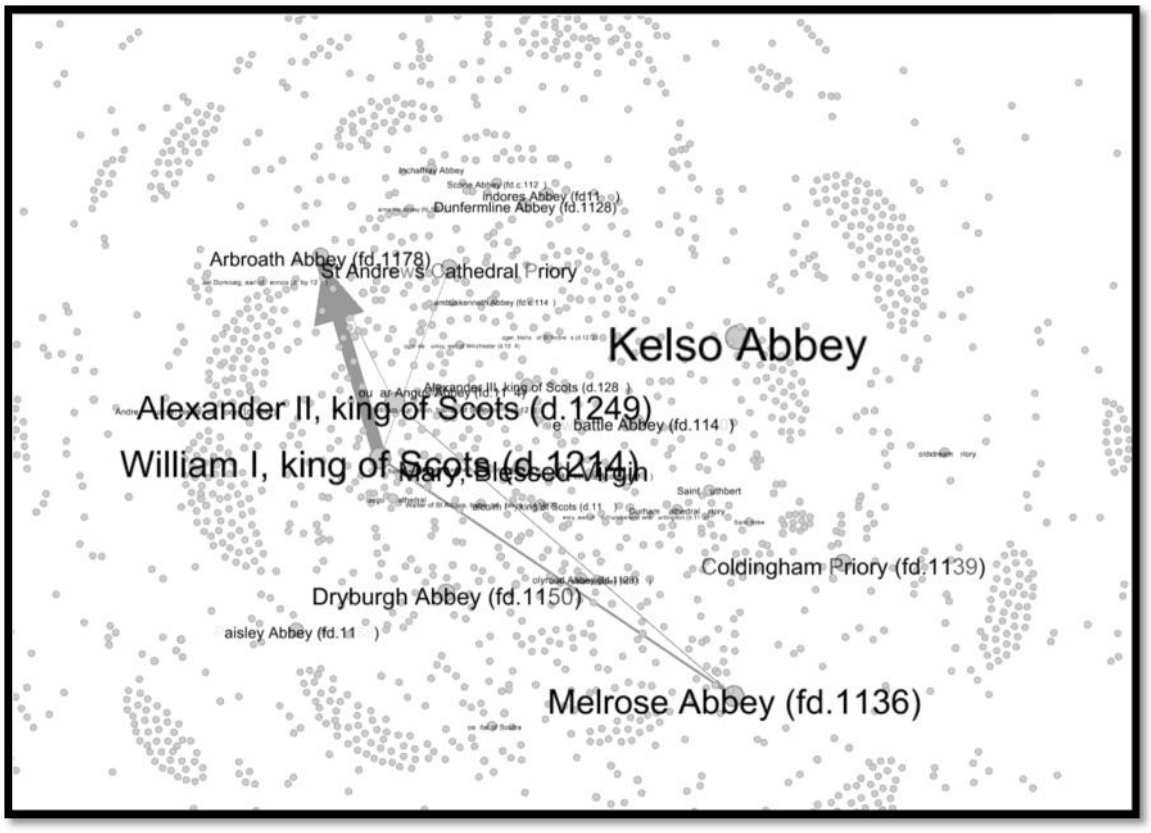


Figure 3.12 through 3.17 show the Grantor-Beneficiary network in Gephi, raising the threshold progressively in terms of displaying the edge weight. In other words, Figure 3.12 shows all the edges, Figure 3.13 shows edges with a weight of five or more, Figure 3.14 shows edges with a weight of ten or more, and so on. These images highlight the points made relevant to Table 3.7

4 Co-Witnessing Networks: All Witnesses

One of the most effective methodologies developed by the project was using Social Network Analysis to examine who witnessed charters with whom. As with Grantors and Beneficiaries, this analysis examined inferred relationships using transaction factoids. People who appear alongside other individuals in witness lists would have spent a good deal of time rubbing shoulders in political assemblies, courts, and other social contexts. Conversely, those who seldom witnessed charters together were more likely not to have enjoyed close working relationships. In SNA terms, this kind of analysis involves several steps. The first one is to create a matrix, using SNA software, with documents on one axis (rows) and witnesses on the other axis (columns). This is known as a 2-mode network, because each axis represents a qualitatively different thing. In the next step, both rows and columns – documents and witnesses – must be converted into affiliation networks or 1-mode networks. These have the same thing, documents or witnesses, on both sides. The space in the matrix where they intersect now represents not a correlation between a unique witness and a unique document (a statement that a certain person appears or does not appear in a certain charter), but rather whether or not (and if so, then the number of times) two people or two documents intersect. This shows us if individuals witnessed together and how many times. In SNA terms, the simple statement that two individuals did or did not appear together is called a binary network, while a matrix showing how many times people witnessed together is called a valued network. With the affiliation network of people who co-witness, we can then begin to examine sociograms and what they tell us about Scottish charters.

A. Creating the dataset

We began by looking at all the witnesses in the database. Because we wanted to restrict the analysis to documents from before the death of Alexander III in March 1286 (for various reasons), we only included documents which were entered during the first stage of project funding (Paradox of Medieval Scotland, 2007 to 2010), and had a ‘Source ID’ of less than 6566. The query resulted in 3816 documents (those with no witnesses were automatically excluded) and 9078 witnesses. Because of the large size of the 9078×9078 matrix, the MS Access query results were run through Pajek64, which was capable of producing one-mode affiliation networks for documents (rows) and witnesses (columns). These results were then plugged into NetDraw to produce sociograms. The sociogram produced by NetDraw for All Witnesses came to be known to us, not without affection, as the fish.

Figure 4.1. All witnesses (‘the fish’). 9078 nodes (2013).

The above sociogram shows the network of all the witnesses before 1286. This network has three components. The first and main component is almost fish-shaped with nodes on its left forming a sort of tail. The bulk of the network connections are in this main component. The second component is the semicircle to the left. This component consists of those who have witnessed charters with a few others at most but interestingly with no one in the main component. This puts them on the periphery. We will need to confirm if these people are on the periphery of elite society in medieval Scotland. For example, Patrick, persona of Muthill (Person ID: 8566) and J. of Dunblane (Person ID: 8567) were the only witnesses to document H4/4/2 and witnessed no other documents. The third component is a set of isolates which are not shown. Isolates are those witnesses who have not witnessed a charter with another witness. There are only a handful of isolates, fewer than 20.

Improvements were made to the database in 2013 and 2014, including new prosopographical work resulting in the merger of persons or creation of new persons, as well as the correction of an error whereby the transactions in inspections had been duplicated; consequently there was a republication of the database in October 2014. There had been 3816 documents used in the initial (2013) All Witnesses Social Network Analysis: this was defined as documents entered before the end of the

Paradox of Medieval Scotland 1093-1286 AHRC project (Sept. 2010), which meant all documents with an internal reference number of less than 6566. This included documents of all document types which had witnesses. After the corrections to the database (on 29/10/2014), the corresponding numbers became 3809 documents and 9049 witnesses. This was out of a potential 6010 documents with a Source ID less than 6566, which meant that 2201 documents did not have transactions with witnesses. In other words, 63% of all documents in Oct. 2014, of documents entered up to 17/09/2010, had witnesses (see Table 4.1). This is not entirely surprising when we consider that many charters come from cartularies, such as that of Dryburgh abbey, which did not include the witnesses' names, and that papal correspondence did not have witnesses (or, if it did, these were not included in the database).

Moreover, a new methodology was developed in 2014 to allow a more precise definition of the pre-1286 dataset for the SNA studies. This created a source selector which allowed individual documents to be selected for datasets. This enabled the inclusion of some additional pre-1286 documents which had been added after the end of the first 'Paradox' project in Sept. 2010. There were 33 such documents (see Table 4.2). The combination of the corrections to the database and the creation of the source selector methodology resulted in a new pre-1286 version of the dataset which on 28 Oct. 2014 included, for all document types, 3836 documents with witnesses, out of a potential 6043 documents total, retaining the percentage of 63%. This version had 9124 witnesses as compared to 9049 witnesses in the 2014 version of the <6566 dataset, or 9078 witnesses in the 2013 <6566 dataset (see Table 4.1). Table 4.2 lists the additional documents dating to before the death of Alexander III in March 1286 which were included in the new dataset.

Table 4.1. Versions of dataset: all witnesses, all document types

	<6566 (2013)	<6566 (2014)	Source Selector (2014)
Total pre-1286 docs		6010	6043
Pre-1286 docs with witnesses (rows)	3816	3809	3836
Number of witnesses (columns)	9078	9049	9124
Number of docs without witnesses		2201	2207
Percentage of docs with witnesses		63.38	63.48

Table 4.2. List of pre-1286 documents added after September 2010.

Source ID	H-number		Source ID	H-number
6592	(3/392/6)		8072	(3/60/2A)
6593	(3/245/7)		8574	(3/486/2A)
6594	(3/42/12)		9370	(2/6/60A)
6990	(3/90/7)		9371	(3/643/2)
7012	(3/x/x)		9408	(1/1000/41)
7013	(3/17/72)		9410	(3/16/24A)
7014	(3/x/x)		9412	(3/19/6)
7016	(3/17/74)		9414	(3/13/2)
7066	(3/585/6)		9415	(3/547/30A)
7269	(2/x/x)		9418	(3/414/17)
7422	(3/207/2)		9430	(1/7/277)
7424	(3/639/5)		9447	(1/7/224)
7694	(3/414/21)		9448	(1/7/113)
7701	(3/193/4)		9449	(1/7/10)
7702	(3/42/07)		9451	(1/7/167)
7979	(1/8/63)		9452	(1/7/214)
7980	(1/8/64)			

While the foregoing data was not restricted by document type, it was decided, as with the Grantor and Beneficiary study, to focus on only the most socially relevant document types. The act of witnessing a charter was substantially different from the act of witnessing a brieve (in English parlance, a writ). The following five specified document types were incorporated in the analysis of what follows, because these for the most part contain evidence about dispositive transactions, like gift-giving: charter, charter/brieve, notification, agreement and settlement.

There are 4606 documents in the Oct. 2014 pre-1286 source selector dataset, with the five specified document types. Of these, 4139 were charters (89.9%), 16 were charter/brieves (0.3%), 106 were notifications (2.3%), 225 were agreements (4.89%), and 120 were settlements (2.6%). However, only 3622 of these documents (78.6%) had witnesses. This percentage is higher than the 63% for the study of all document types because papal documents are not included in the five specified document types used in this more restricted study.

Table 4.3 describes the makeup of the 3622 documents in the SNA study which had witnesses, as a subset of the 4606 total documents of the five specified document types. Charters make up the vast majority, over 93%, with the next most substantial type being agreements, itself only 4% of the total.

Moreover, charters and charter/brieves were more likely to have witnesses and thus to be included in the study – over 80 percent of these types had witnesses. Just shy of two-thirds of agreements had witnesses (145 out of a potential 225), but less than half of settlements and notifications had witnesses.

Table 4.3. Breakdown of document types in study (out of 3622 in SNA study)

Document type	In SNA	% of SNA dataset (3622)	Out of potential (4606)	% of type with witnesses
Charters	3380	93.3%	4139	81.7%
Charter/ brieves	14	0.4%	16	87.5%
Notifications	34	0.9%	106	32%
Agreements	145	4%	225	64.4%
Settlements	49	1.4%	120	40.8%
Totals	3622		4606	

Table 4.4 gives a better sense of how the documents in the study break down by H-number, and thus by grantor type. Just over a quarter of the 3622 documents in the study with witnesses were issued in the names of kings and queens (H1), while just shy of 17% were charters and other documents of bishops, abbots, and other ecclesiastics (H2). Slightly more than half of the documents were private documents (H3), including earls, barons, burgesses, and other laypeople, while only about five percent were in the H4 category (Agreements, Settlements, Perambulations, Inquests, etc.). Table 4.5 describes the transactions to which the witnesses were attached. Together, gifts, confirmations, and renewals make up 75% of all the transactions to which witnesses were attached. Quitclaims made only about 7% of the total, by contrast, while acts of agreement and settlement only made up about 5 and a half percent of transactions with witnesses; sales were only one and a half percent.

Table 4.4. Breakdown of documents by H-number

H-no	Description	Total	Percentage
H1/	Royal	942	26%
H2/	Ecclesiastical	610	16.8%
H3/	Private	1874	51.7%
H4/	Agreements, etc.	196	5.4%
	Total	3622	

Table 4.5. Breakdown of transactions in study

Transaction type	Number	Percentage
Gifts and foundations[13]	1519	41.9%
Confirmations	710	19.6%
Renewals	492	13.6%
Quitclaim & Resignation[14]	245	6.8%
Concessions[15]	169	4.7%
Agreements	149	4.1%
Grants of property (condedo)	68	1.9%
Sales	50	1.4%
Succession	49	1.4%
Settlement	48	1.3%
Statement[16]	33	<1%
Inspection	25	<1%
Obligation	23	<1%
Institution & ordination of vicarage	10	<1%
Lease / wadset	6	<1%
Other/ misc.	26	<1%

[13] Plus one infeftment and three gifts (agreement)
[14] And renunciations of claim
[15] Including concession (agreements) the following follow same pattern
[16] Plus acknowledgement

Shifting from documents to people and institutions, there are a total of 8967 witnesses in the study of all witnesses in the five specified document types, engaging in a total of 31448 acts of witnessing. As Figure 4.2 represents, no fewer than 29074 (92%) of these acts of witnessing occur in charters, 1495 in Agreements, 463 in Settlements, 283 in Notifications, and 133 in charter/brieves. As Figure 4.3 shows, nearly all witnesses were male - 8868 (99%), and the institutional witnesses (53), mainly ecclesiastical chapters, were also generally male. Only 45 witnesses – half of one percent – were female. These are listed in Table 4.6. Witnessing by women seems to have been more commonplace in the twelfth century than in the thirteenth, possibly due to the increasing influence of the legal profession on charter production over the course of that century. There is also a tendency, though not a strict rule by any means, that female witnesses were high-status individuals. Fourteen of the 45 were either countesses or queens.

Figure 4.2. Individuals acts of witnessing, by document type

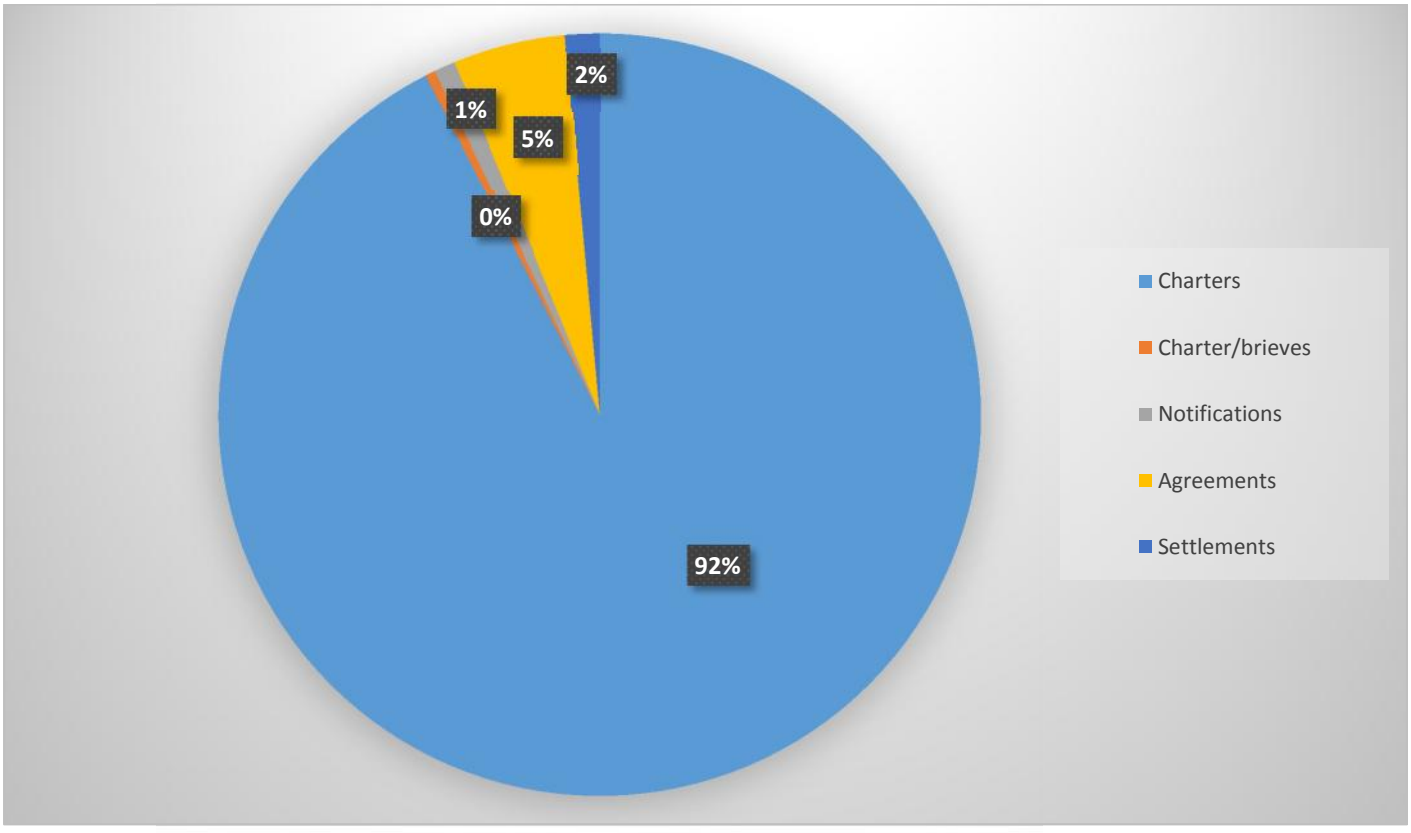


Figure 4.3. Witnesses by gender

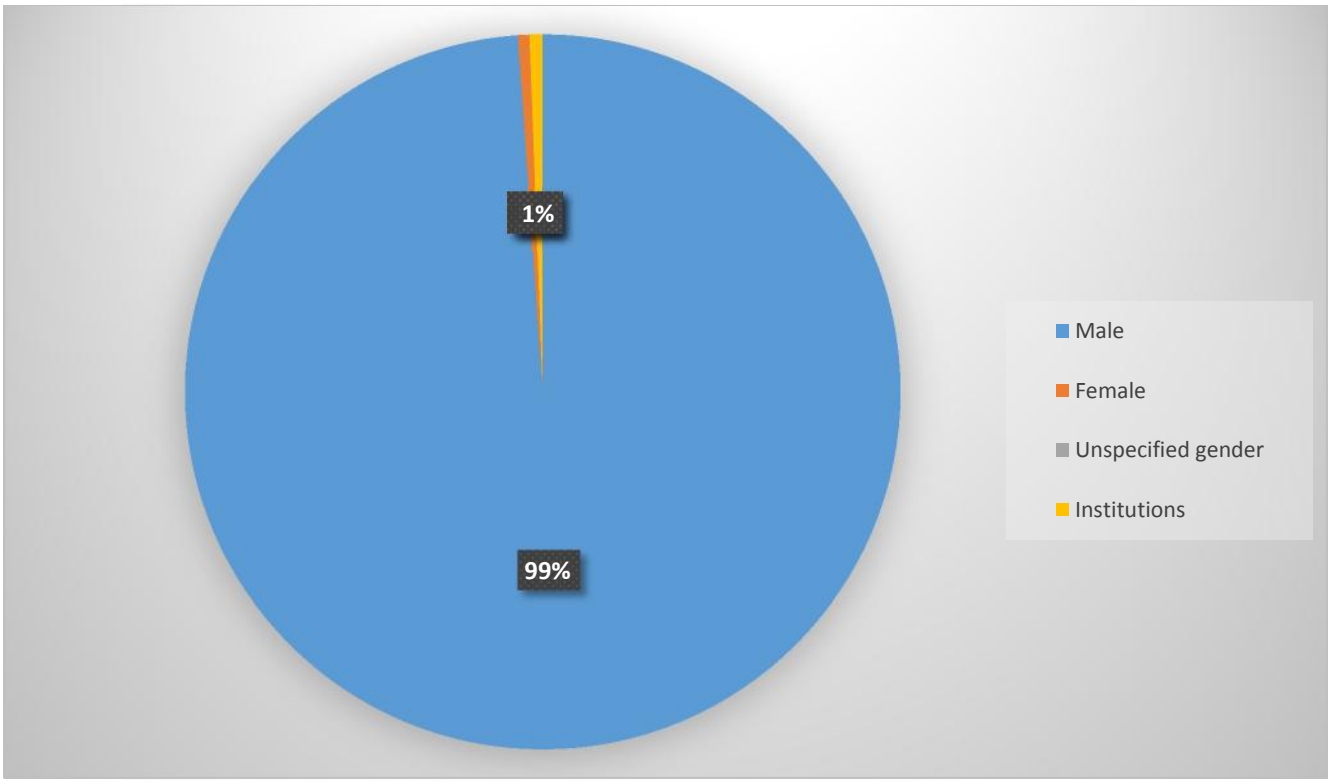


Table 4.6: Female witnesses

Person ID	Person Display Name	Floruits
586	Matilda (Maud) de Senlis, queen of Scots (d.1131)	1124 × 1150
3012	Deirdre, countess of Dunbar	1138 × 1159
95	Ada de Warenne (d.1178), countess of Northumberland	1142 × 1175
8224	Euphemia, wife of Robert Bruce II	1150 × 1191
5726	Maud de Senlis, wife of William Breton/Brito	1154 × 1159
84	Ela, countess of Fife	1159 × 1180
5497	Hextilda, countess of Atholl	1160 × 1183
10630	Margaret, wife of Bernard son of Brian	1165 × 1178
9021	Asa de Umfraville, wife of Walter Corbet	1166 × 1170
6037	Alina, countess of Dunbar (d. 1179)	1166 × 1179
15365	Basilia, wife of Alexander de St Martin	1170 × 1203
6664	Orable, daughter of Ness son of William	1172 × 1178
4393	Avice of Lancaster, wife of Richard de Moreville (d.1191)	1174 × 1190
1043	Eschina of Mow/London	1177 × 1198
6059	Ada, countess of Dunbar (d.1200)	1184 × 1200
8529	Christiana, wife of William de Moreville	1189 × 1196
1010	Agatha, wife of Humphrey Barclay	1195 × 1198

426	Matilda d'Aubigny, countess of Strathearn	1198 × 1210
10087	Avice, daughter of Eschina of Mow	1198 × 1214
5508	Margaret, countess of Atholl	1198 × 1231
6855	Matilda, wife of Earl Malcolm (I) of Fife	1200 × 1202
10013	Matilda of St Andrews	1200 × 1214
1195	Eve, wife of William Hay, lord of Errol	1201 × 1205
11534	Ada, wife of Thomas Hay (12C)	1201 × 1241
11464	Avice, daughter of Ela	1203 × 1212
8770	Sybil, wife of Walter de Bolbec	1206
10410	Sybil, wife of Gervase Avenel	1208 × 1218
4424	Ela de St Martin, daughter of Alexander de St Martin	1209 × 1221
56	Ermengarde de Beaumont, queen of Scots (d.1233)	1212 × 1230
5989	Christiana or Christina Bruce, countess of Dunbar	1212 × 1240
9092	Cecilia, daughter of Eschina of Mow	1214 × 1247
2086	Eve, sister of Mael Domnaig, earl of Lennox	1217 × 1251
13849	Margery Lindsay	1220 × 1241
1365	Margery, countess of Buchan (d.c.1244)	1222 × 1236
6957	Soliva, wife of Robert of Meckphen	1227 × 1234
14173	Rohese de Lacy	1240 × 1250
6663	Eleanor, daughter of William de Ferrers, wife of Roger de Quincy	1257
11977	Christina, daughter of persona of Kippen	1277
14251	Margaret (mother of William de Valognes TRA3)	1284
14254	Mary, sister of William de Valognes (TRA3)	1284
10857	Helen, daughter of William of Horndean	1300
10854	Margery, wife of William of Horndean	1300
11074	Galiena, wife of Walter del Bois	???
11027	Juet, wife of Arnold son of Philip of Kelso	???
10850	Matilda de Moreville, wife of William de Vieuxpont (II)	???

The creation of the new 2014 dataset had very little impact on the macro level of our view of All Witnesses in the PoMS database, but was responsible for small changes as we zoom into more detailed levels. Figure 4.4 demonstrates that the Netdraw image of all the witnesses in the database, the 'fish', produced using the 2014 dataset with only the five specified document type, is virtually indistinguishable from the equivalent sociogram produced with the 2013 dataset of all document types. We also began to use the software program Gephi increasingly with the 2014 dataset, although, as Figures 4.5 and 4.6 reveal, it was not as helpful in producing a useful image for all of the witnesses.

Figure 4.4. All witnesses, ‘the fish’ (Oct. 2014, specified document types)

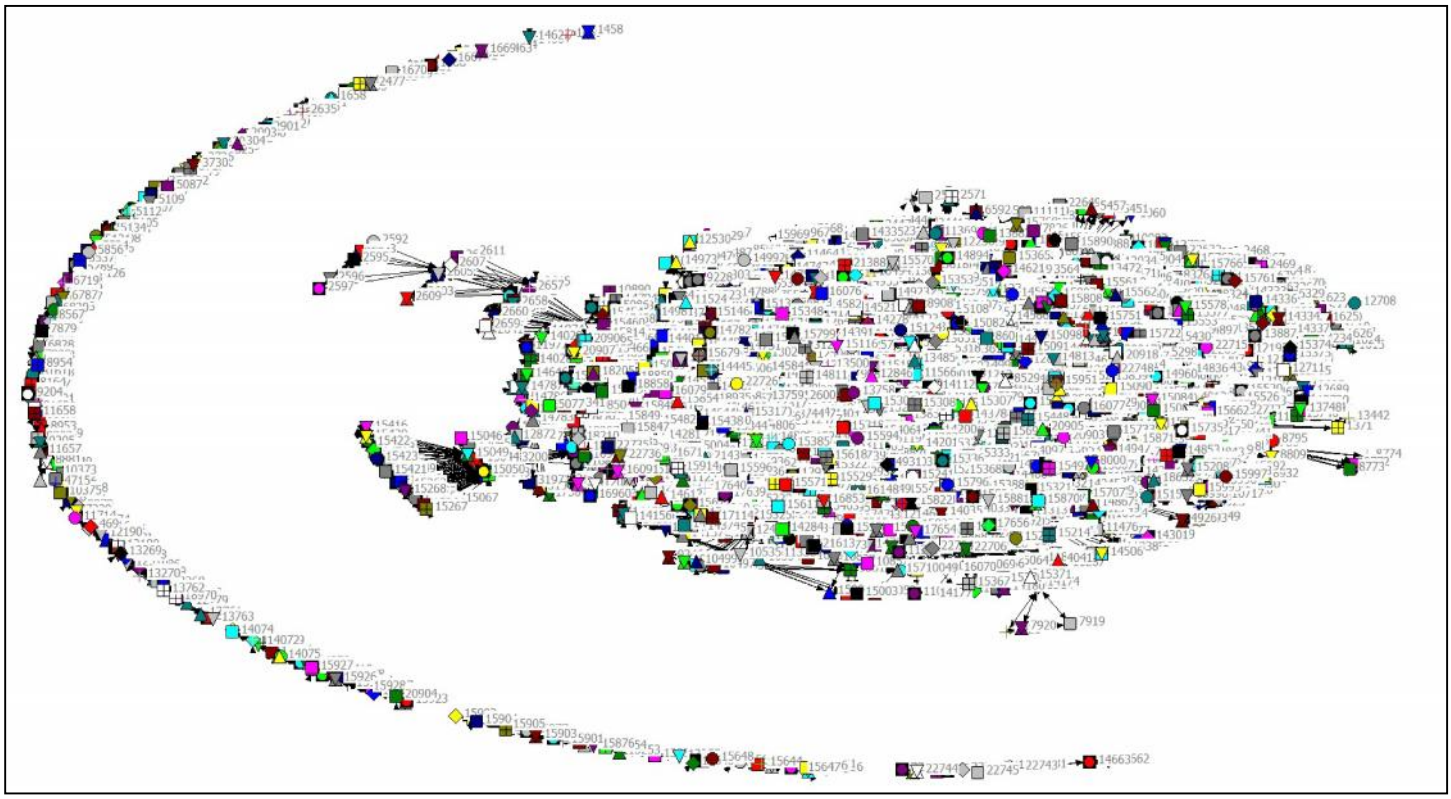


Figure 4.5. All witnesses, specified document types: Gephi (Yifan Hu)

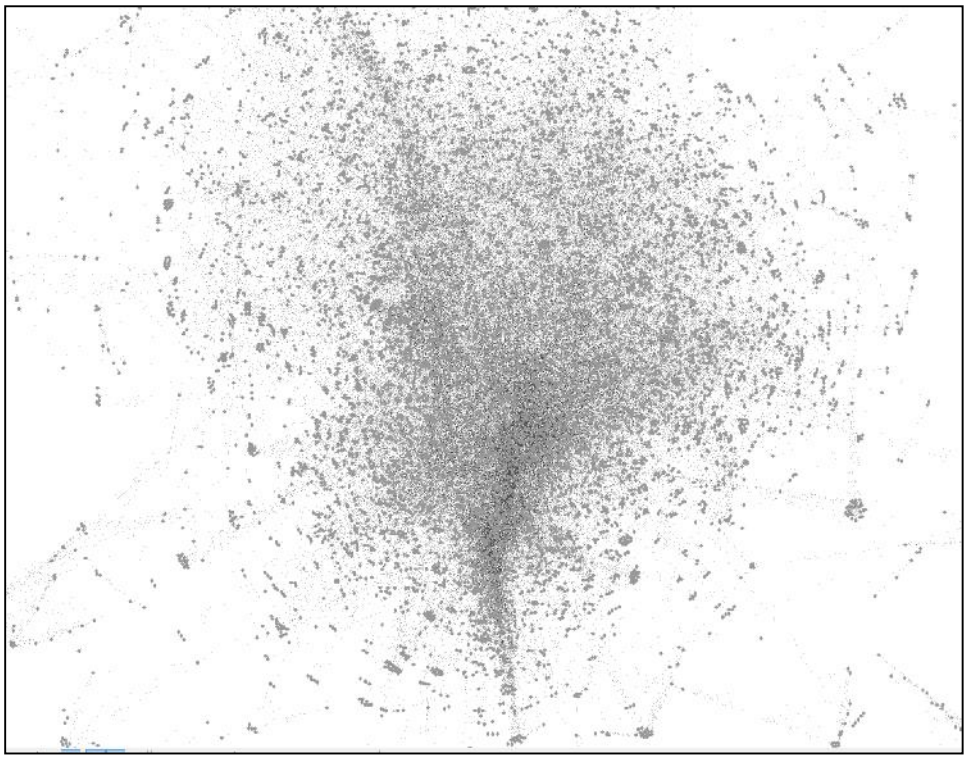
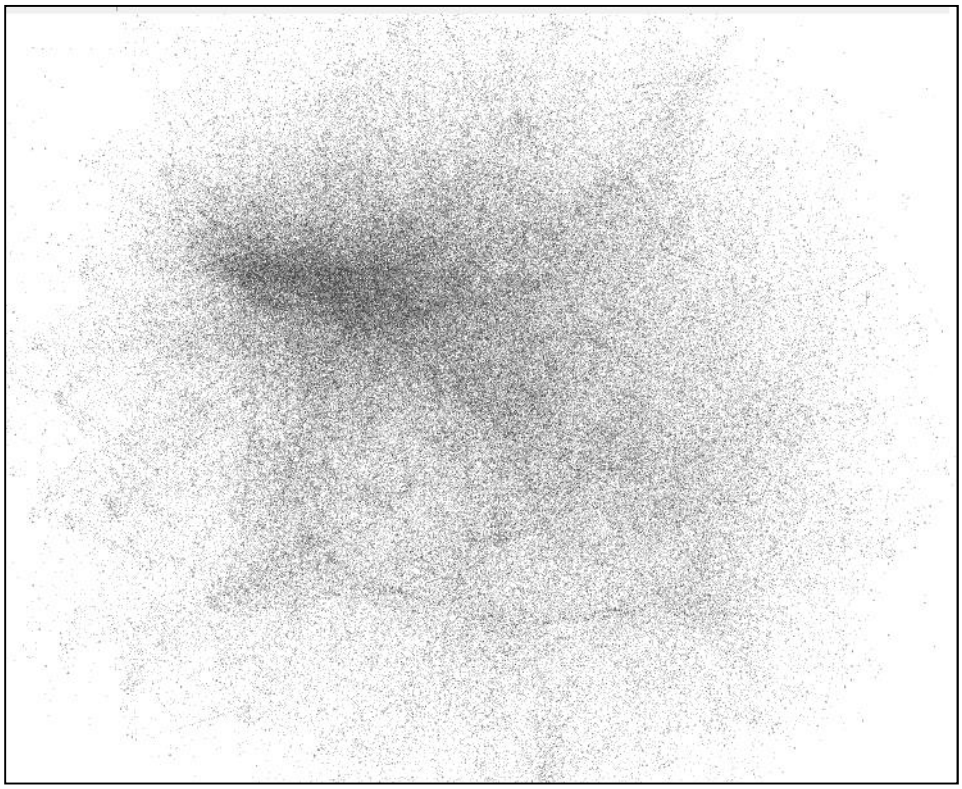


Figure 4.6. All witnesses, specified document types: Gephi (Fruchtermann Reingold)

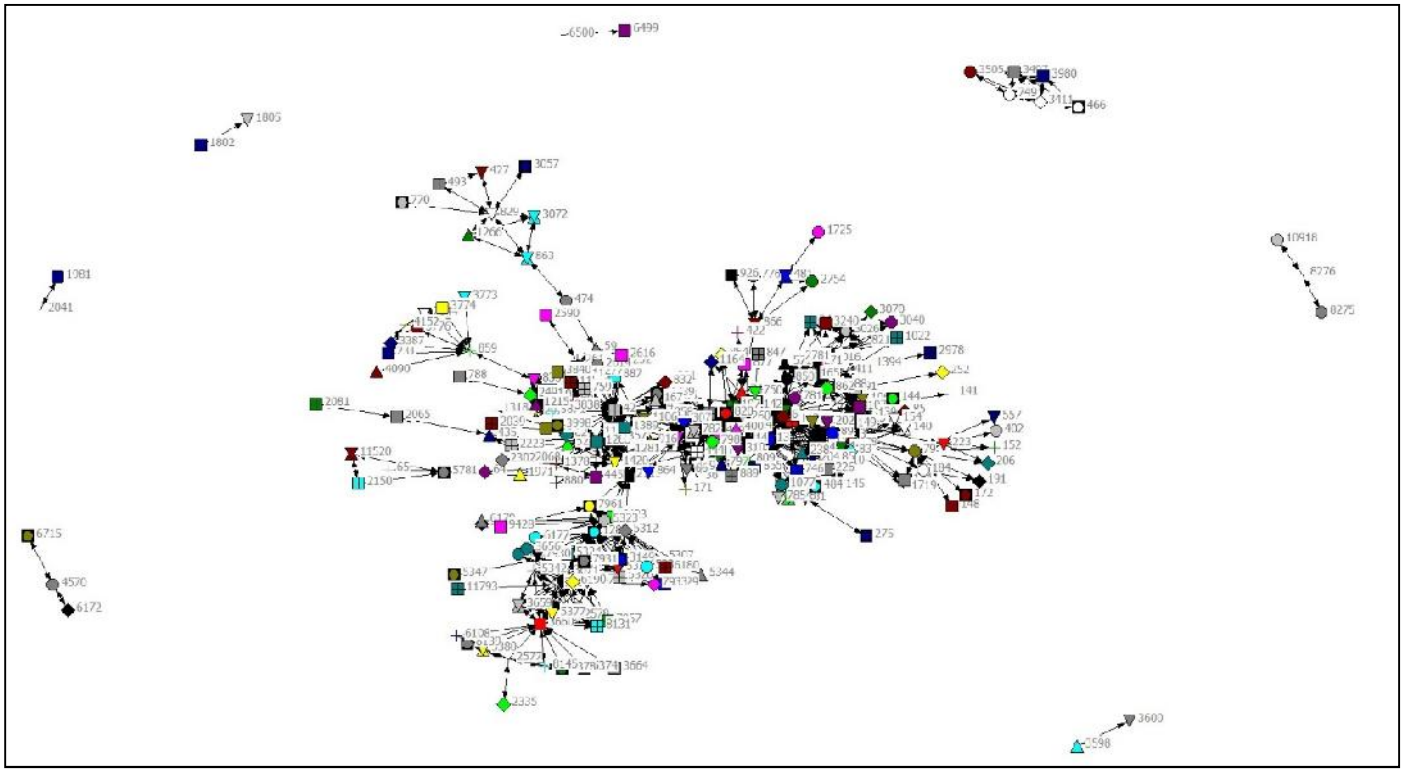


The dataset used for producing these scattershot images of all the witnesses in the five specified document types is useful for creating many of the statistics we will return to later, including lists of the most central people among witnesses and the densities of ego-networks, but as far as useable graphs go, in terms of examining patterns of co-witnesses, it is necessary to raise the threshold of how many times individuals witnesses alongside each other. In the one-mode affiliation network of witnesses on each axis of the matrix, this means telling the software to constrain the data to show only those connections of, for example, people who witness together more than five times. This process is very straightforward in Netdraw. In Gephi, this is achieved by adjusting the edge weight. The number of times two nodes are connected is expressed in the weight of the edge. It is thus possible to thicken the lines connecting nodes to show how often individuals co-witnessed, or, in other words, how many documents two people appeared in together.

Figure 4.7 shows that by raising the threshold to more than ten co-witnessing acts, we have filtered the ‘fish’ down to something more manageable. We can see already that the majority of people are connected to each other through one big network, while most of those who were not attached to that

network only witnessed to two or three other people. Person nos. 1802 and 1805, William Wascelin the knight and Walkelin son of Stephen, witnessed with each other more than ten times, but neither of them witnessed that often with others in the database. This also demonstrates that it is important to remember the social context of witnessing and that it is always necessary to balance our analysis of the graphs with historical knowledge of the period and prosopography. While these two men did not witness more than ten times alongside the more central players in the main segment, they were both prominent household members of David earl of Huntingdon (d. 1219), brother of Kings Malcolm and William, who is himself in the main central segment of the network. We would thus expect these men to appear in other sorts of SNA analyses. William Wascelin is attached to Earl David in the Tenurial and Lordship Relationships sociogram, for example.

Figure 4.7. All witnesses who witnessed together more than ten times (Netdraw)



B. More than twenty co-witnessing acts: network structure

Figure 4.8. All witnesses: more than twenty instances (Netdraw)

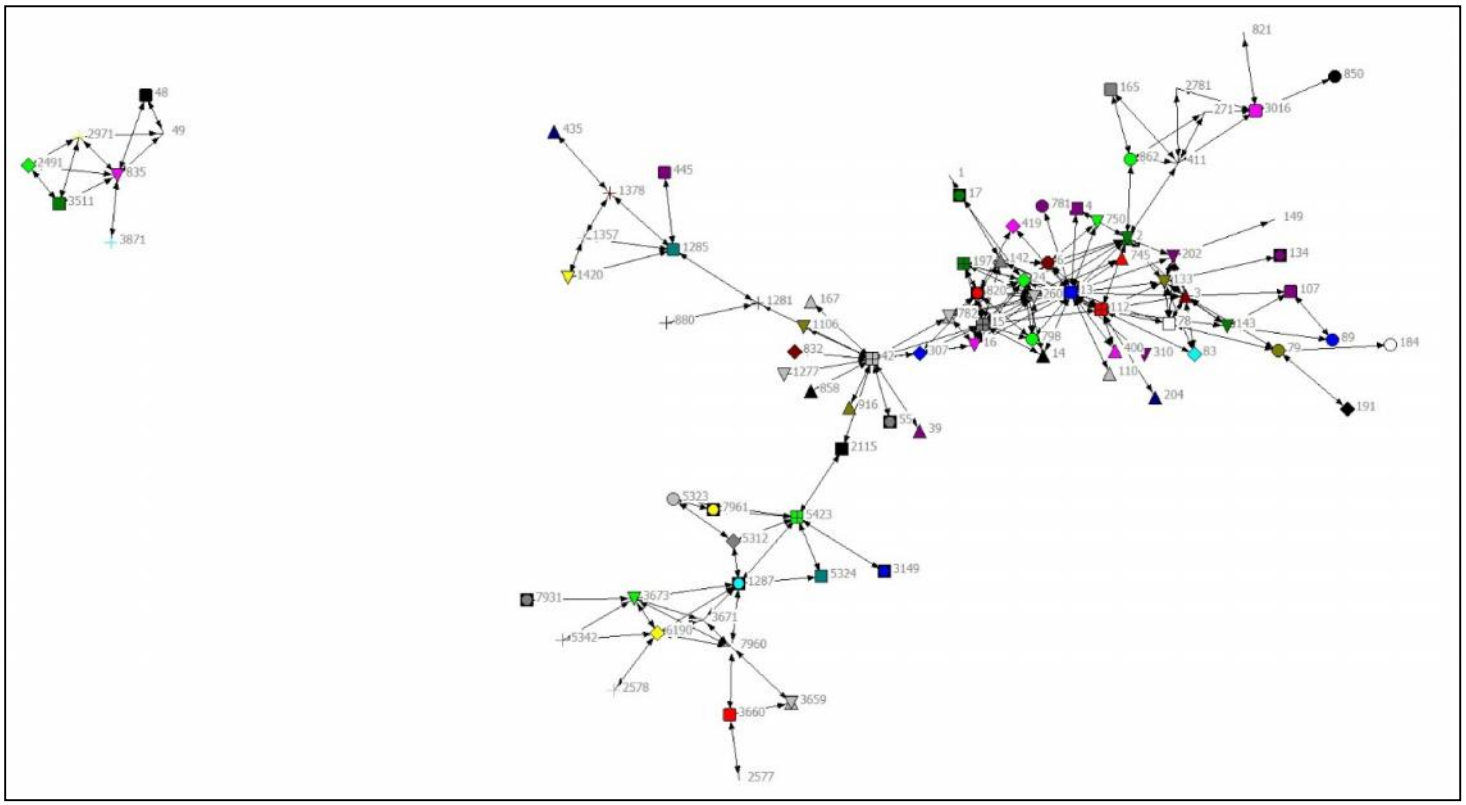
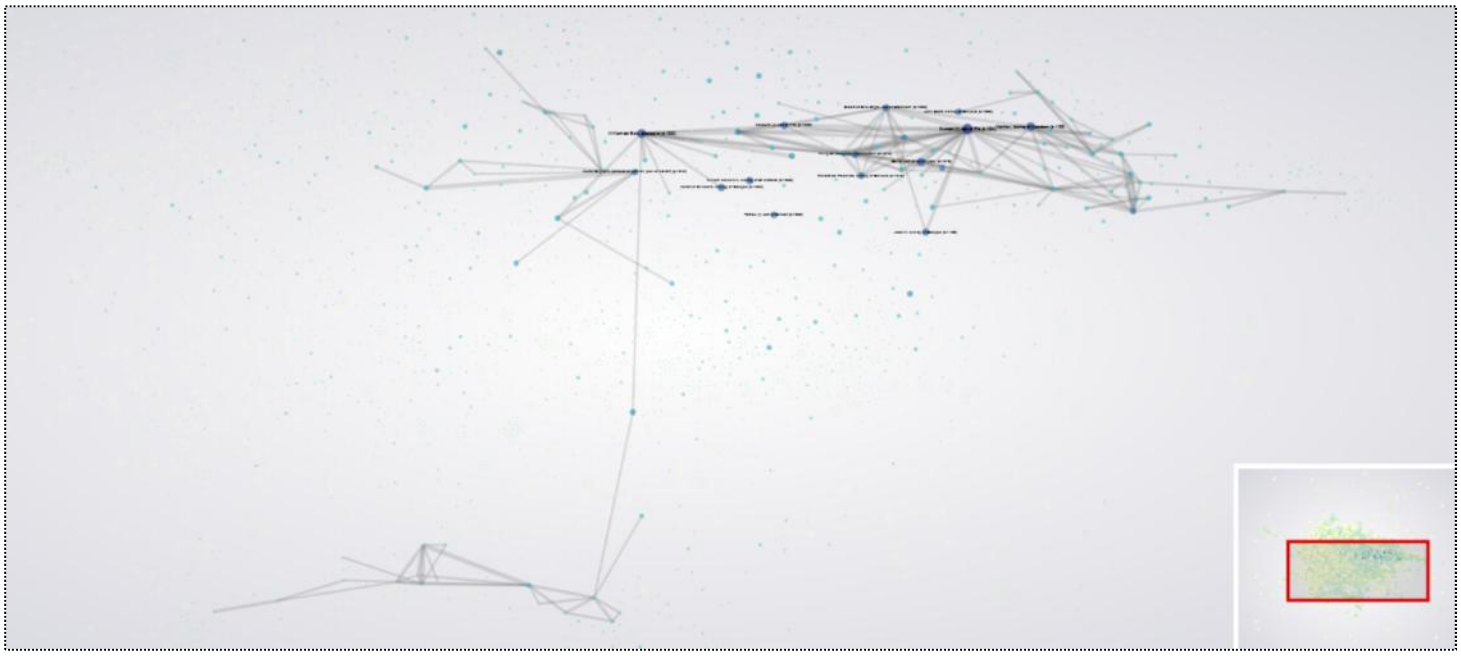


Figure 4.9. All witnesses: more than twenty instances (Gephi)



Figures 4.8 and 4.9 show the network of all witnesses to the five specified document types who co-witness more than twenty times. The downside to this graph layout is that we only have the Person ID numbers labelling the nodes, but the upside is that we can view the patterns and structures more clearly this way. The Gephi sociograms which include the Person Display Names are more legible but do not always allow a clear view of the structures. We can see in this sociogram that there are two segments. Of a total of 89 people who witnessed together more than 20 times, seven appear in an attached segment in the upper left of the sociogram. Figure 4.10 gives a close-up of the ties between these seven people, whose names are listed in Table 4.7. What links these men together is that they were all prominent in the familia and administration of Bishop William Malveisin of St Andrews (1202-38). Sociograms can often be broken down into smaller subgroups such as dyads, triads, and cliques, which describe the relationships between actors. While sociologists in general talk about cliques as 'informal groupings' characterised by feelings of intimacy and cohesiveness, social network analysts reserve the term for the more formal situation when 'three or more actors are directly connected to one another through mutual ties' (Prell 2012, p. 155). There are three cliques in the detached St Andrews segments (Figure 4.10). The first sees nos 835, 2971, 2491, and 3511 all mutually connected. The second sees 835, 2971 and 49 all connected, and the third has 835, 49, and 48 all connected. No 835, the official and archdeacon Laurence of Thornton, is the key figure in this group, as he is the only common denominator in all three cliques. He is also the only one to be connected to all six other people in the segment, and thus is the only one with a significant betweenness centrality.

Figure 4.10. Close-up: more than 20 – detached segment

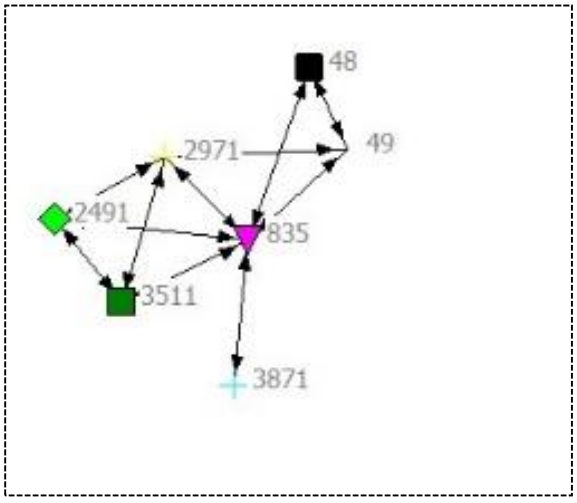
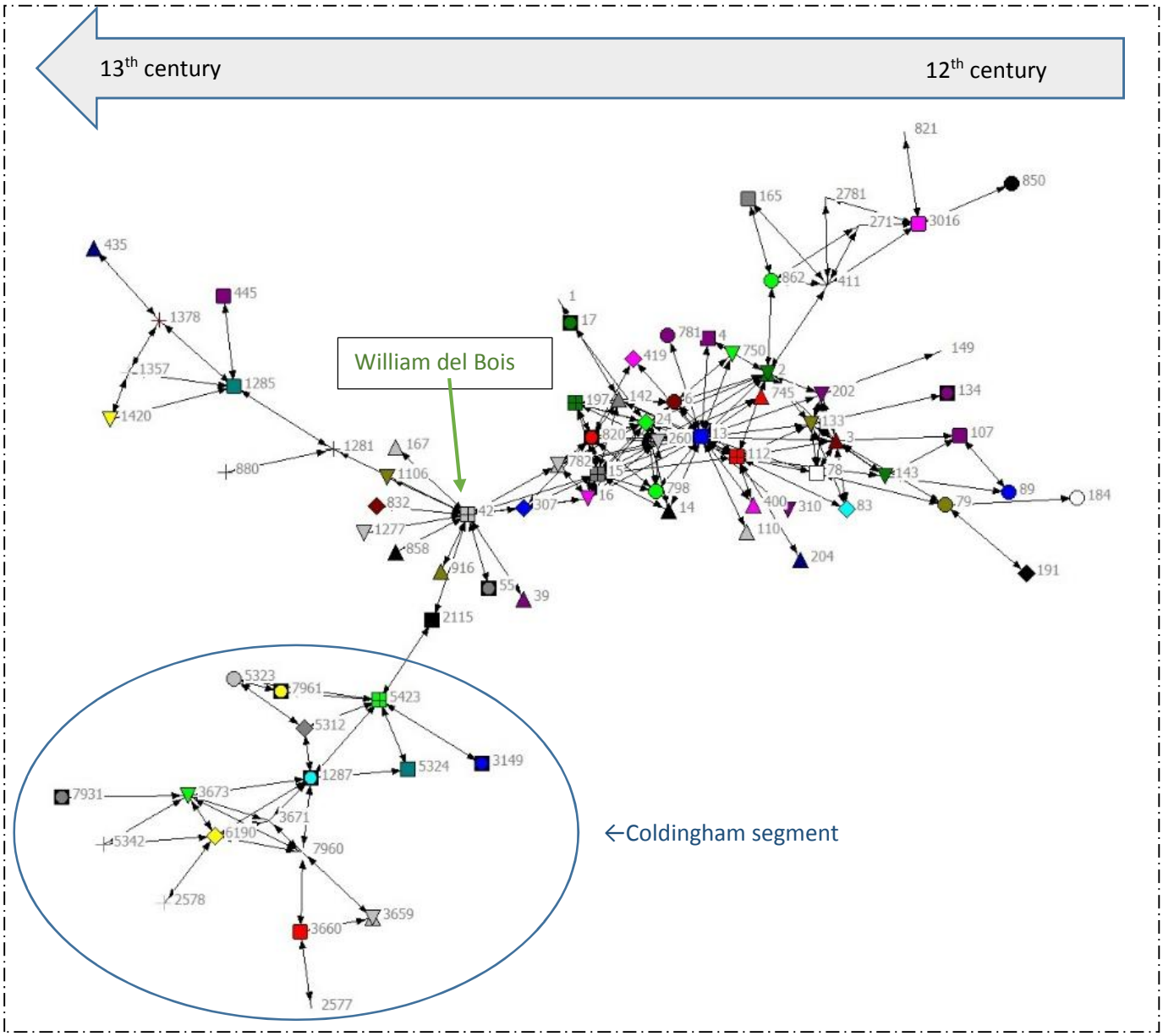


Table 4.7. People in the detached early 13th-century St Andrews segment

ID	Label	Degree	Betweenness
835	Laurence of Thornton, archdeacon of St Andrews (d.1238x40) (& official)	6	8.5
2971	Peter, chaplain and clerk of Bishop William Malveisin (& *magister*)	4	1
3511	Michael, master, clerk, chaplain (fl.1201-1220x25) (St Andrews)	3	0
2491	Stephen of Lilliesleaf, master, clerk, *persona* (& bishop's chaplain)	3	0
49	William of Gullane, rector of Gullane	3	0.5
48	Simon de Noisy, clerk of Bishop William Malveisin of St Andrews	2	0
3871	Edward Murray, master, canon, bishop's clerk (St Andrews and Aberdeen)	1	0

Figure 4.11. Close-up: more than 20, main segment

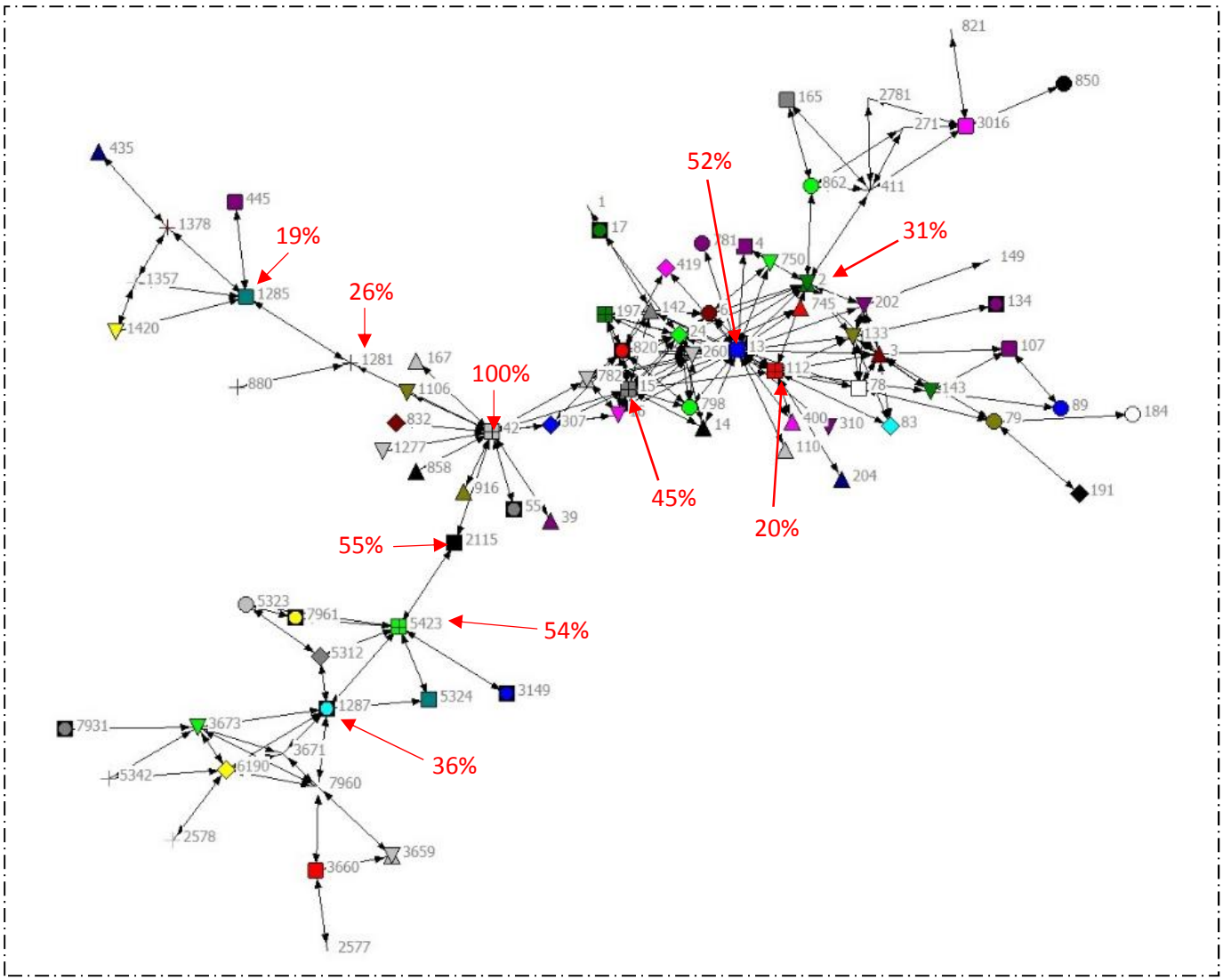


There are 82 people in the main segment of the sociogram of more than 20 co-witnessing acts. There are three main stems of this graph, with Person no. 42 acting as the connector for these three stems. For this reason, William del Bois, king's chancellor (d. 1232) has the highest betweenness centrality in the network (1978.5). There is a chronological sweep to this graph, with people from the middle of the twelfth century in the far right and people from the middle of the thirteenth century on the left (more on this issue below). The stem at the bottom of the graph demonstrates another issue altogether, that of what we may call asymmetric documentary survival. While the people connected to no. 42 on the right and left are all from the upper echelons of society, those individuals in the bottom stem are all from the middling ranks of society. All were connected to the Benedictine priory of Coldingham, a daughter of Durham Cathedral, which produced and preserved documents on an altogether higher plane than the other archives in Scotland. Due to the sheer numbers of surviving documents from Coldingham, these individuals were likely to witness twenty charters together. These peoples' names are italicised in the list of these witnesses (Table 4.8). Walter Lindsay (III), son of William (II) (d. ca 1222) – Person No 2115, is the key connector between the Coldingham group and the main segment, by way of William del Bois, thus his high betweenness centrality of 1088. As sheriff of Berwick, Walter was the crucial point of contact between the local society of the Coldingham area and the kingdom-wide elites who dominate the rest of the sociogram. There are 17 people in this Coldingham segment, all drawn from local knightly and landholding families, such as Swinton, Prenderguest, Mordington, and Lumsdaine. Some of the more influential people were evidently stewards of Coldingham priory. It is a recognised phenomenon in the Historical Social Network Analysis field that sometimes a document or set of documents is qualitatively different in some way from the rest of the corpus. Most SNA datasets are the bespoke creations of the network analysts, and that process allows such documents to be weeded out. In this case, SNA has been applied to a pre-existing dataset with rigorous categories for inclusion, so the best we can do is to identify such anomalies and try to work around them. Luckily, this Coldingham group is not an issue in the analysis of royal charters, where much of our fruitful work was achieved. It must be said, moreover, that the source selector mechanism does allow the possibility of creating a bespoke dataset which cuts out the Coldingham material; however, this would be a painstaking process. Nevertheless, it is perhaps worth keeping in mind for the future.

Table 4.8 – Top ten people by betweenness, more than 20 co-witnesses

Person	ID	Degree	Between	Between percent	Eigenvector
William del Bois, chancellor (d.1232)	42	14	1978.5	100%	25%
Walter Lindsay (III), son of William (II) (d.c.1222)	2115	2	1088	55%	4%
Henry of Prenderguest (I)	5423	7	1074.5	54%	4%
Duncan (II), earl of Fife (d.1204)	13	25	1019.4	52%	100%
Philip de Valognes, chamberlain (d.1215)	15	13	890.3	45%	70%
Alan, son of Cospatric of Swinton	1287	7	710.5	36%	6%
Matthew, bishop of Aberdeen (d.1199)	2	11	608.2	31%	5%
John Maxwell, chamberlain, sheriff of Roxburgh (d.1241)	1281	3	524	26%	4%
Richard de Moreville (d.1189 or 1190)	112	13	398.8	20%	60%
Walter Oliphant, justiciar of Lothian (son of Walter) (d.1242)	1285	5	385	19%	2%

Figure 4.12. Top ten betweenness, as percentage of William del Bois



Betweenness centrality, a concept we first encountered in the discussion of family relationships, is particularly important in making sense of the structure of a sociogram. Table 4.8 reveals the ten individuals with the highest betweenness centrality in the study of people who witnessed together more than twenty times. Comparison to degree and eigenvector centrality shows that individuals with high betweenness were not necessarily connected to large numbers of people or to the most significant people. The important factor is their position in the graph: if an individual is the only way to pass from one part of the graph to another, that person has high betweenness. These are highlighted in Figure 4.12. The importance of the Coldingham segment to the overall structure of the graph is demonstrated by the high betweenness centrality of the principal connectors of the Coldingham group to the rest of the graph. The three individuals with the highest betweenness – William del Bois (42), Walter Lindsay (III) (2115), and Henry of Prenderguest (I) (5423), are also the three steps it is required to pass through to get from the main body of Coldingham actors to the rest of the graph. William del Bois's betweenness – 1978.5 – is dramatically higher than any of the other actors. The next most central, Walter Lindsay (III), has a number only 55% of William del Bois's. This is because William del Bois is central in two key ways: in addition to connecting the Coldingham group to the rest of the graph, he also is the principal bridge chronologically between the reign of William I (1165-1214) and the reign of Alexander II (1214-49). This is because William's career began in the 1190s, and he did not die until 1232; further, he was a royal clerk, then chancellor, so he was supremely well placed to be well-connected, particularly in the context of charter production. Many of the other most central players in terms of betweenness were located in the thickest concentration of the network, reflecting especially the last forty years or so of the twelfth century. These included Duncan (II), earl of Fife (d. 1204), the person with the highest degree and eigenvector centrality in the whole graph of all witnesses, as well as in the graph of more than 20 witnesses, but even Duncan's betweenness centrality is only slightly over half of William del Bois's.

It is also interesting to compare the betweenness centrality numbers between this subset of people who witnessed together more than 20 times, versus the whole graph of all witnesses. William del Bois and Earl Duncan (II) of Fife were the two most central people in both graphs. The ten most central people in the whole graph of all witnesses, however, has a later centre of gravity, chronologically speaking. While the centre of gravity for the study of more than 20 co-witnessing acts is clearly the last forty years of the twelfth century, the centre of gravity for the all witnesses is the first forty years of the thirteenth century. In Table 4.9, all but two witnesses – Earl Duncan II of Fife and Alan Stewart

– were active in the reign of Alexander II. Why this discrepancy? There were fewer documents and fewer people in the late twelfth century than in the early thirteenth, but the critical mass which exists features a very densely interconnected group of witnesses. In the reign of Alexander II, there are more documents overall, but the percentage of these which are royal or which feature the core group of key players is much smaller than for the reign of King William. So while the key actors are less likely to witness together at the threshold of twenty times in the thirteenth century, there are many more peripheral players who are connected to the core group, even if only co-witnessing once or twice with the key players (much more on whom in the next chapter). That is why individuals like Walter Oliphant the justiciar and Andrew Murray, bishop of Moray have such high betweenness centrality. In the second half of the thirteenth century, however, the number of royal charters diminishes while the number of overall documents increased even more. At this point, the evidence does not give a very good window on the key players in the kingdom, and while there are more peripheral individuals than ever, there is often very little in terms of co-witnessing to tie their recorded activities to the most powerful players in the kingdom. For this reason, none of the actors from the time of Alexander III have high betweenness centrality. Figure 4.13 shows the network of the individuals in the whole all witnesses study with the highest betweenness centrality – over 500,000. It clearly demonstrates the key role of individuals in the first half of the thirteenth century. Figure 4.14 demonstrates that key figures from the time of King Alexander III (1249-86) do emerge when we consider all witnesses with a betweenness value over 250,000, such as Alexander Comyn, earl of Buchan (410K), and Alan Durward (307K). However, these values are still only about 31% (for Alexander) and 23% (for Alan) those of Willam del Bois, the graph's most central person.

Table 4.9: Betweenness Centrality – top ten, whole graph

Person Name	ID	Betweenness (whole graph)	Percentage of William's	Betweenness (> 20)
William del Bois, chancellor (d.1232)	42	1317065	100%	1978
Duncan (II), earl of Fife (d.1204)	13	1096891	83%	1019
Alan Stewart, son of Walter (d.1204)	40	904283	69%	0
Patrick (I), earl of Dunbar (d.1232)	444	806374	61%	n/a
Walter Oliphant, justiciar of Lothian (s. Walter) (d.1242)	1285	795570	60%	0.02
Malcolm (I), earl of Fife (d.1229)	782	724271	55%	319
Walter of St Albans, bishop of Glasgow (d.1232)	858	723717	55%	0
Walter Stewart (II), son of Alan (d.1241)	1378	698593	53%	80
Andrew Murray, bishop of Moray (d. 1242)	788	691160	52%	n/a
John Hay (I), lord of Naughton (*TRA2*)	1389	650865	49%	n/a

Figure 4.13. Network of witnesses with betweenness centrality over 500,000.

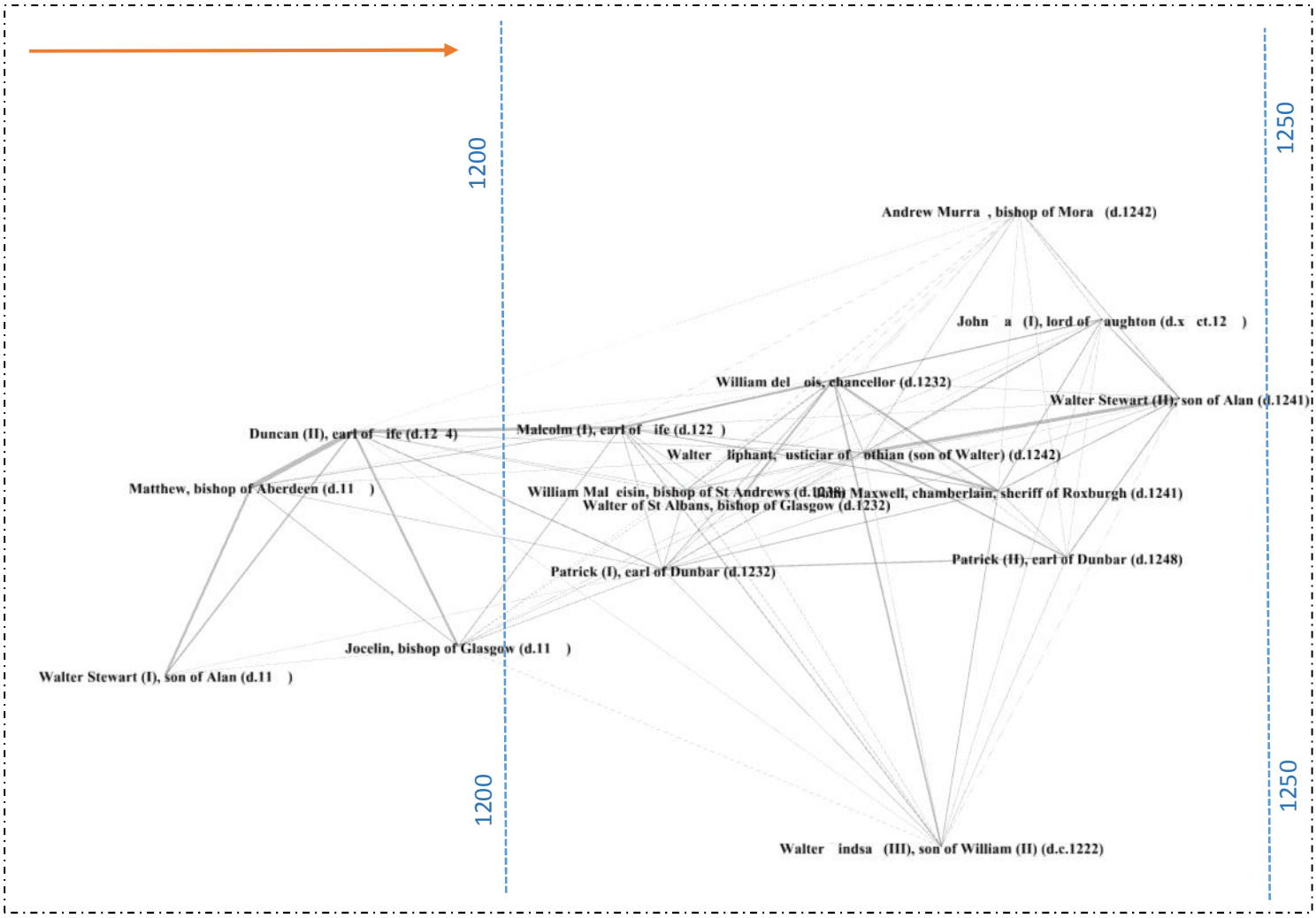
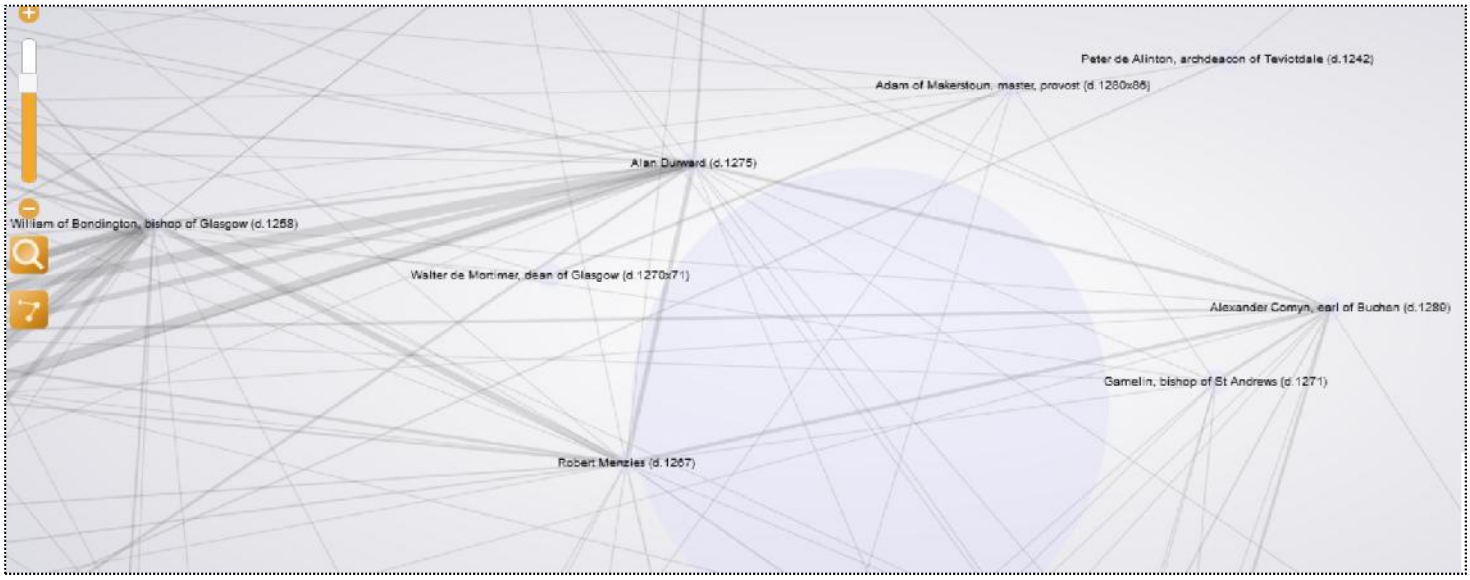


Figure 4.14. Witnesses with betweenness over 250K, close-up on time of Alexander III



Figures 4.15 and 4.16 show the all witnesses study in Gephi using the Force Atlas 2 layout. The connections of more than 20 co-witnessing acts are shown. The unconnected nodes shown in the background represent all of the people who have witnessed fewer than 20 documents. The chronological sweep moves from right to left. The nodes at the far right end of the main segment date to the reign of David I (1124-53). The paucity of documentary material from this reign is clear from the gold box shown in Figure 4.15. The light blue box indicating the short reign of Malcolm IV (1153-65) indicates some growth in the number of individuals showing up in the documents, but the half-century reign of William I (1165-1214) makes clear that with exploding numbers of documents came many more new witnesses on record. Boxed in purple below, the individuals who witnessed together the most often did so in this period. The time of William's son, Alexander II (1214-49), boxed in red, was characterised by ever-growing charter numbers, but fewer of the key players witnessed together 20 times. By the time of his son, Alexander III, the witnesses themselves appear in more and more disparate contexts, and the key players are barely visible on this sociogram. Figure 4.16 gives a closer representation of the distribution of the nodes.

Figure 4.15. All witnesses, with connections of more than 20 shown

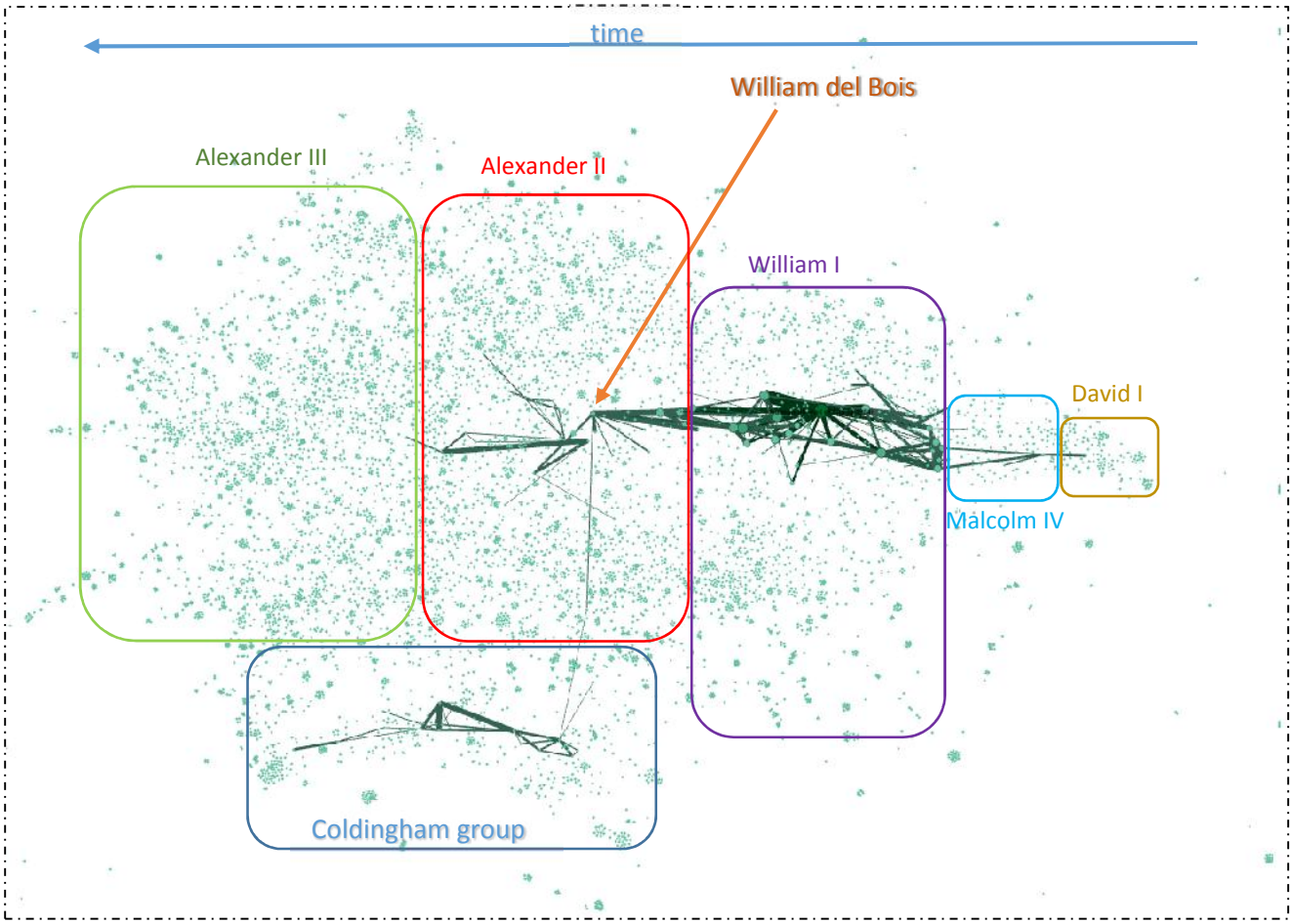
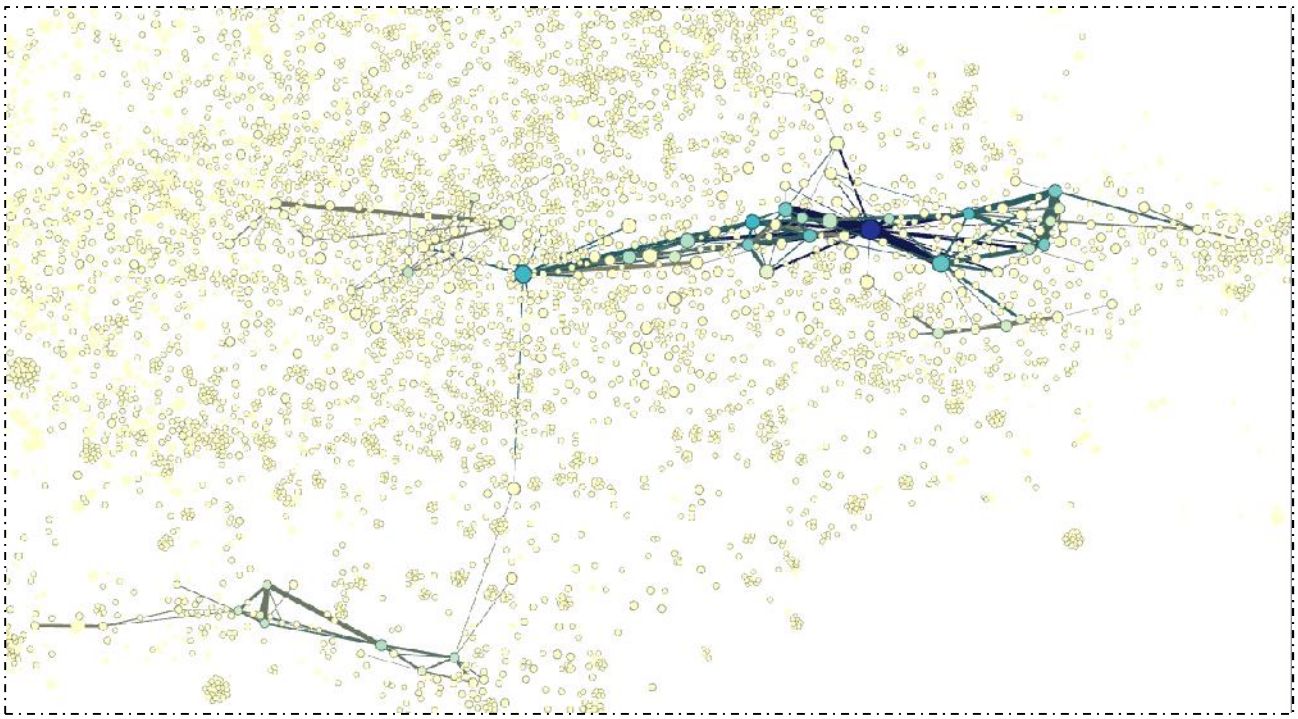


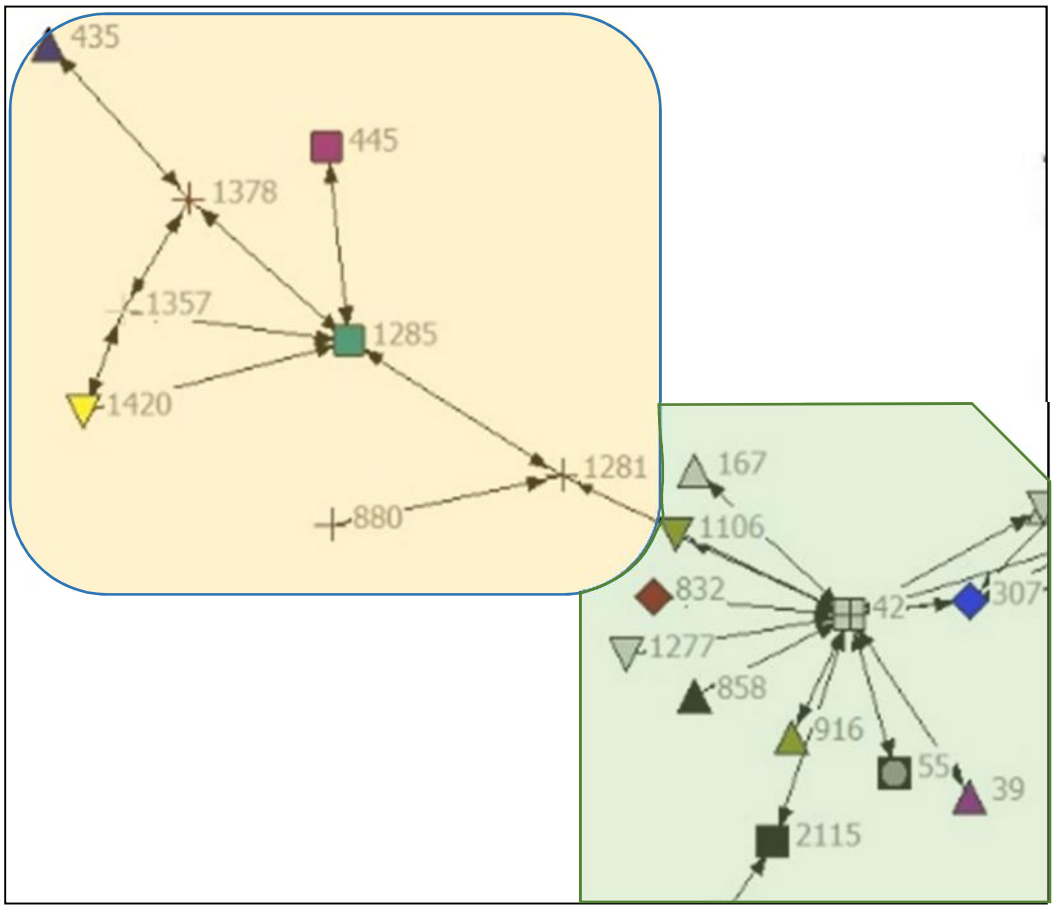
Figure 4.16. All witnesses, with connections of more than 20 shown



C. A brief tour of the main component of the study of more than 20 witnesses

Returning to the Netdraw sociogram of more than 20 witnesses, we can now indulge in a brief ‘tour’ of the main segment of witnesses.

Figure 4.17. Netdraw, all witnesses, >20, reign of Alexander II



The upper-left branch of the main grouping includes a number of the main players from the reign of Alexander II (1214-49). Moving from the left-hand ‘end’, we have [435] William of Bondington, bishop of Glasgow from 1233 to 1258 and chancellor from about 1231 to 1247; he is connected only to [1378] Walter Stewart (II), who was justiciar of Scotia and died in 1241. He in turn is connected to two people (at the level of 20-plus co-witnessing acts): [1357] Walter Comyn, earl of Menteith (d. 1258) and [1285] Walter Oliphant (II), justiciar of Lothian who died in 1242. [445] Patrick [II], earl of Dunbar (d. 1248) is also connected only to Walter Oliphant [II]. Oliphant is the most central person in this part of the graph, having witnessed alongside five others more than 20 times (1378, 1357, 1420, 445, 1281).

Walter Oliphant II is connected to both Walter Stewart and Walter Comyn, while both Oliphant and Comyn are also connected to [1420] Henry Balliol, a chamberlain who died in 1246. The only link between all of these people and the main centre of the sociograph is the link between Walter Oliphant (II) and [1281] John Maxwell, sheriff of Roxburgh and chamberlain who died in 1241. John Maxwell is also connected to [880], Bernard Hadden, sheriff of Roxburgh earlier in the thirteenth century. With the exception of Bernard of Hadden, this whole group were in their prime in the 1230s and 1240s.

The people around no. 42 represent the generation bridging the end of William's reign and the beginning of Alexander II's. These people were mostly active from the 1200s to the 1220s.

[42] is William del Bois, royal clerk and chancellor (d. 1232). He is the sole common connector for the following:

[167] William, chaplain (II) of King William (fl. ca 1196-1214)

[1106] Philip de Mowbray, fl. 1198×1236

[1281] John Maxwell, chamberlain, sheriff of Roxburgh (d. 1241)

[832] William de Valognes (d. 1219) [chamberlain]

[1277] Oliver, king's chaplain (fl. ca 1208-ca 1214)

[858] Walter of St Albans, bishop of Glasgow (d. 1232) [royal chaplain]

[916] Alexander son of William, sheriff of Stirling (fl. late 12C/ early 13C)

[2115] William Lindsay (III), son of William (II) (d. ca 1222)

[55] Richard Revel, lord of Coultra (d. 1215x25)

[39] Hugh de Sigillo, bishop of Dunkeld (d. 1229 or 1230) [king's clerk]

[307] Robert of London (d. 1225) [son of King William]

The main thing that these people have in common is that they were active in the later part of William's reign and the earlier part of Alexander II's reign. In addition to the expected royal clerks and chaplains [42, 858, 1277, 39, 167], chancellor and chamberlain, we also have some barons like Philip de Mowbray, and Richard Revel, as well as prominent sheriffs, John Maxwell and Alexander of Stirling, as well as King William's illegitimate son, Robert of London. William del Bois was chancellor from about 1211 and 1225, straddling two reigns, so it was both his position as chancellor and his chronological

position that partially – but not completely – explain his central role. The main links between this group and the main William I group are [307] Robert of London, bastard son of King William, [16] William Comyn, earl of Buchan, justiciar of Scotia, [15] Philip de Valognes, chamberlain, and [782] Malcolm (I), earl of Fife. From here we connect into the main grouping of William I power players around [13] Duncan (II) earl of Fife.

Figure 4.18. Netdraw, all witnesses, >20, core area

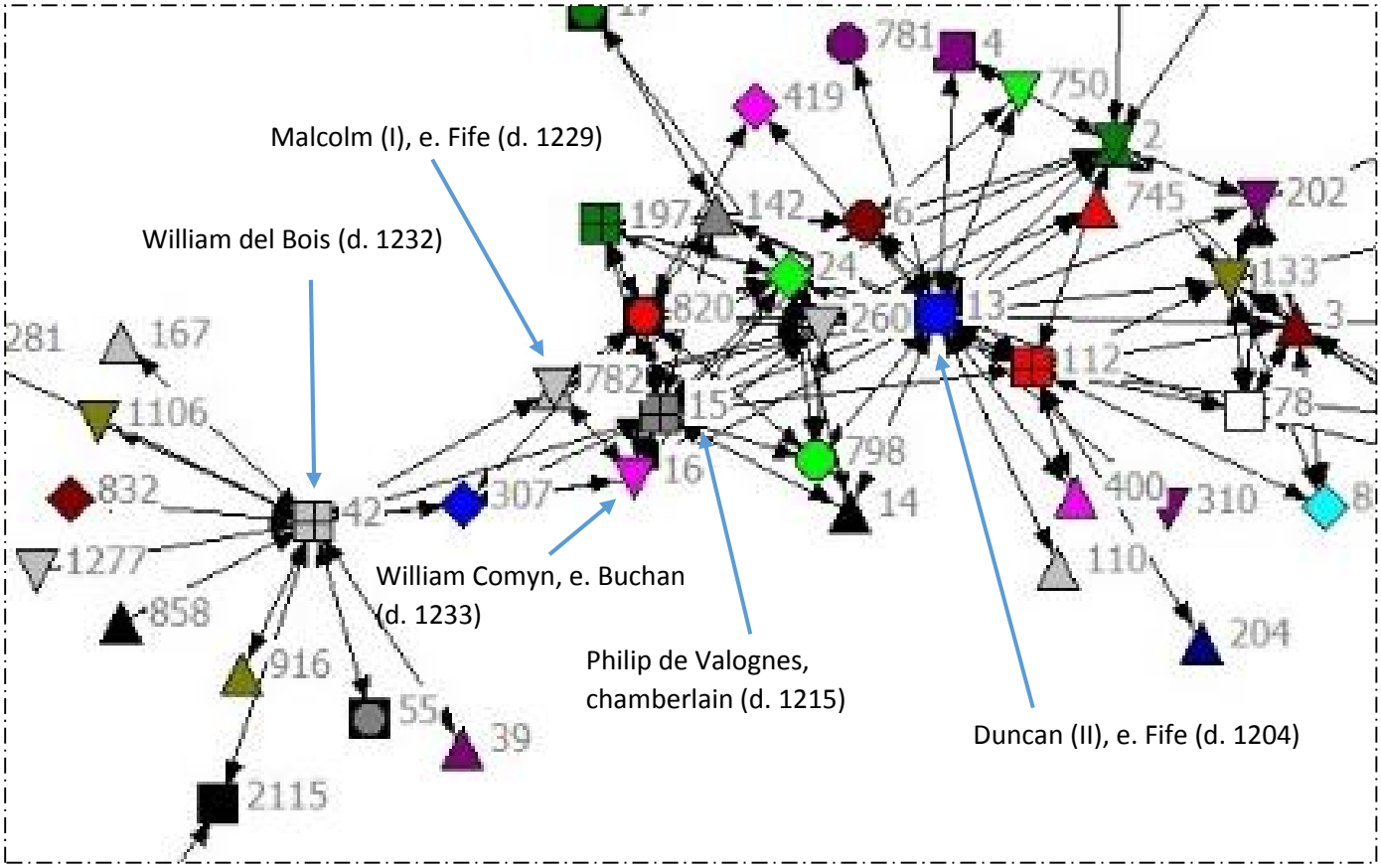
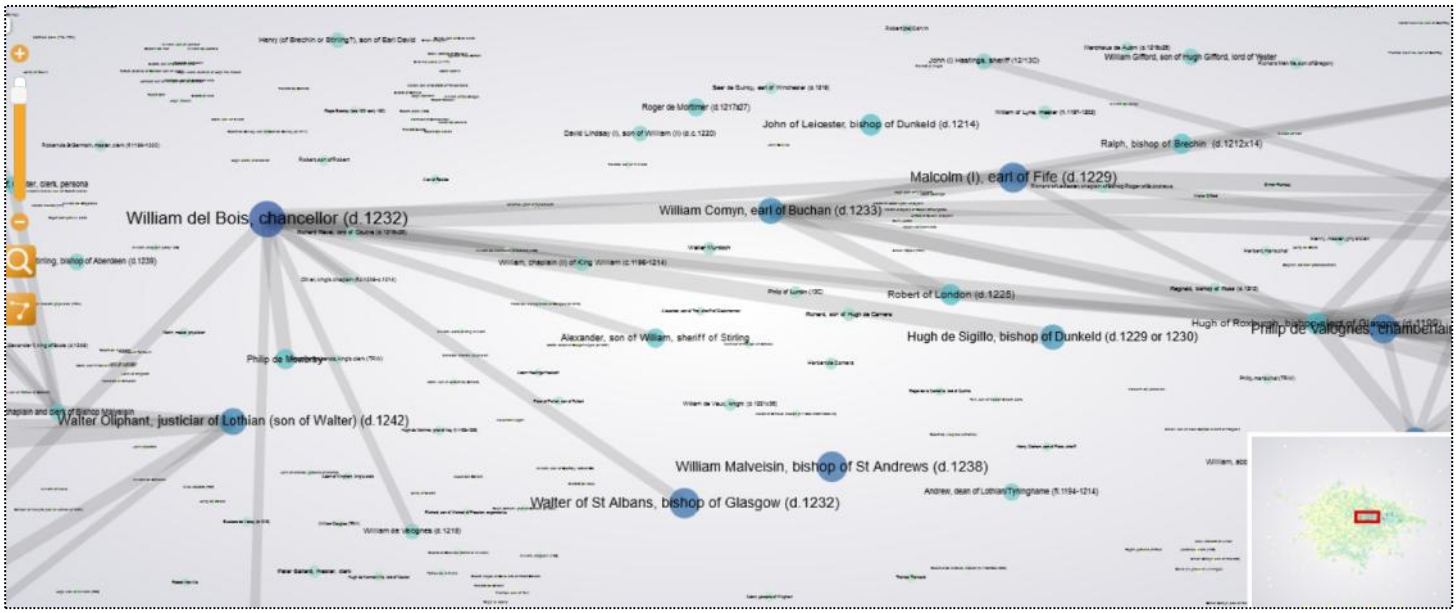


Figure 4.19. Gephi, all witnesses, >20, early thirteenth century



The core area is dominated by [13] Duncan (II), earl of Fife, a long-standing royal justice, and individuals to whom he was closely connected, including [260] Gilbert or Gilla Brigte, earl of Strathearn (d.1223), [2] Matthew, bishop of Aberdeen (d. 1199), a nephew of Bishop Robert of St Andrews (d. 1159), who was also first archdeacon of St Andrews in the 1150s and 1160s, [24], William Hay, lord of Errol near Perth, [142] David, earl of Huntingdon (d. 1219), the king's younger brother, [6] Walter Barclay, king's chamberlain (d. ca 1193), and [14] important baron and knight Robert de Quincy (d. 1200). This period represents a phase of great interconnectedness from perhaps the 1160s to the 1190s. In the earlier part of this phase (see Figure 4.21), the key players were [3] Walter son of Alan, the king's steward (d. 1177), [202] court bishop Andrew, bishop of Caithness (d. 1184), [112] king's constable Richard de Moreville (d. 1189 or 1190), and royal chancellors [133] Nicholas of Roxburgh (d.1171) and [78] Walter de Bidun (d. 1178).

Figure 4.20. Gephi, all witnesses, >20, core area, ca 1200

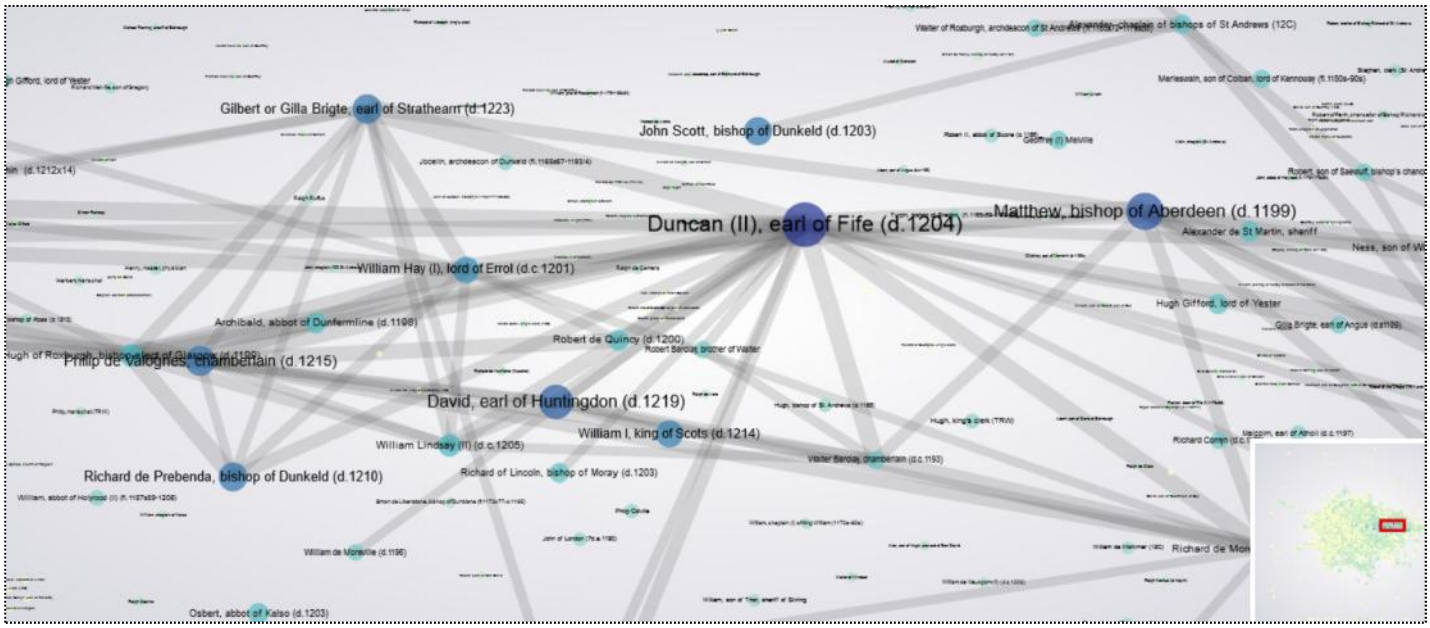
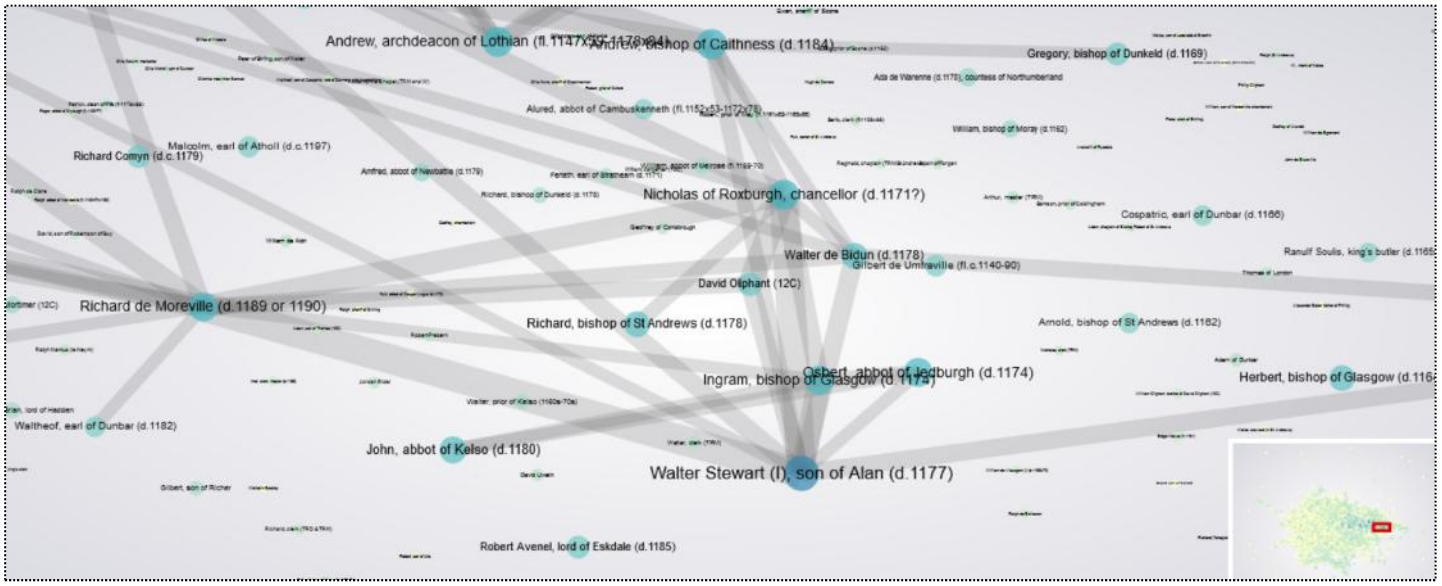


Figure 4.21. Gephi, all witnesses, >20, ca 1180



Very few people who were active before about 1160 were able to witness more than twenty times. Figures 4.22 and 4.23 illustrate the earliest phase of the network of people who witnessed more than 20 times. The key figures here were [143] Ingram, bishop of Glasgow, as well as an archdeacon and chancellor (d. 1174), [107] Osbert, first abbot of Jedburgh (d. 1174), [79] Hugh de Moreville (d. 1162), constable and a key lieutenant of kings David and Malcolm, [89] John, abbot of Kelso (d. 1180), [184] William de Somerville, a long-serving household knight of King David, and [191] King David's right-hand-man, John, bishop of Glasgow (d. 1147).

Figure 4.22. Netdraw, all witnesses, >20, mid-twelfth century

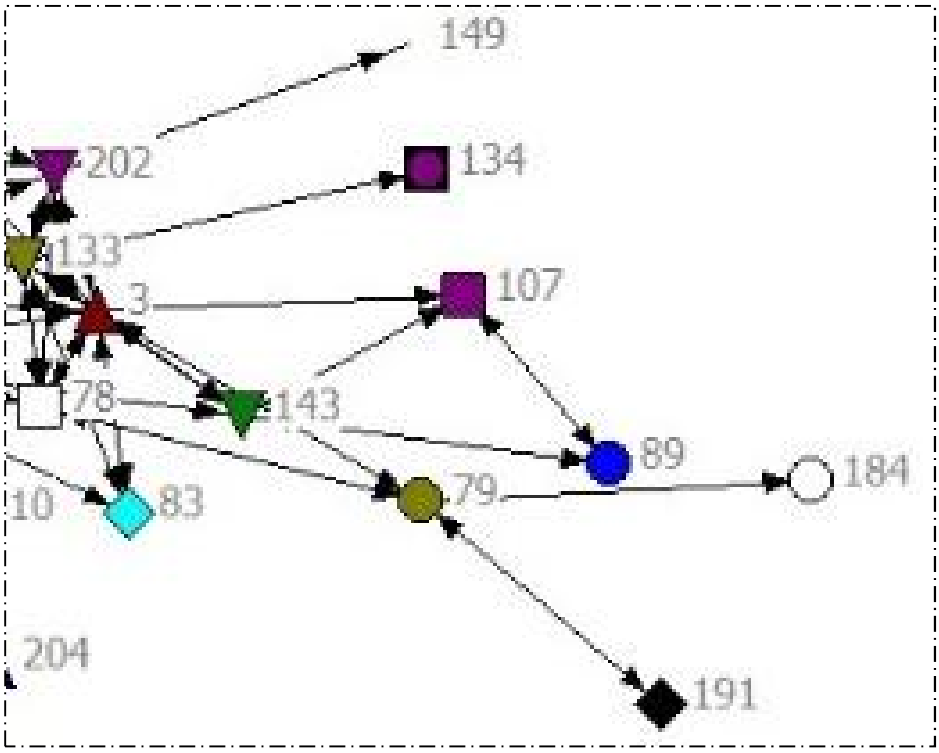


Figure 4.23. Gephi, all witnesses, >20, mid-twelfth century

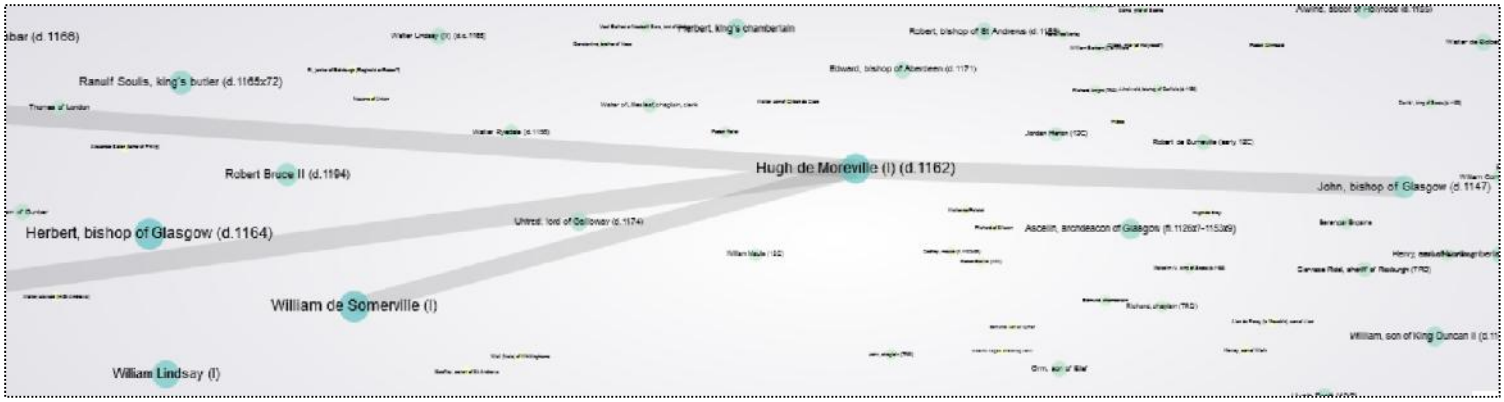
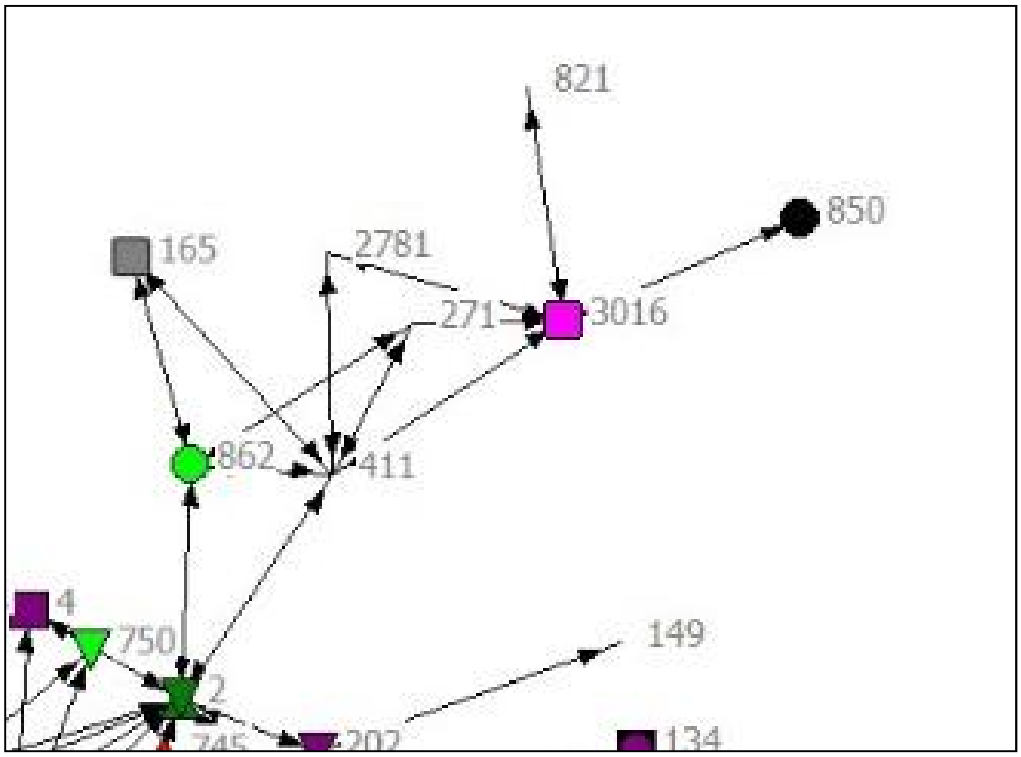


Figure 4.24. Netdraw, all witnesses, >20, twelfth-century ecclesiastics



There are 8 people connected only to the main group by [2] Matthew, bishop of Aberdeen (d. 1199).

[821] Walter of Roxburgh, archdeacon of St Andrews (fl. 1165×72- 1179×88), connected to [3016]

[850] John Scot, bishop of Dunkeld (d. 1203), relative of [2] Bishop Matthew of Aberdeen (d. 1199) and [148] Bishop Robert of St Andrews (d. 1159); was elected bishop of St Andrews in 1178 resulting in a major dispute with the king. Connected to [3016].

[3016] Alexander, chaplain of the bishop of St Andrews (12C), who is connected to [2781], [271], [411], and [850].

[2781] Abraham of Dunkeld, master, canon (fl.1162×78), connected to [3016] and [411]

[271] Robert, son of Saewulf, bishop's chancellor, connected to [3016] and [411] and [862]

[411] Andrew, archdeacon of Lothian (fl. 1147×59 – 1178×84), connected to [3016], [2781], [271], [165], [862], [2].

[165] Aiulf, dean of Lothian (fl.1150/51-1186), connected to [411], [862].

[862] Herbert Scott, master, clerk (fl.1144×59-1172×78), connected to [165], [271], [411], and [2]

All of these individuals held positions in the dioceses of St Andrews and Dunkeld, and were likely part of a network based around relatives of Bishop Robert of St Andrews (d. 1159).

Figure 4.25. Gephi, all witnesses, >20, close-up of some ecclesiastics

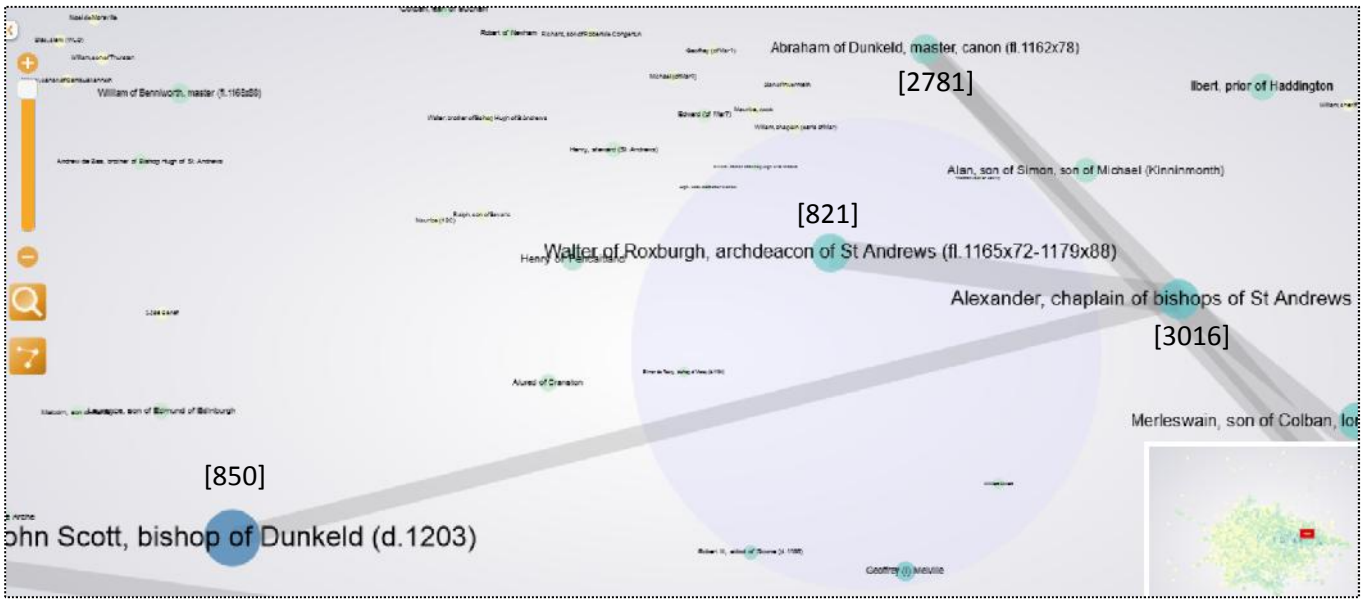


Table 4.10. People in main segment, more than 20 co-witnessing (ordered by degree)

Label	PoMS ID	Degree	Betweenness Centrality	Eigenvector (Gephi)	Eigenvector (UCINet)
Duncan (II), earl of Fife (d.1204)	13	25	1019.442	1	0.433
William del Bois, chancellor (d.1232)	42	14	1978.5	0.2529	0.098
Richard de Moreville (d.1189 or 1190)	112	13	398.8462	0.600799	0.254
Philip de Valognes, chamberlain (d.1215)	15	13	890.2596	0.696467	0.305
William Hay (I), lord of Errol (d.c.1201)	24	12	200.3839	0.661449	0.291
Hugh of Roxburgh, bishop-elect of Glasgow (d.1199)	820	11	41.80455	0.597226	0.265
Matthew, bishop of Aberdeen (d.1199)	2	11	608.15	0.526195	0.221
Gilbert or Gilla Brigte, earl of Strathearn (d.1223)	260	10	132.1803	0.586073	0.259
Walter Stewart (I), son of Alan (d.1177)	3	10	233.2714	0.409794	0.167
Nicholas of Roxburgh, chancellor (d.1171?)	133	9	106.1202	0.39618	0.163
William Comyn, earl of Buchan (d.1233)	16	8	327.8136	0.484188	0.211
Henry of Prenderguest (I)	5423	7	1074.5	0.04167	0.001
Alan, son of Cospatric of Swinton	1287	7	710.5	0.059053	0

William Lindsay (II) (d.c.1205)	197	7	2.2	0.475075	0.211
David, earl of Huntingdon (d.1219)	142	7	82.0369	0.41865	0.184
Walter Barclay, chamberlain (d.c.1193)	6	7	57.51526	0.423907	0.184
Robert, son of Gregory steward of Coldingham	7960	6	234	0.048993	0
Adam of Prenderguest	6190	6	118.5	0.04832	0
William of Mordington	3673	6	118.5	0.04832	0
Malcolm (I), earl of Fife (d.1229)	782	6	318.7424	0.393101	0.171
Andrew, archdeacon of Lothian (fl.1147x59-1178x84)	411	6	377.5	0.092505	0.03
Andrew, bishop of Caithness (d.1184)	202	6	81.8	0.300169	0.124
Walter de Bidun (d.1178)	78	6	94.9	0.313355	0.129
Alexander, chaplain of bishops of St Andrews (12C)	3016	5	159.5	0.029241	0.005
Walter Oliphant, justiciar of Lothian (son of Walter) (d.1242)	1285	5	385	0.02125	0.001
Richard de Prebenda, bishop of Dunkeld (d.1210)	798	5	0	0.383455	0.171
Ingram, bishop of Glasgow (d.1174)	143	5	81.74881	0.173217	0.068
Bertram of Little Reston (son of Adam of Little Reston)	3671	4	0	0.042235	0
Herbert Scott, master, clerk (fl.1144x59-1172x78)	862	4	74.5	0.083312	0.029
Robert of London (d.1225)	307	4	13.75	0.224867	0.097
Hugh de Moreville (I) (d.1162)	79	4	159	0.087855	0.033
Elias of Prenderguest	5323	3	0.5	0.019271	0
Adam of Little Reston	5312	3	5.5	0.026297	0
Gilbert of Lumsdaine	3660	3	80	0.01624	0
Walter Stewart (II), son of Alan (d.1241)	1378	3	80	0.012223	0
Walter Comyn, earl of Menteith (d.1258)	1357	3	1	0.013351	0
John Maxwell, chamberlain, sheriff of Roxburgh (d.1241)	1281	3	524	0.040628	0.011
Robert, son of Saewulf, bishop's chancellor	271	3	1.5	0.031954	0.007
Osbert, abbot of Jedburgh (d.1174)	107	3	8.534524	0.072871	0.027
David Oliphant (12C)	83	3	0	0.158136	0.064
Robert de Quincy (d.1200)	14	3	0	0.256219	0.113
Gregory of Coldingham, steward	7961	2	0	0.014304	0
Thomas of Nisbet	5342	2	0	0.020045	0
William of Lumsdaine	5324	2	0	0.021332	0
David of Lumsdaine	3659	2	0	0.01467	0
Abraham of Dunkeld, master, canon (fl.1162x78)	2781	2	0	0.020315	0.004
Walter Lindsay (III), son of William (II) (d.c.1222)	2115	2	1088	0.041654	0.011
Henry Balliol (d.1246)	1420	2	0	0.010146	0
Robert Barclay, brother of Walter	750	2	0	0.155641	0.068
Jocelin, bishop of Glasgow (d.1199)	745	2	0	0.172468	0.076
Archibald, abbot of Dunfermline (d.1198)	419	2	0	0.17377	0.077
Alan Stewart, son of Walter (d.1204)	400	2	0	0.175937	0.076
Aiulf, dean of Lothian (fl.1150/51-1186)	165	2	0	0.025267	0.006
John, abbot of Kelso (d.1180)	89	2	0	0.030794	0.01

Ness, son of William, lord of Leuchars (d.1178x83)	4	2	0	0.168098	0.072
John, son of Elias of Ayton	7931	1	0	0.010023	0
Patrick, son of Adam son of Aldan the steward	3149	1	0	0.009338	0
William of Scremerston, knight	2578	1	0	0.010023	0
Henry of Prenderguest (II) knight	2577	1	0	0.004473	0
Oliver, king's chaplain (fl.c.1208-c.1214)	1277	1	0	0.032315	0.011
Philip de Mowbray	1106	1	0	0.032315	0.011
Alexander, son of William, sheriff of Stirling	916	1	0	0.032315	0.011
Bernard of Hadden, sheriff of Roxburgh	880	1	0	0.007214	0.001
Walter of St Albans, bishop of Glasgow (d.1232)	858	1	0	0.032315	0.011
John Scott, bishop of Dunkeld (d.1203)	850	1	0	0.006687	0.001
William de Valognes (d.1219)	832	1	0	0.032315	0.011
Walter of Roxburgh, archdeacon of St Andrews (fl.1165x72-1179x88)	821	1	0	0.006687	0.001
Richard of Lincoln, bishop of Moray (d.1203)	781	1	0	0.109501	0.048
Patrick (II), earl of Dunbar (d.1248)	445	1	0	0.005923	0
William of Bondington, bishop of Glasgow (d.1258)	435	1	0	0.00404	0
William de Moreville (d.1196)	310	1	0	0.109501	0.048
Waltheof, earl of Dunbar (d.1182)	204	1	0	0.066437	0.028
John, bishop of Glasgow (d.1147)	191	1	0	0.011714	0.004
William de Somerville (I)	184	1	0	0.011714	0.004
William, chaplain (II) of King William (c.1196-1214)	167	1	0	0.032315	0.011
Gregory, bishop of Dunkeld (d.1169)	149	1	0	0.034005	0.014
Richard, bishop of St Andrews (d.1178)	134	1	0	0.044883	0.018
Gilla Brigte, earl of Angus (d.x1189)	110	1	0	0.109501	0.048
Richard Revel, lord of Coultra (d.1215x25)	55	1	0	0.032315	0.011
Hugh de Sigillo, bishop of Dunkeld (d.1229 or 1230)	39	1	0	0.032315	0.011
John (I) Hastings, sheriff (12/13C)	17	1	0	0.071242	0.032
William I, king of Scots (d.1214)	1	1	0	0.04548	0.02

D. Co-witnessing at more than 30 instances

At the level of more than 30 co-witnessing instances, a core segment runs from people who died in the 1170s through people who died in the 1230s, but the remains of a few other segments are also there. In the top right corner of the Netdraw sociogram (Figure 4.26), we have three individuals who were active in St Andrews diocese from the 1160s through the 1180s. Interestingly, [821] Walter of Roxburgh, archdeacon of St Andrews (fl. 1165×72- 1179×88) and [411] Andrew, archdeacon of Lothian (fl. 1147×59 – 1178×84) are connected at the level of more than 30 co-witnessing acts through the person of [3016] Alexander, chaplain of the bishop of St Andrews (12C). While the appearance of archdeacons should not be surprising, it is precisely individuals like Alexander the chaplain, whom the historian would normally be tempted to pass over without comment, who are brought into the spotlight by SNA techniques for further investigation.

Nine individuals from the Coldingham material appear at the level of more than 30 witnessing acts, but two of them – nos. 2577 and 3660 – have become detached from the other seven. The most important of these Coldingham people seem to be [3673] William of Mordington, who is connected to four others at this level, and [1287] Alan, son of Cospatric of Swinton, who is connected to two.

Table 4.11. Degree (number of connections) of people who witnessed >30 times

ID	Name	Degree
13	Duncan (II), earl of Fife (d.1204)	12
2	Matthew, bishop of Aberdeen (d.1199)	7
16	William Comyn, earl of Buchan (d.1233)	6
3	Walter Stewart (I), son of Alan (d.1177)	6
133	Nicholas of Roxburgh, chancellor (d.1171?)	6
15	Philip de Valognes, chamberlain (d.1215)	5
24	William Hay (I), lord of Errol (d.c.1201)	5
112	Richard de Moreville (d.1189 or 1190)	5
42	William del Bois, chancellor (d.1232)	4
820	Hugh of Roxburgh, bishop-elect of Glasgow (d.1199)	4
3673	*William of Mordington*	4
202	Andrew, bishop of Caithness (d.1184)	3

Three important players from the reign of Alexander II have also become detached from the main segment at the level of more than 30. These are the three close contemporaries [1281] John Maxwell, chamberlain, sheriff of Roxburgh (d. 1241), [1285] Walter Oliphant (II), justiciar of Lothian (d. 1242), and [1378] Walter Stewart (II), justiciar of Scotia (d. 1241). This is illustrated in Figure 4.27, which shows the disconnect between these three indviduals and the latest figures from the main segment, William del Bois and Philip de Mowbray.

The main segment has 27 individuals, spanning in time roughly the period of William the Lion's reign (1165-1214). This segment is illustrated in Figure 4.28. Shorn of his attachments to the players in the reign of Alexander II, to the Coldingham segment, and with fewer players from later in the reign of William co-witnessing at this level, the centrality of [42] William del Bois has diminished considerably. Here he has a degree of only 4, with attachments to his colleague the royal clerk [39] Hugh de Sigillo, bishop of Dunkeld (d. 1229 or 1230), prominent baron [1106] Philip de Mowbray, fl. 1198×1236, [15] Philip de Valognes, chamberlain (d. 1215), and the powerful justiciar [16] William Comyn, earl of Buchan (d.1233). By contrast, [13] Duncan (II), earl of Fife (d. 1204) witnessed more than 30 documents alongside twelve other people. These connections are illustrated by Figure 4.29. The second most connected individual in this graph is [2] Matthew, archdeacon of St Andrews from around 1150 to 1172 and bishop of Aberdeen from then until his death in 1199. Matthew held a pivotal position in a network involving various relatives and allies of Bishop Robert of St Andrews (d. 1159), including the Kinninmonth stewards of St Andrews. As well as being in very close contact with [13] Earl Duncan, [2] Bishop Matthew witnessed alongside key players from the time of King Malcolm IV (1153-65), including [3] Walter son of Alan, the steward (d. 1177), Richard de Moreville, the constable (d. 1189 or 1190), and Nicholas, the chancellor (d. 1171). Matthew's connections are illustrated in Figure 4.30.

Figure 4.26. Netdraw, all witnesses, more than 30 witnessing instances.

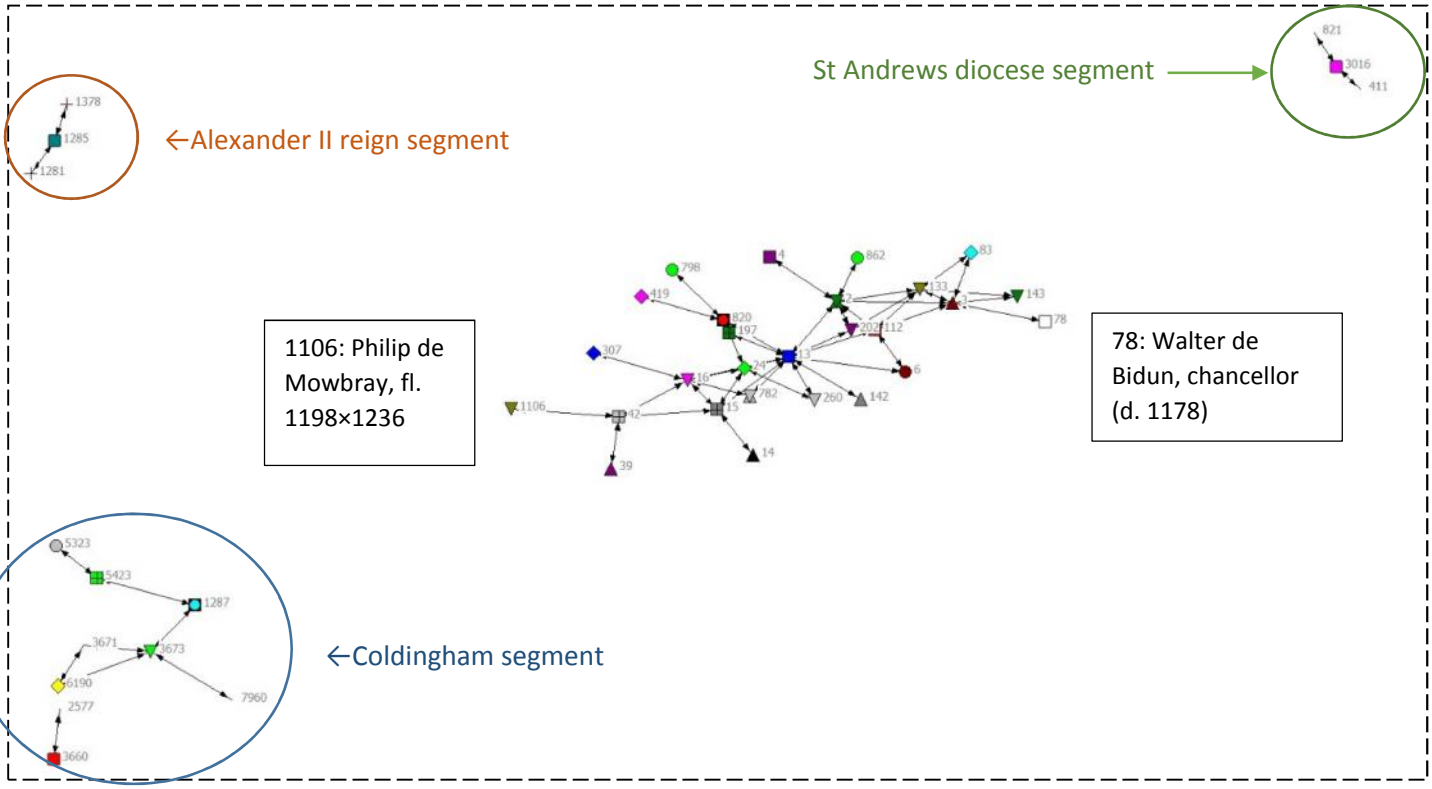


Figure 4.27. Gephi, >30, close-up of time of King Alexander II

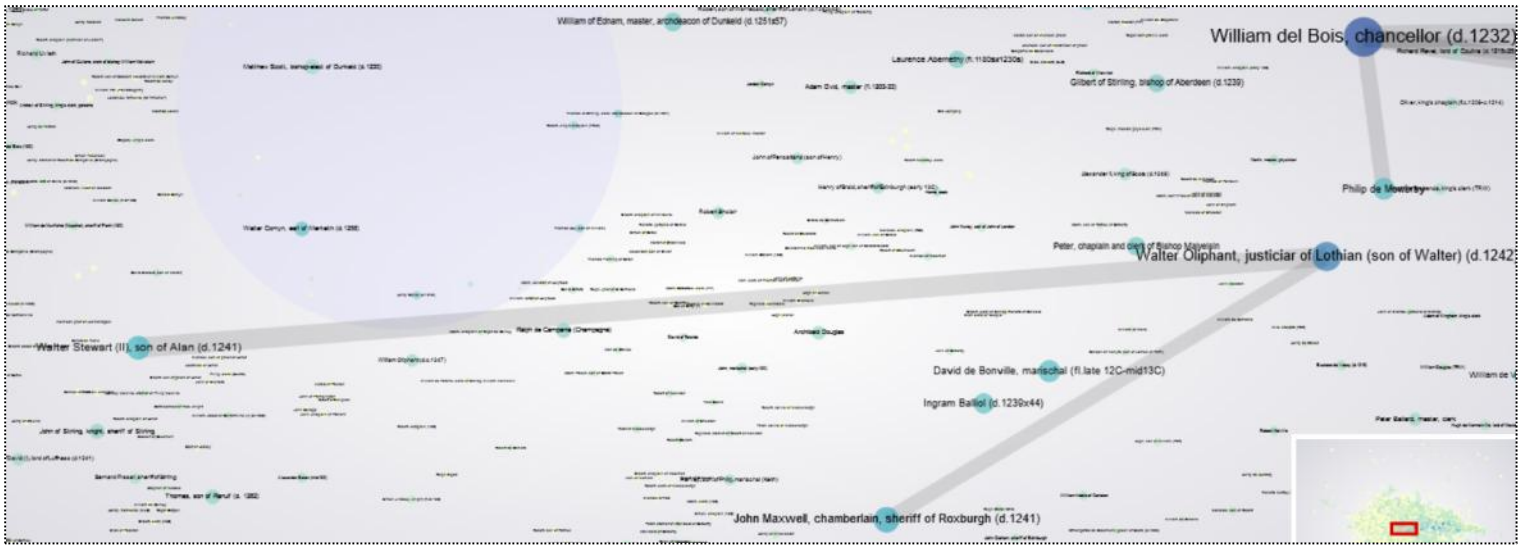


Figure 4.28. Gephi sociogram of >30 co-witnessing, nodes adjusted by degree

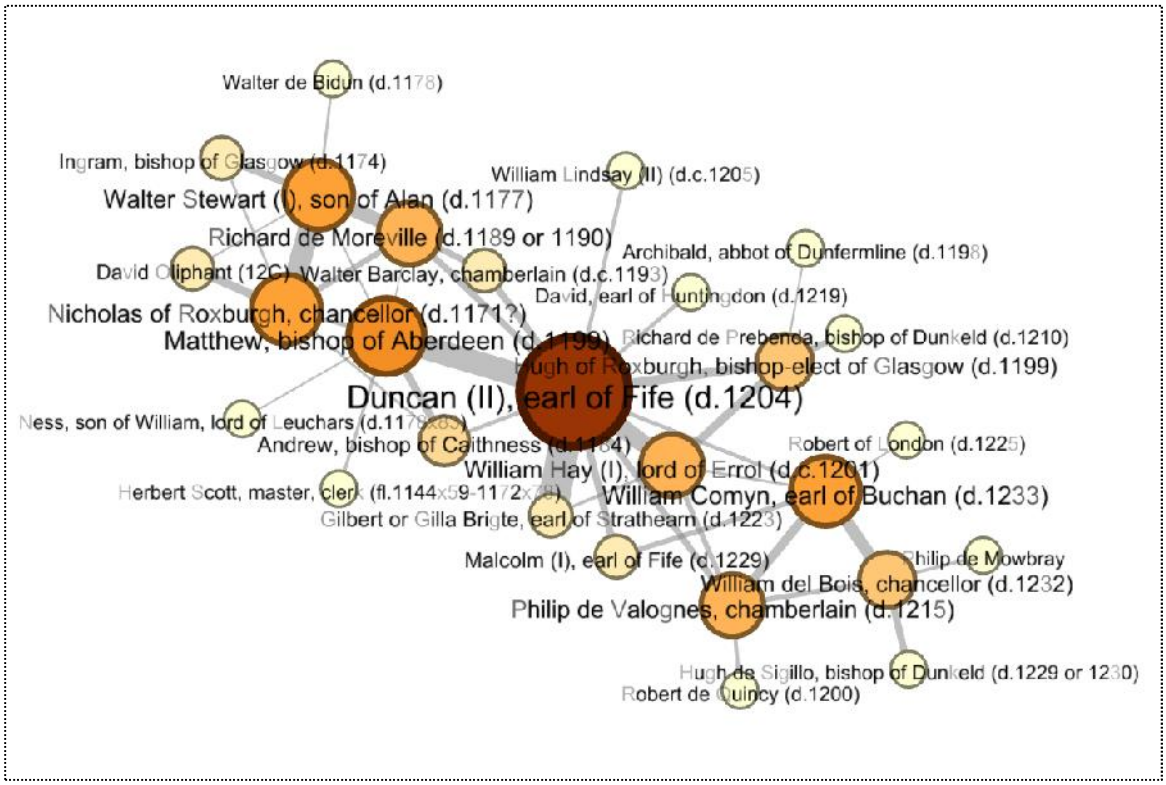


Figure 4.29. Connections of Duncan (II), earl of Fife, >30 witnessing acts

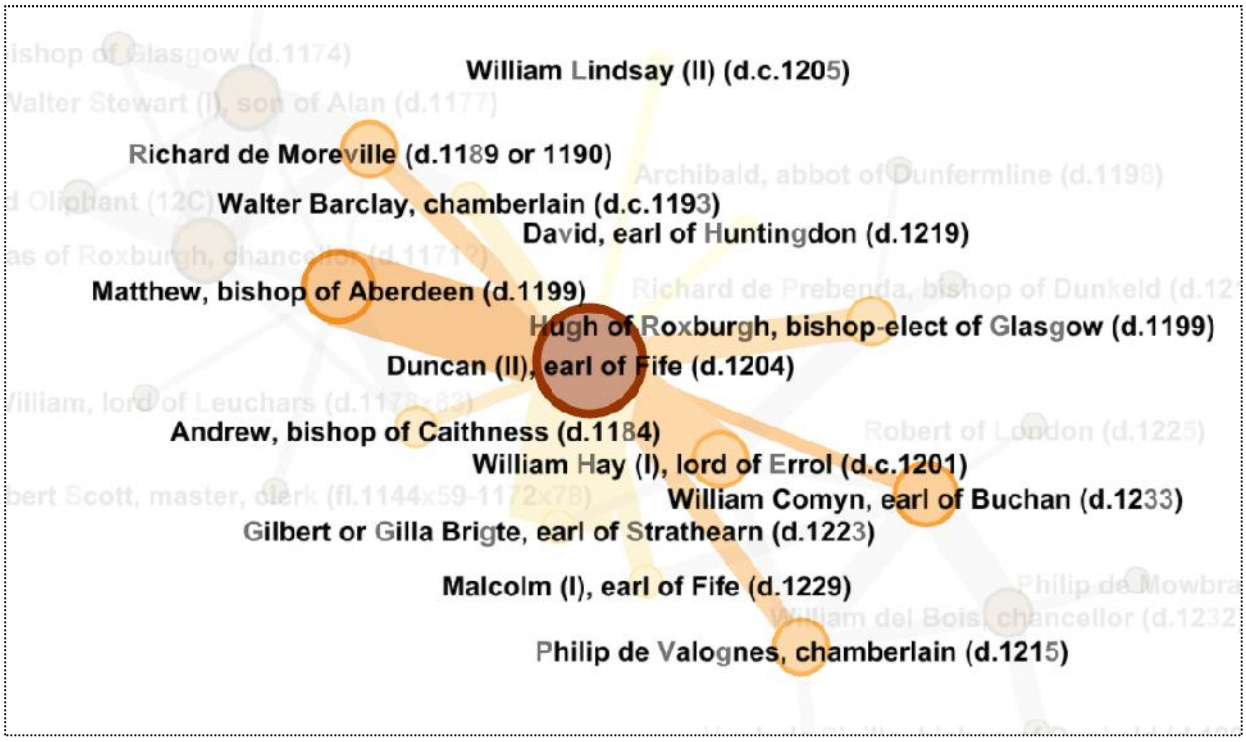
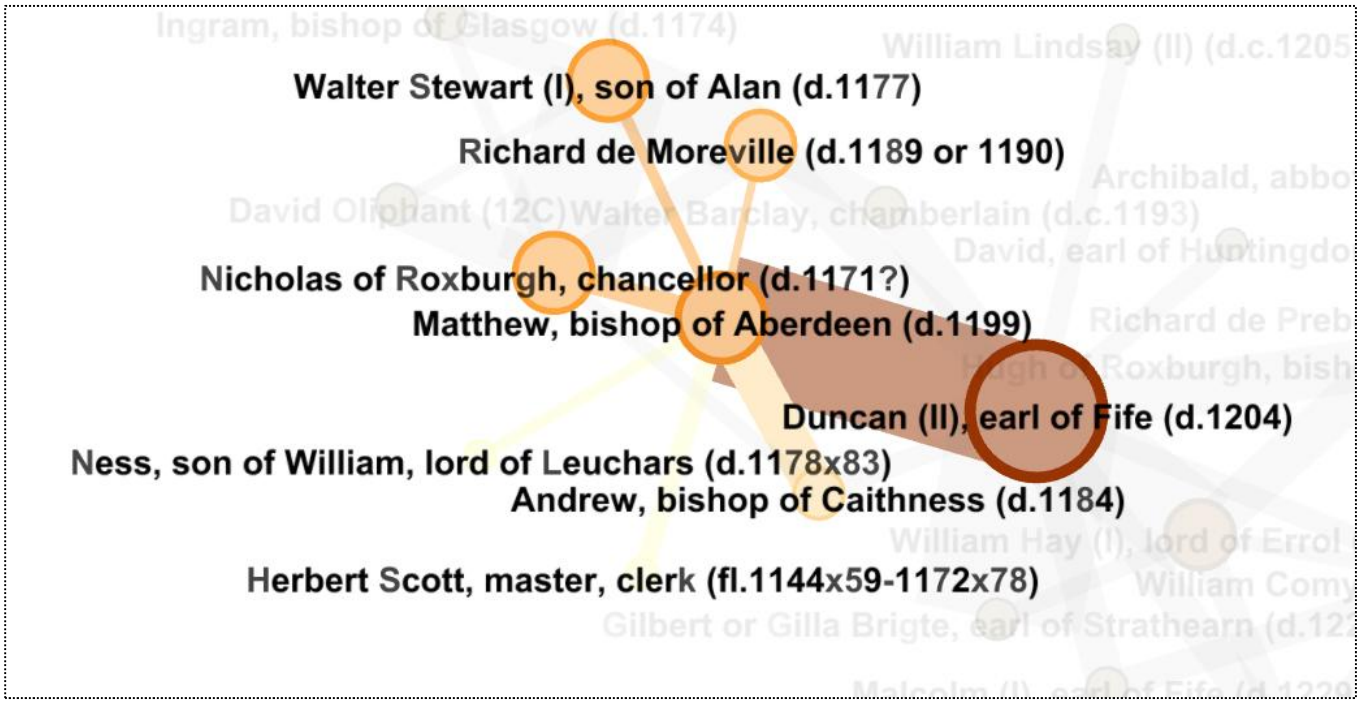
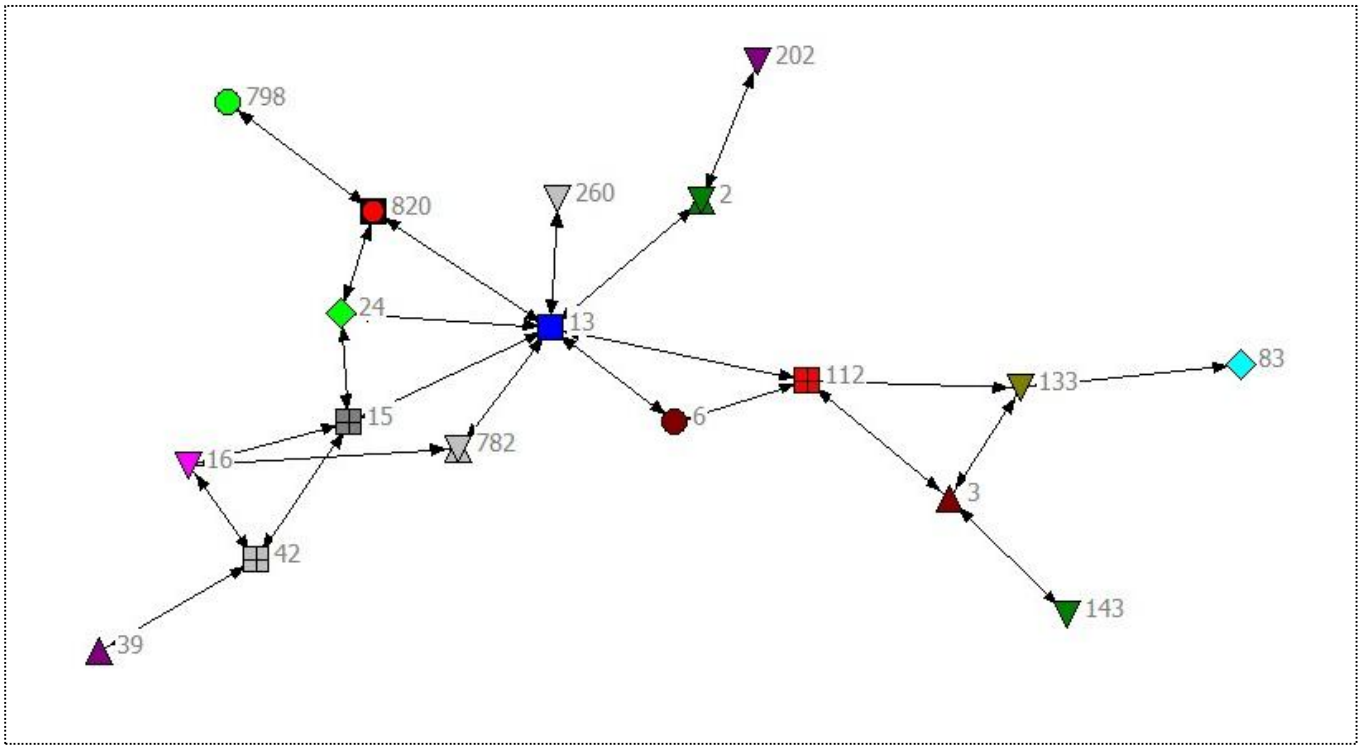


Figure 4.30. Connections of Matthew, bishop of Aberdeen, >30 witnessing acts



The central position of [13] Earl Duncan is even clearer at the level of more than 35 co-witnessing acts. Here, he acts as a chronological bridge between the key players of the mid-twelfth century and those of the later part of that century and early thirteenth. He also seems to be the single point in common (again, only at this level of witnessing 36 times) between a host of other players. In SNA theory terms, this would mean he could act as a power broker or otherwise as a key point of contact between various important individuals. While we know that these other people were in contact at lower levels of witnessing, this is less important here, but we should perhaps hold onto the idea of Duncan as an influential person for later. At the very least, he seems to have rubbed shoulders with just about every person of any account in the kingdom in the second half of the twelfth century. Here, Duncan is connected to eight individuals, while only one other person has a degree higher than three, and that is [15] Philip de Valognes, who is connected to four people. Exactly how many documents Earl Duncan witnessed with each of these eight people can be looked up in Table 4.12.

Figure 4.31. Netdraw, more than 35, main segment only.



At the level of more than 40 co-witnessing acts, that core segment divides into three fragments. Altogether at this level, we have one dyad, two triads, a segment of four, and a segment of six (see Figure 4.32). The dyad consists of [1378] Walter Stewart (II), justiciar of Scotia (d. 1241) and [1285] Walter Oliphant (II), justiciar of Lothian (d. 1242). A slightly earlier period is represented by the triad of [42] William del Bois, [16], William Comyn, earl of Buchan, and [15] Philip de Valognes. Table 4.00 lists all pairs who co-witnessed more than 25 times. We can look up any of these (implicit) relationships to see exactly how many times they co-witnessed in this study of the five specified document types. For example, William Comyn and William del Bois witnessed alongside each other 48 times. The second triad represents the lingerings of the Coldingham crowd, nos. 6190, 3673, and 1287. The most productive pair of these in terms of witnessing were [3673] William of Mordington and [1287] Alan, son of Cospatric of Swinton, who witnessed together 44 times. The group of four are individuals from the mid-twelfth century, especially the reign of Malcolm IV (1153-65): [112] Richard de Moreville, the constable, [3] Walter son of Alan (I), the steward, [133] Nicholas of Roxburgh, chancellor (d.1171?), and [83] David Oliphant, a perhaps unexpected player at this level.

Figure 4.32. More than 40 co-witnessing acts.

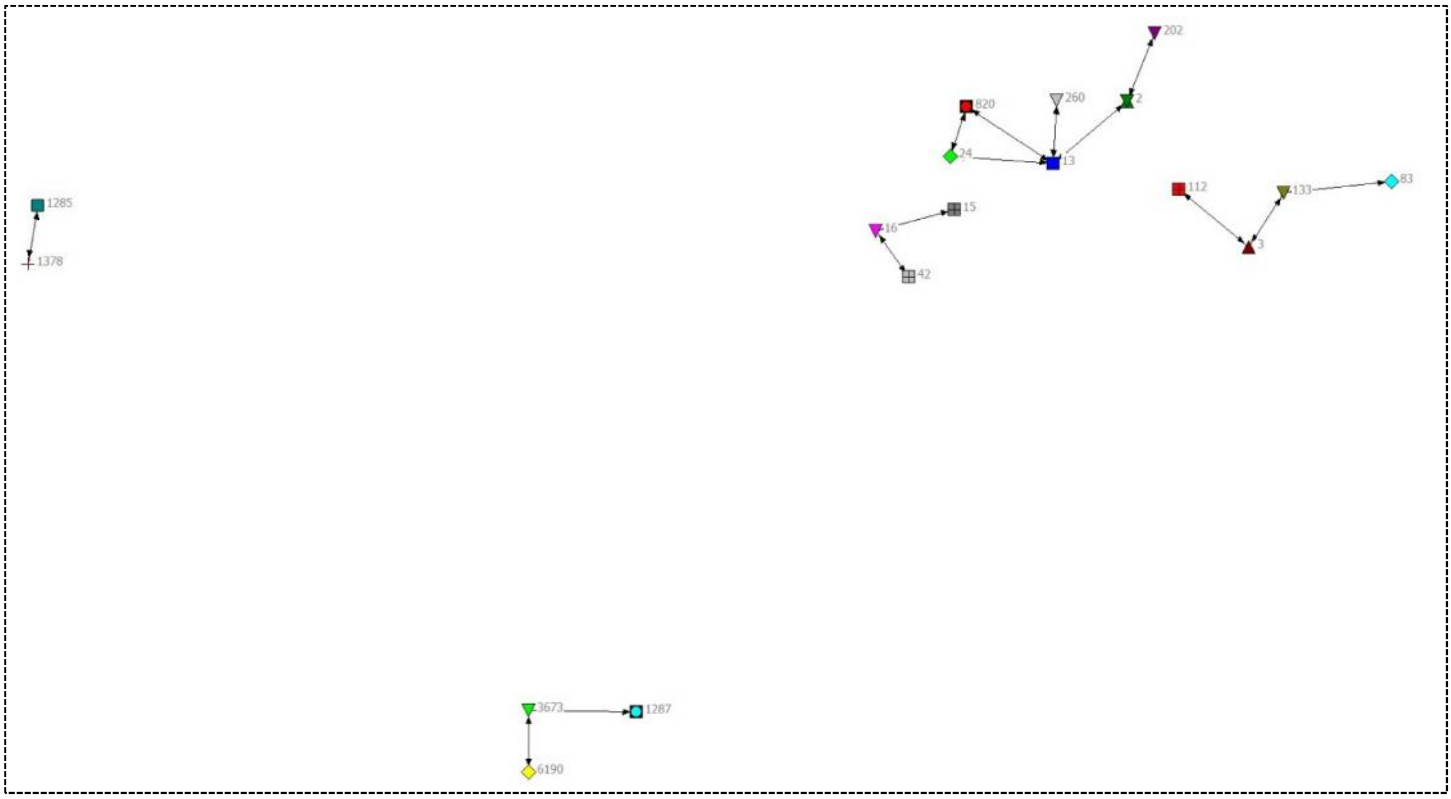
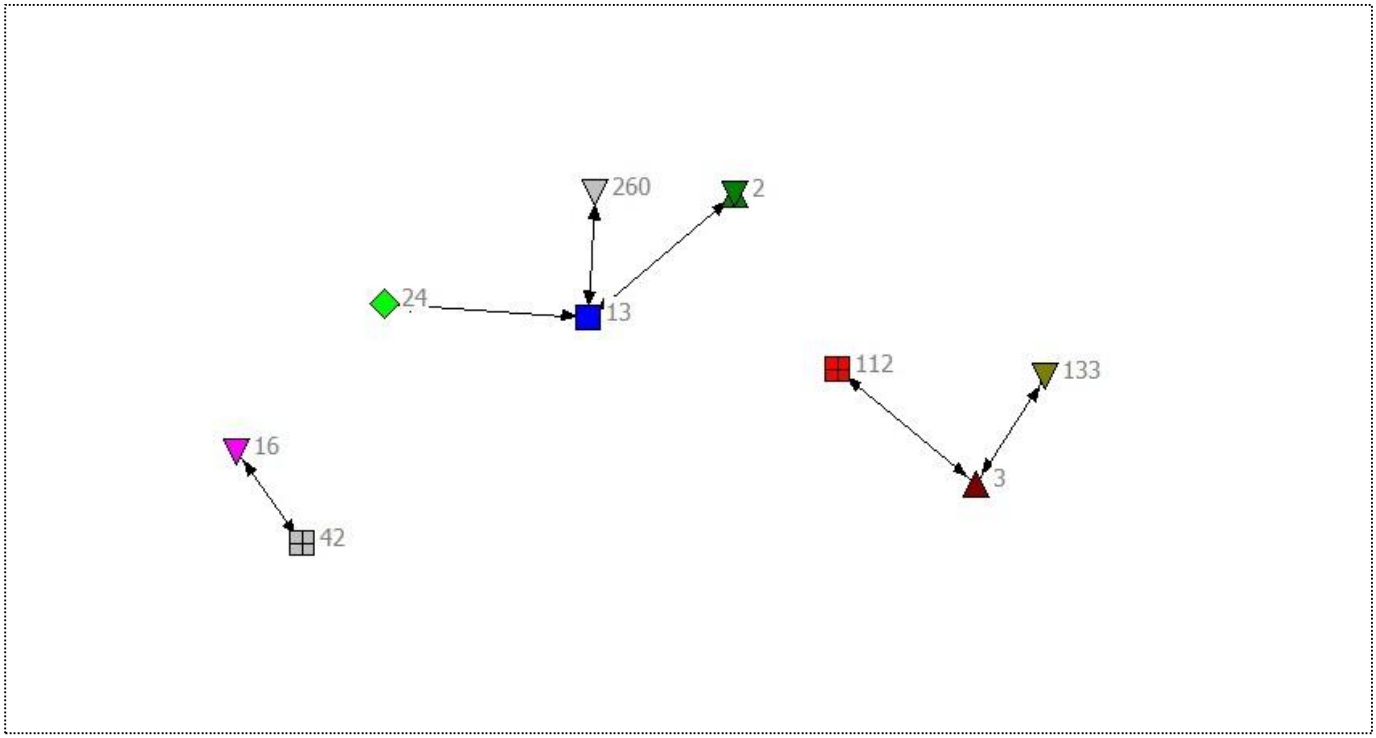


Figure 4.33. More than 45 co-witnessing acts.



At the level of more than 45 (Figure 4.33), all that remains are 9 people, all of whom were once part of the 'core segment'. By the level of >50, two of these have disappeared. This is the connection between [16] William Comyn, earl of Buchan, and [42] William del Bois, chancellor, who co-witnessed 48 times. At the level of more than 50 co-witnessing acts, we find [3] Walter son of Alan (I), the steward (d. 1177), acting as the connector between [112] Richard de Moreville, the constable (d. 1189 or 1190) and [133] Nicholas of Roxburgh, chancellor (d.1171?), representing the key players of the 1150s and 1160s. The link between [3] and [133] is still active at the level of more than 55 and more than 60 co –witnessing acts. Indeed, Walter and Nicholas witnessed alongside each other 63 times. As far as the 1170s through the 1190s, there is group of four players, connected by [13] Earl Duncan. [24] William Hay, lord of Errol, who witnessed alongside Earl Duncan 57 times, is obviously no longer visible in the sociogram of >60. The triad of Earl Duncan with [260] Gilbert, earl of Strathearn (d. 1223) and [2] Matthew, bishop of Aberdeen (d. 1199) is active to the level of more than 65 co-witnessing acts. (Duncan and Matthew witnessed together 66 times). Remarkably, Earls Duncan and Gilbert witnessed together more than any two other people in the database, appearing alongside each other 78 times. Relationships that were this productive are obviously worthy of further investigation.

Figure 4.34. More than 50 co-witnessing acts.

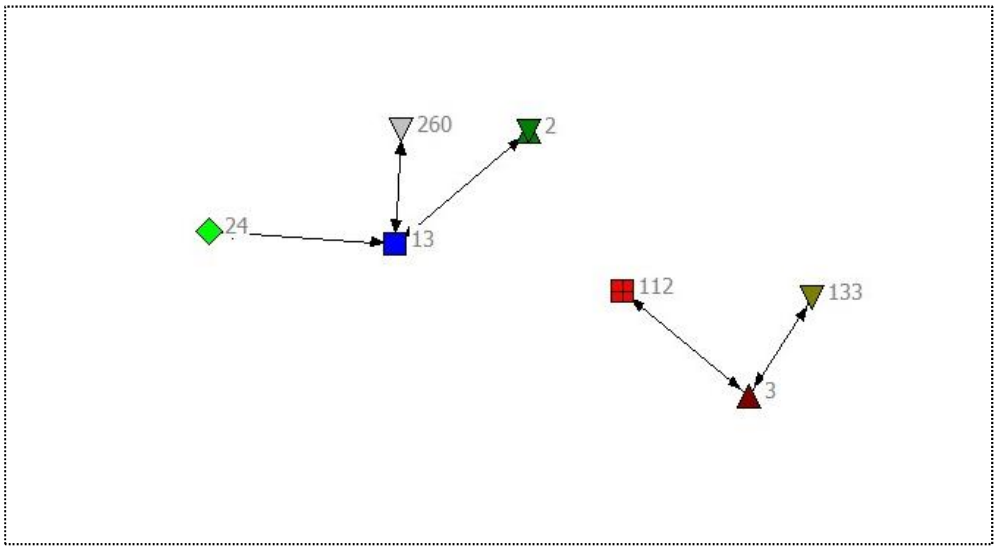


Figure 4.35. More than 55 co-witnessing acts.

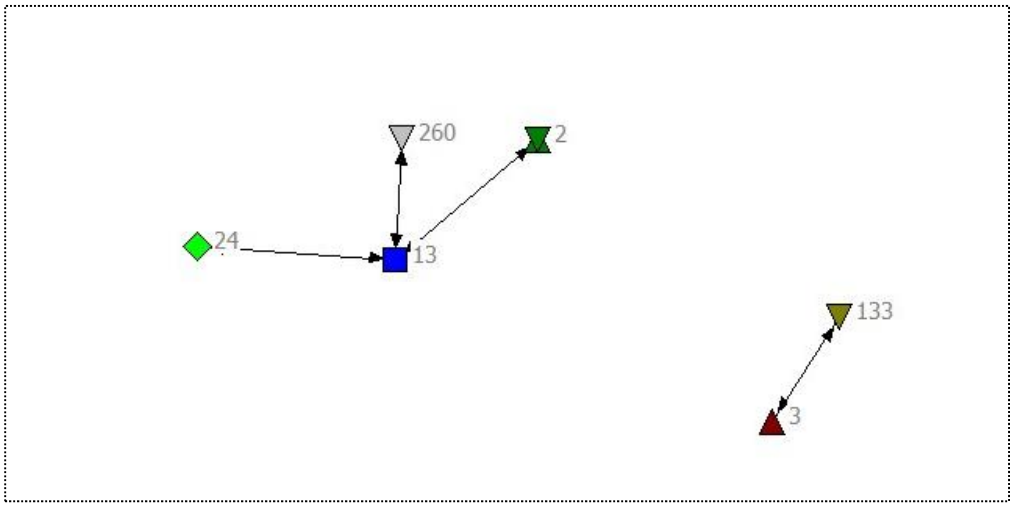


Figure 4.36. More than 60 co-witnessing acts.

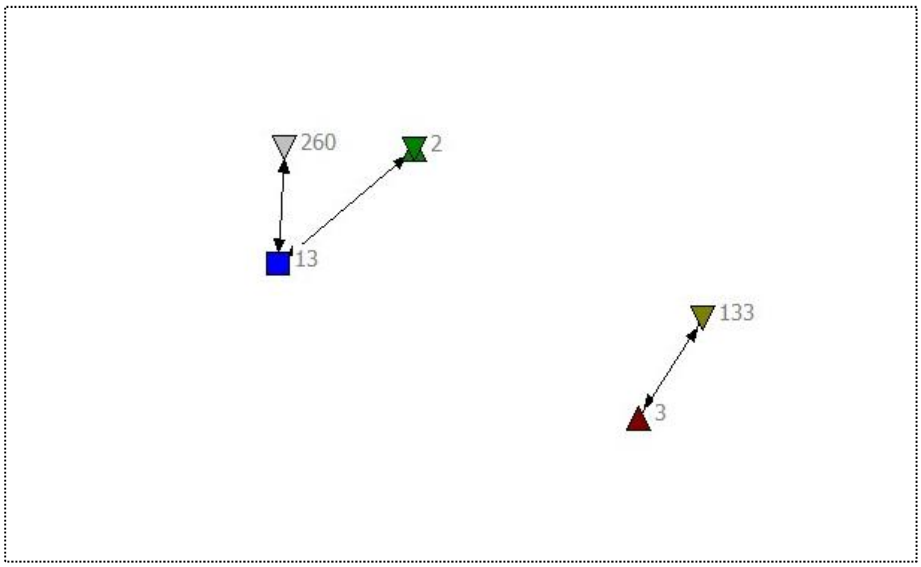


Figure 4.37. More than 65 co-witnessing acts.

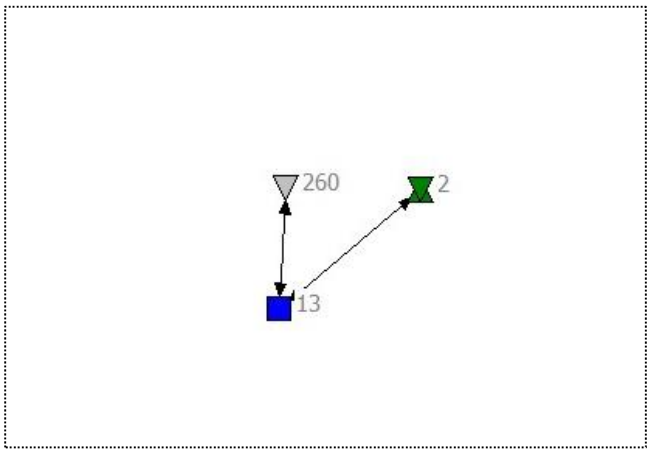


Figure 4.38. More than 70 co-witnessing acts.

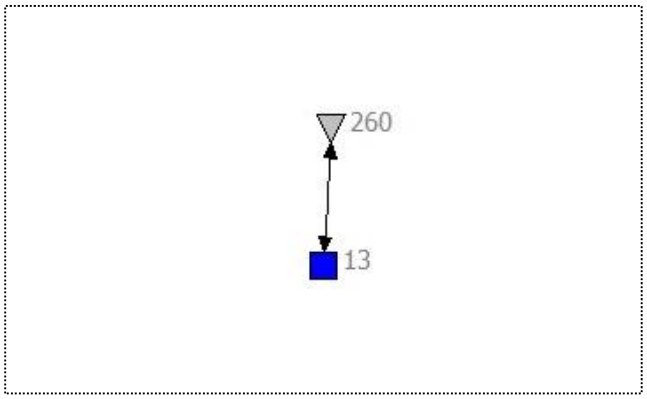


Table 4.12. shows all the (implicit) relationships between co-witnessing pairs who have witnessed together 25 times or more. Of 34 such co-witnessing 'relationships', no fewer than 12 (35%) included [13] Duncan (II), earl of Fife (d. 1204) – these are highlighted in yellow. A number of these also involved individuals from the Coldingham group; because these are not of kingdom-wide importance, they have been italicized for easy recognition. The earliest such 'relationship' is that of John, bishop of Glasgow (d. 1147) and Hugh de Moreville (I) (d.1162), King David's chief religious and secular advisors, respectively. The latest non-Coldingham 'relationship' are those of William of Bondington, bishop of Glasgow (d.1258) and Walter Stewart (II), son of Alan (d.1241) (26 times) and the same Walter Stewart with Walter Comyn, earl of Menteith (d.1258) (28 times). The number of times key players in the reign of William I appeared as witnesses together is a testament to a degree of cohesiveness among the elites of that period which is apparently either not extant or not visible in other reigns; this is an issue which deserves further scholarly attention.

Table 4.12. Pairs who co-witnessed more than 25 times

Person 1	Person 2	Co-Witness
Duncan (II), earl of Fife (d.1204)	Gilbert or Gilla Brigte, earl of Strathearn (d.1223)	78
Duncan (II), earl of Fife (d.1204)	Matthew, bishop of Aberdeen (d.1199)	66
Walter Stewart (I), son of Alan (d.1177)	Nicholas of Roxburgh, chancellor (d.1171?)	63
Duncan (II), earl of Fife (d.1204)	William Hay (I), lord of Errol (d.c.1201)	57
Richard de Moreville (d.1189 or 1190)	Walter Stewart (I), son of Alan (d.1177)	51
William Comyn, earl of Buchan (d.1233)	William del Bois, chancellor (d.1232)	48
Duncan (II), earl of Fife (d.1204)	Hugh of Roxburgh, bishop-elect of Glasgow (d.1199)	44
William of Mordington	*Alan, son of Cospatric of Swinton*	44
Philip de Valognes, chamberlain (d.1215)	William Comyn, earl of Buchan (d.1233)	43

Walter Oliphant, justiciar of Lothian (son of Walter) (d.1242)	Walter Stewart (II), son of Alan (d.1241)	43
William of Mordington	*Adam of Prenderguest*	43
Nicholas of Roxburgh, chancellor (d.1171?)	David Oliphant (12C)	42
William Hay (I), lord of Errol (d.c.1201)	Hugh of Roxburgh, bishop-elect of Glasgow (d.1199)	42
Matthew, bishop of Aberdeen (d.1199)	Andrew, bishop of Caithness (d.1184)	41
Hugh de Sigillo, bishop of Dunkeld (d.1229 or 1230)	William del Bois, chancellor (d.1232)	40
Walter Stewart (I), son of Alan (d.1177)	Ingram, bishop of Glasgow (d.1174)	40
Duncan (II), earl of Fife (d.1204)	Walter Barclay, chamberlain (d.c.1193)	40
Duncan (II), earl of Fife (d.1204)	Malcolm (I), earl of Fife (d.1229)	40
Duncan (II), earl of Fife (d.1204)	Philip de Valognes, chamberlain (d.1215)	39
Duncan (II), earl of Fife (d.1204)	Richard de Moreville (d.1189 or 1190)	39
Richard de Moreville (d.1189 or 1190)	Walter Barclay, chamberlain (d.c.1193)	39
Hugh of Roxburgh, bishop-elect of Glasgow (d.1199)	Richard de Prebenda, bishop of Dunkeld (d.1210)	39
Richard de Moreville (d.1189 or 1190)	Nicholas of Roxburgh, chancellor (d.1171?)	38
Philip de Valognes, chamberlain (d.1215)	William Hay (I), lord of Errol (d.c.1201)	37
Philip de Valognes, chamberlain (d.1215)	William del Bois, chancellor (d.1232)	37
William Comyn, earl of Buchan (d.1233)	Malcolm (I), earl of Fife (d.1229)	37
William of Mordington	*Bertram of Little Reston (son of Adam of Little Reston)*	37
Robert de Quincy (d.1200)	Philip de Valognes, chamberlain (d.1215)	35
Duncan (II), earl of Fife (d.1204)	William Comyn, earl of Buchan (d.1233)	35
Matthew, bishop of Aberdeen (d.1199)	Nicholas of Roxburgh, chancellor (d.1171?)	35
Duncan (II), earl of Fife (d.1204)	David, earl of Huntingdon (d.1219)	35
Duncan (II), earl of Fife (d.1204)	Andrew, bishop of Caithness (d.1184)	35
Duncan (II), earl of Fife (d.1204)	William Lindsay (II) (d.c.1205)	35
Robert, son of Gregory steward of Coldingham	*William of Mordington*	35
William Hay (I), lord of Errol (d.c.1201)	Gilbert or Gilla Brigte, earl of Strathearn (d.1223)	34
Andrew, archdeacon of Lothian (fl.1147x59-1178x84)	Alexander, chaplain of bishops of St Andrews (12C)	34
Matthew, bishop of Aberdeen (d.1199)	Herbert Scott, master, clerk (fl.1144x59-1172x78)	34
William del Bois, chancellor (d.1232)	Philip de Mowbray	34
Adam of Prenderguest	*Bertram of Little Reston (son of Adam of Little Reston)*	34
William Comyn, earl of Buchan (d.1233)	William Hay (I), lord of Errol (d.c.1201)	33
Walter de Bidun (d.1178)	Walter Stewart (I), son of Alan (d.1177)	33
Nicholas of Roxburgh, chancellor (d.1171?)	Ingram, bishop of Glasgow (d.1174)	33
Nicholas of Roxburgh, chancellor (d.1171?)	Andrew, bishop of Caithness (d.1184)	33
Matthew, bishop of Aberdeen (d.1199)	Walter Stewart (I), son of Alan (d.1177)	32
Walter Stewart (I), son of Alan (d.1177)	David Oliphant (12C)	32
Matthew, bishop of Aberdeen (d.1199)	Ness, son of William, lord of Leuchars (d.1178x83)	32
Archibald, abbot of Dunfermline (d.1198)	Hugh of Roxburgh, bishop-elect of Glasgow (d.1199)	32
William Comyn, earl of Buchan (d.1233)	Robert of London (d.1225)	32

John Maxwell, chamberlain, sheriff of Roxburgh (d.1241)	Walter Oliphant, justiciar of Lothian (son of Walter) (d.1242)	32
Alexander, chaplain of bishops of St Andrews (12C)	Walter of Roxburgh, archdeacon of St Andrews (fl.1165x72-1179x88)	32
Henry of Prenderguest (I)	*Elias of Prenderguest*	32
Gilbert of Lumsdaine	*Henry of Prenderguest (II) knight*	32
Richard de Moreville (d.1189 or 1190)	Matthew, bishop of Aberdeen (d.1199)	31
Alan, son of Cospatric of Swinton	*Henry of Prenderguest (I)*	31
Walter Stewart (I), son of Alan (d.1177)	Hugh de Moreville (I) (d.1162)	30
Aiulf, dean of Lothian (fl.1150/51-1186)	Andrew, archdeacon of Lothian (fl.1147x59-1178x84)	30
Andrew, archdeacon of Lothian (fl.1147x59-1178x84)	Herbert Scott, master, clerk (fl.1144x59-1172x78)	30
Duncan (II), earl of Fife (d.1204)	Jocelin, bishop of Glasgow (d.1199)	30
William Comyn, earl of Buchan (d.1233)	Hugh of Roxburgh, bishop-elect of Glasgow (d.1199)	30
Duncan (II), earl of Fife (d.1204)	Richard de Prebenda, bishop of Dunkeld (d.1210)	30
Robert, son of Gregory steward of Coldingham	*Adam of Prenderguest*	30
Alan, son of Cospatric of Swinton	*Adam of Little Reston*	30
Philip de Valognes, chamberlain (d.1215)	Richard de Moreville (d.1189 or 1190)	29
Philip de Valognes, chamberlain (d.1215)	Hugh of Roxburgh, bishop-elect of Glasgow (d.1199)	29
Gilbert or Gilla Brigte, earl of Strathearn (d.1223)	Hugh of Roxburgh, bishop-elect of Glasgow (d.1199)	29
William del Bois, chancellor (d.1232)	John Maxwell, chamberlain, sheriff of Roxburgh (d.1241)	29
Matthew, bishop of Aberdeen (d.1199)	Gilbert or Gilla Brigte, earl of Strathearn (d.1223)	28
Philip de Valognes, chamberlain (d.1215)	Walter Barclay, chamberlain (d.c.1193)	28
Matthew, bishop of Aberdeen (d.1199)	Walter Barclay, chamberlain (d.c.1193)	28
Hugh de Moreville (I) (d.1162)	John, bishop of Glasgow (d.1147)	28
William Lindsay (II) (d.c.1205)	Hugh of Roxburgh, bishop-elect of Glasgow (d.1199)	28
William del Bois, chancellor (d.1232)	William, chaplain (II) of King William (c.1196-1214)	28
Walter Comyn, earl of Menteith (d.1258)	Walter Stewart (II), son of Alan (d.1241)	28
Henry of Prenderguest (I)	*Adam of Little Reston*	28
Richard de Moreville (d.1189 or 1190)	David Oliphant (12C)	27
Walter de Bidun (d.1178)	Hugh de Moreville (I) (d.1162)	27
Walter Stewart (I), son of Alan (d.1177)	Andrew, bishop of Caithness (d.1184)	27
William del Bois, chancellor (d.1232)	Robert of London (d.1225)	27
William del Bois, chancellor (d.1232)	Malcolm (I), earl of Fife (d.1229)	27
Alexander, chaplain of bishops of St Andrews (12C)	Abraham of Dunkeld, master, canon (fl.1162x78)	27
Alan, son of Cospatric of Swinton	*Adam of Prenderguest*	27
Laurence of Thornton, archdeacon of St Andrews (d.1238x40)	Stephen of Lilliesleaf, master, clerk, persona	27
Duncan (II), earl of Fife (d.1204)	Robert de Quincy (d.1200)	26
Walter de Bidun (d.1178)	Richard de Moreville (d.1189 or 1190)	26
Duncan (II), earl of Fife (d.1204)	Ness, son of William, lord of Leuchars (d.1178x83)	26
Hugh of Roxburgh, bishop-elect of Glasgow (d.1199)	Robert of London (d.1225)	26
William del Bois, chancellor (d.1232)	Walter of St Albans, bishop of Glasgow (d.1232)	26

William of Bondington, bishop of Glasgow (d.1258)	Walter Stewart (II), son of Alan (d.1241)	26
Adam of Little Reston	*Elias of Prenderguest*	26
Henry of Prenderguest (I)	*William of Lumsdaine*	26
Alan, son of Cospatric of Swinton	*Bertram of Little Reston (son of Adam of Little Reston)*	26
Nicholas of Roxburgh, chancellor (d.1171?)	Richard, bishop of St Andrews (d.1178)	25
Osbert, abbot of Jedburgh (d.1174)	Ingram, bishop of Glasgow (d.1174)	25
Hugh de Moreville (I) (d.1162)	William de Somerville (I)	25
Alexander, chaplain of bishops of St Andrews (12C)	Robert, son of Saewulf, bishop's chancellor	25
Aiulf, dean of Lothian (fl.1150/51-1186)	Herbert Scott, master, clerk (fl.1144x59-1172x78)	25
William Hay (I), lord of Errol (d.c.1201)	Richard de Prebenda, bishop of Dunkeld (d.1210)	25
William Hay (I), lord of Errol (d.c.1201)	Malcolm (I), earl of Fife (d.1229)	25
Gilbert or Gilla Brigte, earl of Strathearn (d.1223)	Malcolm (I), earl of Fife (d.1229)	25
William del Bois, chancellor (d.1232)	Oliver, king's chaplain (fl.c.1208-c.1214)	25
Michael, master, clerk, chaplain (fl.1201-1220x25)	Laurence of Thornton, archdeacon of St Andrews (d.1238x40)	25

Finally, we can compare the centralities of the most significant players in the study of co-witnesses overall. First, it is helpful to compare the most active co-witnessing relationships in the table above with the lists of the most central actors: they are not always the same people. Witnessing many times with certain individuals is different from witnessing at least once with a large number of individuals (degree), or with the most well-connected individuals (eigenvector). Another way of thinking of degree is as the number of contacts any given person had, if the definition of ‘contact’ is someone alongside whom one has witnessed. As we shall see in Chapter 9, the degree is the same as the size of one’s ego-network, which is to say that the degree is the number of individuals in one’s own personal network. Earl Duncan II of Fife (d. 1204), with 585 such ‘contacts’, had over 100 more than William del Bois (d. 1232), or Bishop Matthew of Aberdeen (d. 1199), and over 200 more than his contemporary, the chamberlain Philip de Valognes (d. 1215). While the degree, or number of ‘contacts’, is clearly related to how many documents one has witnessed, how many witnesses those documents themselves had, and the length of one’s career, factors such as these are not wholly determinative. There is no easy way to filter out the significance of such factors, but it is possible to examine them in various ways which may help in our interpretation of what else is going on – shifting patterns of how interconnected were the top actors at various times and in various contexts.

Table 4.13. Top 30 witnesses by degree centrality

Rank	poms id	name	degree	Decade of death
1	13	Duncan (II), earl of Fife (d.1204)	585	1200
2	42	*William del Bois, chancellor (d.1232)*	476	1230
3	2	*Matthew, bishop of Aberdeen (d.1199)*	475	1190
4	142	David, earl of Huntingdon (d.1219)	411	1210
5	858	*Walter of St Albans, bishop of Glasgow (d.1232)*	380	1230
6	40	*William Malveisin, bishop of St Andrews (d.1238)*	379	1230
7	782	Malcolm (I), earl of Fife (d.1229)	377	1220
8	15	Philip de Valognes, chamberlain (d.1215)	363	1210
9	745	*Jocelin, bishop of Glasgow (d.1199)*	356	1190
10	260	Gilbert or Gilla Brigte, earl of Strathearn (d.1223)	354	1220
11	798	*Richard de Prebenda, bishop of Dunkeld (d.1210)*	347	1210
12	444	Patrick (I), earl of Dunbar (d.1232)	343	1230
13	850	*John Scott, bishop of Dunkeld (d.1203)*	337	1200
14	1285	Walter Oliphant, justiciar of Lothian (son of Walter) (d.1242)	327	1240
15	1	William I, king of Scots (d.1214)	323	1210
16	16	William Comyn, earl of Buchan (d.1233)	320	1230
17	3	Walter Stewart (I), son of Alan (d.1177)	316	1170
18	24	William Hay (I), lord of Errol (d.c.1201)	310	1200
19	39	*Hugh de Sigillo, bishop of Dunkeld (d.1229 or 1230)*	303	1220
20	2115	Walter Lindsay (III), son of William (II) (d.c.1222)	293	1220
21	866	*Simon, archdeacon of Glasgow (fl.1165x74-1195x96)*	286	1190?
22	1281	John Maxwell, chamberlain, sheriff of Roxburgh (d.1241)	277	1240
(22)	829	*Ranulf de Wat, archdeacon of St Andrews (d.1209)*	277	1200
24	788	*Andrew Murray, bishop of Moray (d.1242)*	273	1240
25	400	Alan Stewart, son of Walter (d.1204)	262	1200
26	202	*Andrew, bishop of Caithness (d.1184)*	260	1180
(26)	445	Patrick (II), earl of Dunbar (d.1248)	260	1240
28	133	*Nicholas of Roxburgh, chancellor (d.1171?)*	257	1170
(28)	411	*Andrew, archdeacon of Lothian (fl.1147x59-1178x84)*	257	1170/80
30	66	David Hay, lord of Errol (d.1237x41)	256	1230/40

The ‘sweet spot’ effect, whereby the period between about 1170 and 1230 produces the best balance between a critical mass of documents as well as a highly interconnected group of top actors, is on display in Table 4.13. Both factors – the numbers of documents and witnesses, on the one hand, and the high rate at which they witnessed with each other, on the other, are at play in the tendency for individuals with a high number of contacts – a high degree centrality – to have flourished in the period of this ‘sweet spot’. 23 out of the top 30 died in the first half of the thirteenth century. There are only four people who died before about 1195, and these were of the generation which died in the 1170s

and 1180s. Even absolutely key individuals from the mid-twelfth century, as we shall see in the next chapter, like Hugh de Moreville (d. 1162), do not appear on this list, because there simply was not a critical mass of documents. By the same token, similarly crucial power players from the mid-13th century fail to show up here, like Walter Comyn, earl of Menteith (d. 1258), because while there were many surviving documents from his time, there were not enough royal and other sources documenting the activities of the kingdom's core elite on a 'national' level. Clearly degree on its own is not sufficient for thinking about centrality.

Table 4.14. Top 30 witnesses by weighted degree centrality

rank	poms id	name	degree	weighted degree
1	13	Duncan (II), earl of Fife (d.1204)	585	2327
2	42	William del Bois, chancellor (d.1232)	476	1746
3	2	Matthew, bishop of Aberdeen (d.1199)	475	1738
4	15	Philip de Valognes, chamberlain (d.1215)	363	1493
5	24	William Hay (I), lord of Errol (d.c.1201)	310	1296
6	16	William Comyn, earl of Buchan (d.1233)	320	1295
7	142	David, earl of Huntingdon (d.1219)	411	1260
8	3	Walter Stewart (I), son of Alan (d.1177)	316	1192
9	260	Gilbert or Gilla Brigte, earl of Strathearn (d.1223)	354	1191
10	112	Richard de Moreville (d.1189 or 1190)	245	1175
11	782	Malcolm (I), earl of Fife (d.1229)	377	1105
12	133	Nicholas of Roxburgh, chancellor (d.1171?)	257	1103
13	820	Hugh of Roxburgh, bishop-elect of Glasgow (d.1199)	255	1089
14	1285	Walter Oliphant, justiciar of Lothian (son of Walter) (d.1242)	327	1023
15	798	Richard de Prebenda, bishop of Dunkeld (d.1210)	347	989
16	1287	Alan, son of Cospatric of Swinton	236	926
17	202	Andrew, bishop of Caithness (d.1184)	260	907
18	745	Jocelin, bishop of Glasgow (d.1199)	356	886
19	850	John Scott, bishop of Dunkeld (d.1203)	337	877
20	307	Robert of London (d.1225)	244	847
21	197	William Lindsay (II) (d.c.1205)	238	830
22	6	Walter Barclay, chamberlain (d.c.1193)	189	824
23	444	Patrick (I), earl of Dunbar (d.1232)	343	817
24	411	Andrew, archdeacon of Lothian (fl.1147x59-1178x84)	257	808
25	858	Walter of St Albans, bishop of Glasgow (d.1232)	380	802
26	1281	John Maxwell, chamberlain, sheriff of Roxburgh (d.1241)	277	777
27	107	Osbert, abbot of Jedburgh (d.1174)	243	762
28	1	William I, king of Scots (d.1214)	323	760
29	143	Ingram, bishop of Glasgow (d.1174)	245	752
30	79	Hugh de Moreville (I) (d.1162)	198	748

As Table 4.14 shows, it is also possible to alter the degree calculations by weighting them. This is achieved by adding the weights of all the edges and using that sum as the 'weighted degree'. In other words, it calculates based on not simply how many contacts one has, or in this case, how many people with whom one has witnessed, but also how many times one has witnessed with each of those individuals. William Comyn, earl of Buchan (d. 1233), climbs from sixteenth place to sixth place; Walter Stewart (I) climbs from seventeeth to eighth place. Philip de Valognes (d. 1215) climbs from eighth to fourth. But all in all, weighted degree does not offer much new insight.

Table 4.15. Top 30 witnesses by Eigenvector centrality (churchmen in italics)

rank	poms id	name	degree	eigencentrality	movement
1	13	Duncan (II), earl of Fife (d.1204)	585	1	-
2	142	David, earl of Huntingdon (d.1219)	411	0.86973	↑ (2)
3	2	*Matthew, bishop of Aberdeen (d.1199)*	475	0.851917	-
4	798	*Richard de Prebenda, bishop of Dunkeld (d.1210)*	347	0.780663	↑ (7)
5	15	Philip de Valognes, chamberlain (d.1215)	363	0.760862	↑ (3)
6	1	William I, king of Scots (d.1214)	323	0.752247	↑ (9)
7	260	Gilbert or Gilla Brigte, earl of Strathearn (d.1223)	354	0.744801	↑ (3)
8	42	*William del Bois, chancellor (d.1232)*	476	0.724501	↓ (6)
9	782	Malcolm (I), earl of Fife (d.1229)	377	0.717778	↓ (2)
10	24	William Hay (I), lord of Errol (d.c.1201)	310	0.70904	↑ (8)
11	444	Patrick (I), earl of Dunbar (d.1232)	343	0.689286	↑ (1)
12	39	*Hugh de Sigillo, bishop of Dunkeld (d.1229 or 1230)*	303	0.687926	↑ (7)
13	40	*William Malveisin, bishop of St Andrews (d.1238)*	379	0.682593	↓ (7)
14	850	*John Scott, bishop of Dunkeld (d.1203)*	337	0.675865	↓ (1)
15	745	*Jocelin, bishop of Glasgow (d.1199)*	356	0.672786	↓ (6)
16	858	*Walter of St Albans, bishop of Glasgow (d.1232)*	380	0.671745	↓ (11)
17	16	William Comyn, earl of Buchan (d.1233)	320	0.664618	↓ (1)
18	820	*Hugh of Roxburgh, bishop-elect of Glasgow (d.1199)*	255	0.618468	↑ (13)
19	197	William Lindsay (II) (d.c.1205)	238	0.599261	↑ (21)
20	14	Robert de Quincy (d.1200)	231	0.595883	↑ (26)
21	307	Robert of London (d.1225)	244	0.593988	↑ (16)
22	400	Alan Stewart, son of Walter (d.1204)	262	0.56372	↑ (3)
23	1285	Walter Oliphant, justiciar of Lothian (son of Walter) (d.1242)	327	0.561028	↓ (9)
24	419	*Archibald, abbot of Dunfermline (d.1198)*	225	0.558259	↑ (27)
25	112	Richard de Moreville (d.1189 or 1190)	245	0.547401	↑ (10)
26	781	*Richard of Lincoln, bishop of Moray (d.1203)*	208	0.542228	↑ (36)
27	202	*Andrew, bishop of Caithness (d.1184)*	260	0.533907	↓ (1)
28	3	Walter Stewart (I), son of Alan (d.1177)	316	0.533774	↓ (11)
29	6	Walter Barclay, chamberlain (d.c.1193)	189	0.529756	↑ (48)
30	809	*Ralph, bishop of Brechin (d.1212x14)*	226	0.526366	↑ (18)

If degree centrality tells us who were the most-connected people, Eigenvector centrality tells us about who were the best-connected people. Eigenvector refines degree centrality by considering the degree centrality of those to whom an individual is immediately 'adjacent'. In other words, it asks how many contacts one's own contacts have, and factors this into the eigenvector score. Mathematically, this depends on the use of an algorithm to calculate the largest eigenvalue of an adjacency matrix (Prell 2012, p. 102). Comparing the degree table and the eigenvector table yields some interesting observations. Duncan (II), earl of Fife, and Matthew, bishop of Aberdeen, have retained their places near the top of the league tables, but William del Bois, the chancellor, has fallen six places to 8th. By contrast, Richard de Prebenda rose 7 places to 4th, presumably on the back of his position as a top royal clerk. Not surprisingly, the place of King William himself has gone up significantly: it should not surprise us that although he had fewer co-witnessing 'contacts' than some others, the centrality of those contacts is on the higher end of the spectrum. Those who rose co-witnessed with fewer people, but witnessed alongside more people who themselves had high degrees (or large ego-networks). Those who fell in the tables may have co-witnessed with more individuals, but more of these contacts were themselves less well-connected. By examining those who fell and rose, we can better characterise their own networks of contacts and formulate questions as historians to ask about these people. The eigenvector calculation has not done much for smoothing out our chronological lumpiness, and approaches to deal with this issue will be considered in the next chapter and in chapter 9. Indeed, it is hard not to notice that those whose stock has fallen most precipitously were either on the early side (Walter Stewart (I), d. 1177, down 11 places (although note that his younger contemporary Richard de Moreville went up 10 places), or died after about 1230, such as Walter Oliphant, justiciar of Lothian (d. 1242), down nine, Walter of St Albans, bishop of Glasgow (d.1232), down 11, or William Malveisin, bishop of St Andrews (d.1238), down 7. However, the eigenvector calculation has offered what is likely a much more accurate assessment of those who were in positions of power within the 'sweet spot' time period. Thus, chamberlain Walter Barclay (d. ca 1193) rose 48 spots to his new ranking at no. 29; Abbot Archibald of Dunfermline (d. 1198), identified as a key advisor to King William, has risen 27 places; Robert of London, that king's well-favoured bastard son, has gone up 16 spots, and Robert de Quincy, a royal justice in the late twelfth century, has risen by 26.

Table 4.16, below, offers another method for contextualising centrality results. This table includes the top 100 people by degree and by eigenvector. It lists Eigenvector as calculated in Gephi, as well as a percentage, degree, the number of documents witnessed, of the five document types in the study,

and, finally, the degree divided by the number of documents witnessed. The question is, by factoring in the number of documents in which a person was a witness, can we better examine the relative size of networks of co-witness 'contacts'? The table below is ordered by this quotient of degree divided by documents witnessed, from smallest to largest. The results certainly help 'iron out' the chronological bumps of our dataset. The chronological periods outside of the 'sweet spot' are better represented. Important individuals from the mid-12th century appear in the top fifteen, including Nicholas of Roxburgh (d. 1171), Hugh de Moreville (I) (d. 1162), and Walter de Bidun (d. 1178). At the same time, key players from the mid-thirteenth century, like Walter Comyn, earl of Menteith (d. 1258) have gone up in the world. Interestingly, the chamberlain Philip de Valognes, who was in the top ten by both degree and eigenvector, has kept a high position in these rankings, while other familiar top names, like Duncan (II) earl of Fife (d. 1204), Matthew, bishop of Aberdeen (d. 1199), William Hay, Gilbert earl of Strathearn, and Malcolm (I), earl of Fife, have fallen significantly. This is probably partially due to a 'law of diminishing returns', whereby the more documents one has witnessed, the more likely one is to have witnessed alongside the same people again and again, and the less likely one is to add new people to one's network. So Walter Barclay appears very high in these rankings, because he has quite a large degree (189) for a small number of documents witnessed (67). But even though Earl Duncan has a remarkable size of network (a degree of 585), he has witnessed so many documents (202) that he appears to be less significant according to these calculations.

Table 4.16. Degree divided by number of documents witnessed

poms id	name	eigen	x100	degree	Docs W (SD)	Degree/ docs w
112	Richard de Moreville (d.1189 or 1190)	0.547401	54.8	245	117	2.094
133	Nicholas of Roxburgh, chancellor (d.1171?)	0.46928623	46.9	257	121	2.124
6	Walter Barclay, chamberlain (d.c.1193)	0.529756439	53	189	87	2.17
15	Philip de Valognes, chamberlain (d.1215)	0.760862	76.1	363	166	2.187
16	William Comyn, earl of Buchan (d.1233)	0.664618	66.5	320	145	2.207
1357	Walter Comyn, earl of Menteith (d.1258)	0.307711901	30.8	209	93	2.25
880	Bernard of Hadden, sheriff of Roxburgh	0.330923601	33.1	226	43	2.26
79	Hugh de Moreville (I) (d.1162)	0.241463827	24.1	198	85	2.33
42	William del Bois, chancellor (d.1232)	0.724501	72.5	476	202	2.356
1378	Walter Stewart (II), son of Alan (d.1241)	0.281964672	28.2	253	101	2.505

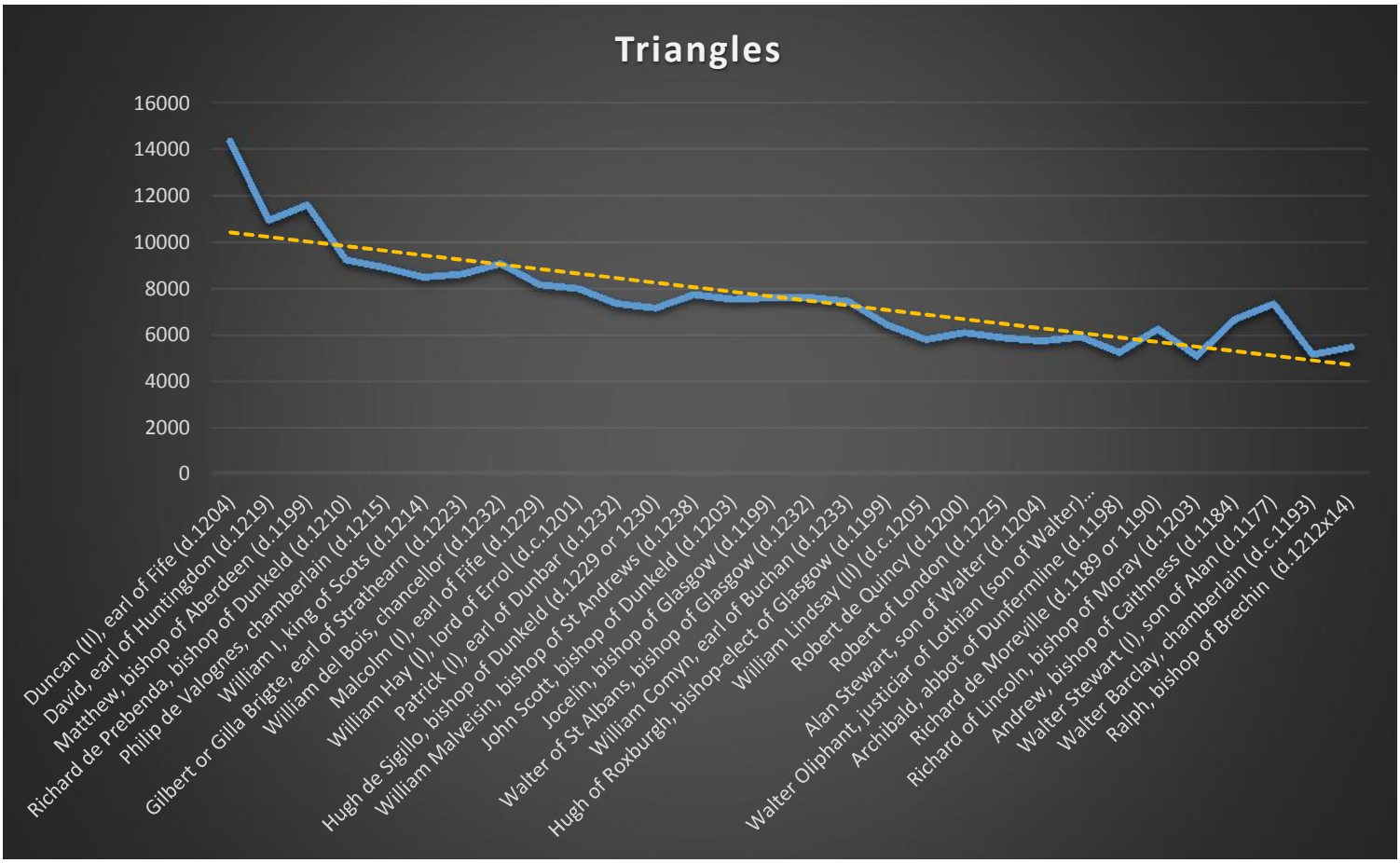
78	Walter de Bidun (d.1178)	0.448021711	44.8	208	83	2.51
3	Walter Stewart (I), son of Alan (d.1177)	0.533774	53.4	316	124	2.548
820	Hugh of Roxburgh, bishop-elect of Glasgow (d.1199)	0.618468	61.8	255	99	2.576
24	William Hay (I), lord of Errol (d.c.1201)	0.70904	71	310	120	2.583
1285	Walter Oliphant, justiciar of Lothian (son of Walter) (d.1242)	0.561028	56.1	327	123	2.659
1281	John Maxwell, chamberlain, sheriff of Roxburgh (d.1241)	0.38726845	38.7	277	98	2.827
13	Duncan (II), earl of Fife (d.1204)	1	100	585	202	2.896
435	William of Bondington, bishop of Glasgow (d.1258)	0.207814025	20.8	188	64	2.94
202	Andrew, bishop of Caithness (d.1184)	0.533907	53.4	260	88	2.955
307	Robert of London (d.1225)	0.593988	59.4	244	82	2.976
1135	David de Bonville, marischal (fl.late 12C-mid13C)	0.437461152	43.7	228	76	3
197	William Lindsay (II) (d.c.1205)	0.599261	59.9	238	78	3.05
1287	Alan, son of Cospatric of Swinton	0.222909947	22.3	236	76	3.11
2	Matthew, bishop of Aberdeen (d.1199)	0.851917	85.1	475	152	3.125
83	David Oliphant (12C)	0.412169227	41.2	185	59	3.14
143	Ingram, bishop of Glasgow (d.1174)	0.462743746	46.3	245	78	3.141
14	Robert de Quincy (d.1200)	0.595883	59.6	231	71	3.25
750	Robert Barclay, brother of Walter	0.485312292	48.5	177	53	3.34
3016	Alexander, chaplain of bishops of St Andrews (12C)	0.335842735	33.6	211	61	3.46
5423	Henry of Prenderguest (I)	0.179690537	18	179	51	3.51
1389	John Hay (I), lord of Naughton (d.xOct.1266)	0.296893256	29.7	234	66	3.55
260	Gilbert or Gilla Brigte, earl of Strathearn (d.1223)	0.744801	74.5	354	97	3.649
782	Malcolm (I), earl of Fife (d.1229)	0.717778	71.2	377	103	3.66
167	William, chaplain (II) of King William (c.1196-1214)	0.34163079	34.2	148	39	3.79
1106	Philip de Mowbray	0.4682436	46.8	224	59	3.8
862	Herbert Scott, master, clerk (fl.1144x59-1172x78)	0.318296419	31.8	191	50	3.82
835	Laurence of Thornton, archdeacon of St Andrews (d.1238x40)	0.299216077	29.9	233	61	3.82
916	Alexander, son of William, sheriff of Stirling	0.452352127	45.2	212	55	3.85
107	Osbert, abbot of Jedburgh (d.1174)	0.43334691	43.3	243	63	3.86
64	Henry of Stirling, son of Earl David	0.21925628	21.9	191	49	3.9
310	William de Moreville (d.1196)	0.421733784	42.2	168	42	4
419	Archibald, abbot of Dunfermline (d.1198)	0.558259	55.8	225	56	4.02
62	Ingram Balliol (d.1239x44)	0.362063061	36.2	204	50	4.08
204	Waltheof, earl of Dunbar (d.1182)	0.385609181	38.6	151	37	4.08

445	Patrick (II), earl of Dunbar (d.1248)	0.352620704	35.3	260	63	4.127
411	Andrew, archdeacon of Lothian (fl.1147x59-1178x84)	0.376716301	37.7	257	62	4.145
142	David, earl of Huntingdon (d.1219)	0.86973	86.9	411	99	4.152
821	Walter of Roxburgh, archdeacon of St Andrews (fl.1165x72-1179x88)	0.306128284	30.6	176	42	4.19
798	Richard de Prebenda, bishop of Dunkeld (d.1210)	0.780663	78.1	347	82	4.232
39	Hugh de Sigillo, bishop of Dunkeld (d.1229 or 1230)	0.687926	68.8	303	71	4.268
17	John (I) Hastings, sheriff (12/13C)	0.413108816	41.3	163	38	4.29
832	William de Valognes (d.1219)	0.335410736	33.5	155	36	4.31
2971	Peter, chaplain and clerk of Bishop Malveisin	0.212164792	21.2	178	40	4.45
2491	Stephen of Lilliesleaf, master, clerk, persona	0.245203703	24.5	179	40	4.475
746	Walter Oliphant, elder	0.405027041	40.5	151	33	4.58
149	Gregory, bishop of Dunkeld (d.1169)	0.375538766	37.6	174	38	4.58
400	Alan Stewart, son of Walter (d.1204)	0.56372	56.4	262	57	4.596
745	Jocelin, bishop of Glasgow (d.1199)	0.672786	67.2	356	76	4.68
5323	Elias of Prenderguest	0.145823076	14.6	187	40	4.68
271	Robert, son of Saewulf, bishop's chancellor	0.316852129	31.7	183	39	4.69
444	Patrick (I), earl of Dunbar (d.1232)	0.689286	68.9	343	73	4.699
4	Ness, son of William, lord of Leuchars (d.1178x83)	0.430000076	43	207	44	4.7
2115	Walter Lindsay (III), son of William (II) (d.c.1222)	0.470907523	47.1	293	62	4.726
781	Richard of Lincoln, bishop of Moray (d.1203)	0.542227514	54.2	208	44	4.73
797	Robert, archdeacon of Glasgow (d.1222)	0.486549605	48.7	233	52	4.81
165	Aiulf, dean of Lothian (fl.1150/51-1186)	0.345666973	34.6	238	49	4.86
9	William Gifford, son of Hugh Gifford, lord of Yester	0.372937394	37.3	167	34	4.912
35	Roger de Mortimer (d.1217x27)	0.446832707	44.7	192	39	4.92
89	John, abbot of Kelso (d.1180)	0.439256712	43.9	220	44	5
850	John Scott, bishop of Dunkeld (d.1203)	0.675865	67.6	337	67	5.03
114	Richard Comyn (d.c.1179)	0.445498207		173	34	5.09
91	Geoffrey, abbot of Dunfermline (d.1178)	0.377870376	37.8	173	34	5.09
1394	John of London (?d.a.1190)	0.367151062	36.7	118	23	5.13
31	Hugh Gifford, lord of Yester	0.440500472	44.1	216	42	5.14
145	Hugh Ridel (I)	0.376180471	37.6	140	27	5.19
275	Alexander de St Martin, sheriff	0.394754866	39.5	208	40	5.2
140	Herbert, bishop of Glasgow (d.1164)	0.331635072	33.2	205	39	5.26

866	Simon, archdeacon of Glasgow (fl.1165x74-1195x96)	0.499410123	49.9	286	54	5.296
238	Malcolm, earl of Atholl (d.c.1197)	0.448488446	44.8	155	23	5.3
184	William de Somerville (I)	0.361642492	36.2	208	39	5.33
841	Malise, son of Ferteth earl of Strathearn (d.a.1214)	0.417147082	41.7	203	38	5.34
144	Gilbert de Umfraville (fl.c.1140-90)	0.35136342	35.1	162	30	5.4
854	Gervase Avenel, lord of Eskdale (d.1219)	0.492231239	49.2	226	40	5.65
134	Richard, bishop of St Andrews (d.1178)	0.418886308	41.9	209	37	5.65
40	William Malveisin, bishop of St Andrews (d.1238)	0.682593	68.3	379	67	5.66
858	Walter of St Albans, bishop of Glasgow (d.1232)	0.671745	67.1	380	66	5.76
66	David Hay, lord of Errol (d.1237x41)	0.501202323	50.1	256	44	5.818
106	Alured, abbot of Cambuskenneth (fl.1152x53-1172x78)	0.339752903	34	146	25	5.84
889	Adam of Ceres, knight (fl.1154x1200)	0.366125114	36.6	183	31	5.9
788	Andrew Murray, bishop of Moray (d.1242)	0.341394876	34.1	273	46	5.935
474	Guy, abbot of Lindores (d.1219)	0.438421886	43.8	202	34	5.94
185	Geoffrey (I) Melville	0.463538289	46.4	193	32	6.03
829	Ranulf de Wat, archdeacon of St Andrews (d.1209)	0.516129191	51.6	277	45	6.156
1969	William of Ednam, master, archdeacon of Dunkeld (d.1251x57)	0.181070207	18.1	183	29	6.31
110	Gilla Brigte, earl of Angus (d.x1189)	0.482444182	48.2	179	28	6.39
485	Jocelin, archdeacon of Dunkeld (fl.1165x67-1193/4)	0.392370474	39.2	148	23	6.43
481	Herbert, dean of Glasgow (fl.1179x89-1204x07)	0.328105853	32.8	207	32	6.47
926	Elias of Partick, clerk, canon (son of Fulbert)	0.281506857	28.2	188	29	6.48
298	Walter Corbet	0.367528779	36.8	169	26	6.5
2762	Henry, archdeacon of Dunkeld (fl.1183x1203-1220x25)	0.141416556	14.1	175	26	6.73
905	David Lindsay (I), son of William (II) (d.c.1220)	0.387199089	38.7	155	23	6.74
234	Robert II, abbot of Scone (d.1186)	0.351338028	35.1	128	19	6.74
863	Isaac Scott, master, clerk	0.363677435	36.4	187	28	6.79
478	Henry, abbot of Arbroath (fl.1179-1207)	0.49049068	49	219	32	6.84
770	William of Hailes, master, dean of St Andrews (fl.1189x98)	0.345437241	34.5	137	20	6.85
3149	Patrick, son of Adam son of Aldan the steward	0.299858994	30	222	32	6.94
873	Hugh, king's clerk (TRW)	0.353957221	35.4	139	20	6.95
2754	Walter, clerk of Bishops Ingram and Jocelin	0.34459047	34.4	165	23	7.17

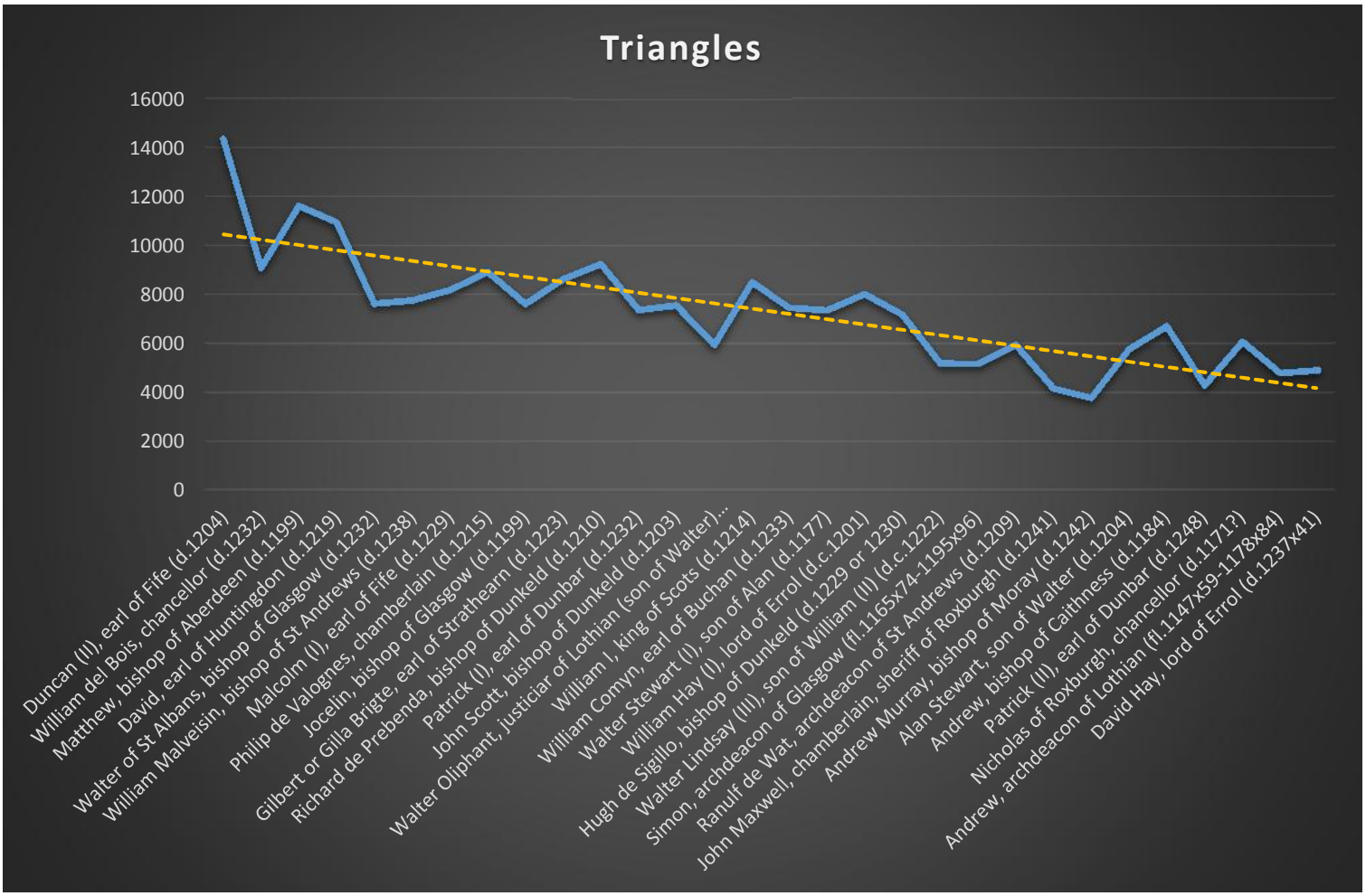
776	John of Huntingdon, master, official of Glasgow (fl.1179x1208)	0.351003034	35.1	251	35	7.171
1719	William Lindsay (I)	0.300258701	30	174	24	7.25
1204	Gilbert of Stirling, bishop of Aberdeen (d.1239)	0.339442338	33.9	168	23	7.3
965	Thomas Colville 'Scot', lord of Keresban (d.1219)	0.362518493	36.3	180	24	7.5
1	William I, king of Scots (d.1214)	0.752247	75.2	323	43	7.512
1231	Philip Colville	0.348676236	34.9	128	17	7.53
226	Merleswain, son of Colban, lord of Kennoway (fl.1150s-90s)	0.383688775	38.4	187	24	7.79
493	John of Leicester, bishop of Dunkeld (d.1214)	0.455544852	45.6	241	30	8.03
774	Hugh, abbot of Newbattle (fl.1179-1201)	0.379720708	38	133	15	8.67
809	Ralph, bishop of Brechin (d.1212x14)	0.526366	52.6	226	26	8.69
794	William, abbot of Holyrood (II) (fl.1187x89-1206)	0.400162824	40	152	17	8.94
817	Roger, bishop of St Andrews (d.1202)	0.372158755	37.2	139	15	9.27
16019	Robert Crook, knight (12C)	0.32132297	32.1	187	20	9.35
256	Walter, prior of St Andrews (fl.1160-1198x99)	0.359307178	35.9	160	17	9.41
414	Andrew, dean of Lothian/Tyninghame (fl.1194-1214)	0.277652684	27.8	182	19	9.58
500	Osbert, abbot of Kelso (d.1203)	0.520762736	52.1	215	22	9.77
10	Reginald, bishop of Ross (d.1213)	0.342161085	34.2	102	9	11.3
1326	Duncan, son of Earl Duncan (II) of Fife	0.282567852	28.3	182	16	11.375

Figure 4.40: Top 30 actors by eigenvector centrality, number of triangles



One final method to keep in mind for contextualising the centrality of key actors in the network is through the number of triangles in which each person appears. The concept of the group of three is very important in social network analysis: homophily suggests that the friend (or 'contact') of my friend is also likely to be, or to become, a friend. The more triangles one is part of, the more embedded he is in the network and the more likely his connections are to be meaningful. Figures 4.40 and 4.41 show numbers of triangles for the top thirty individuals, first by eigenvector, then by degree. While there is a general tendency for the lower a person's centrality, the lesser the number of triangles, we can also see that there is a fair amount of variation among individuals. Eigenvector seems to track more closely with the number of triangles in one's network than degree.

Figure 4.41: Top 30 actors by degree centrality, number of triangles



References

Prell, Christina (2012), Social Network Analysis: history, theory and methodology