

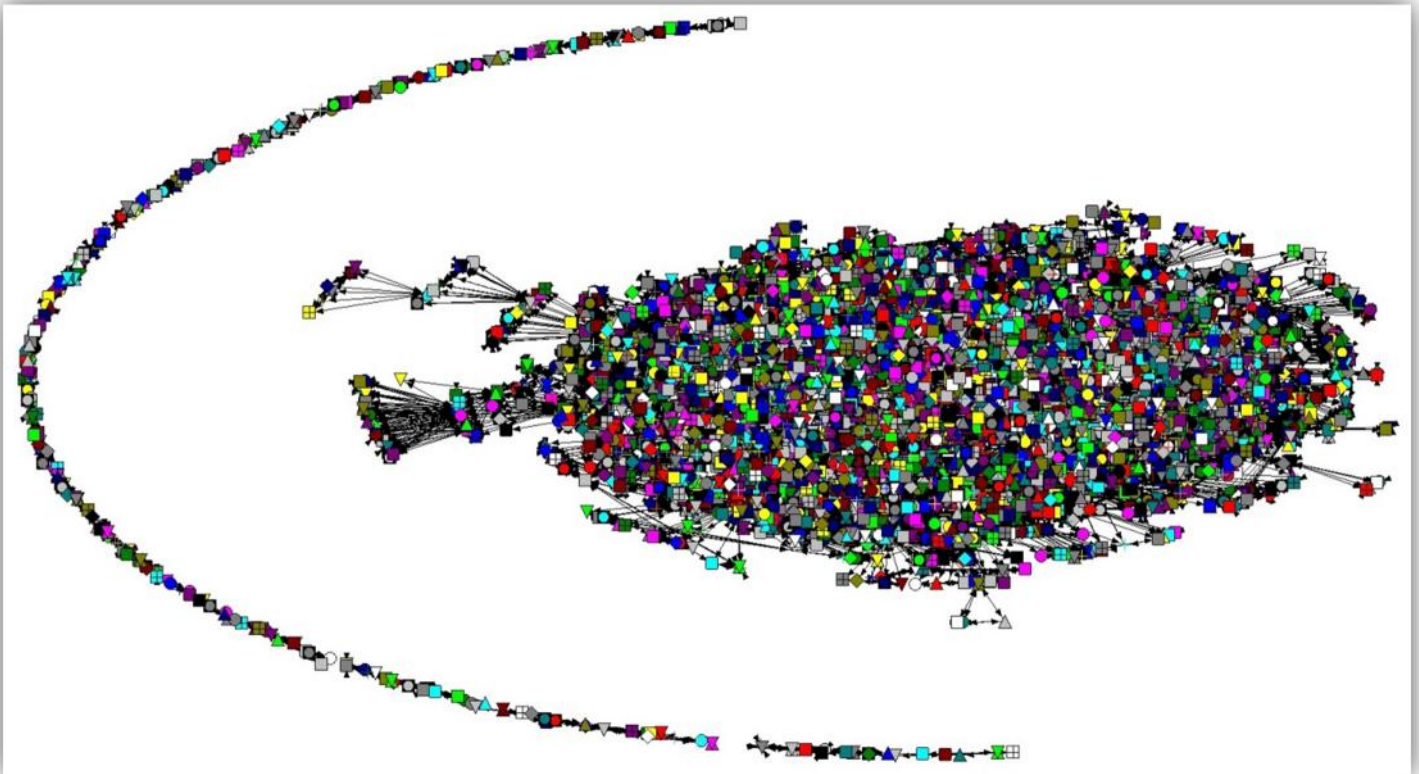
4 CO-WITNESSING NETWORKS: ALL WITNESSES

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 ¹	1519	41.9%
Confirmations	710	19.6%
Renewals	492	13.6%
Quitclaim & Resignation ²	245	6.8%
Concessions ³	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 ⁴	33	<1%
Inspection	25	<1%
Obligation	23	<1%
Institution & ordination of vicarage	10	<1%
Lease / wadset	6	<1%
Other/ misc.	26	<1%

¹ Plus one infertment and three gifts (agreement)

² And renunciations of claim

³ Including concession (agreements) the following follow same pattern

⁴ 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

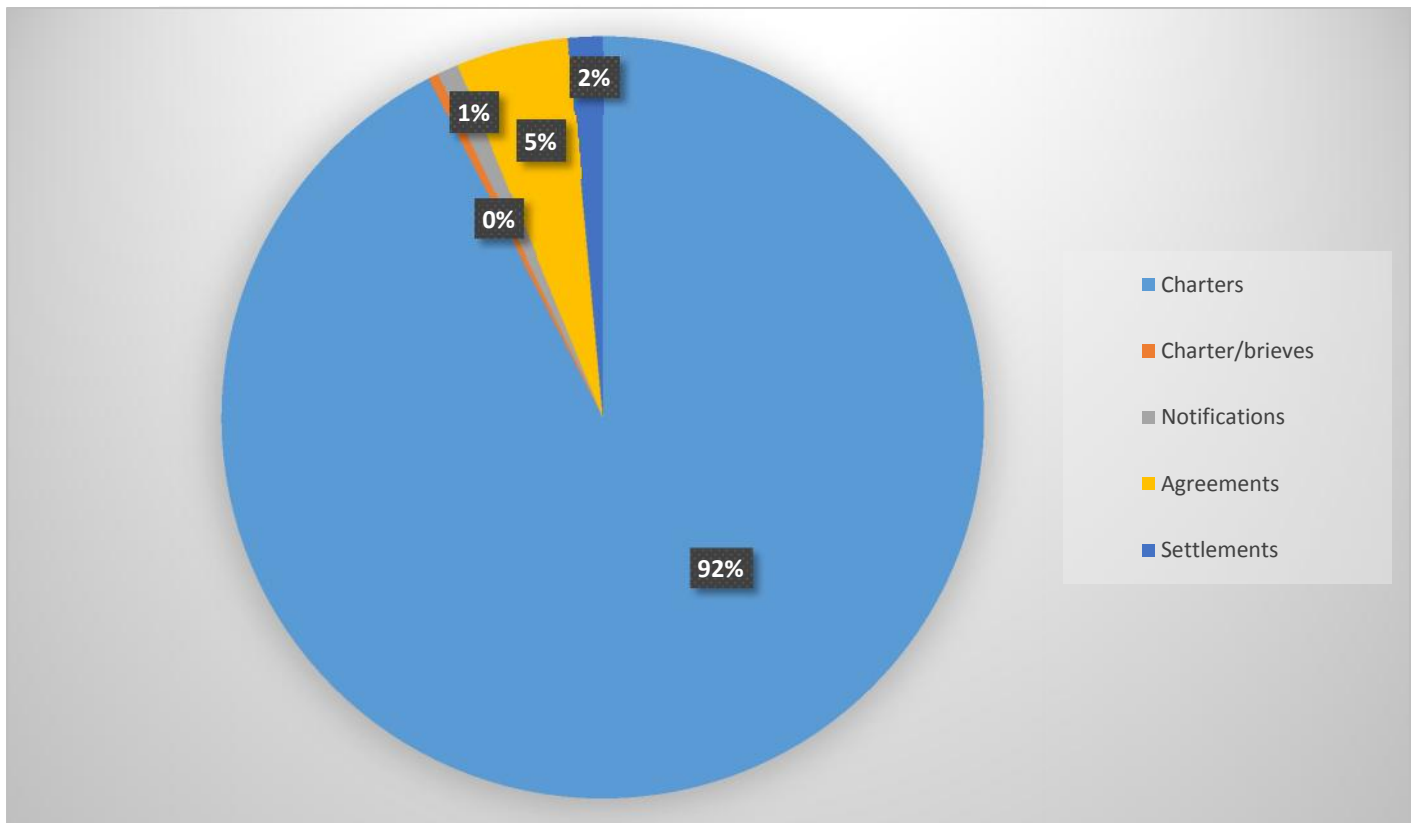


Figure 4.3. Witnesses by gender

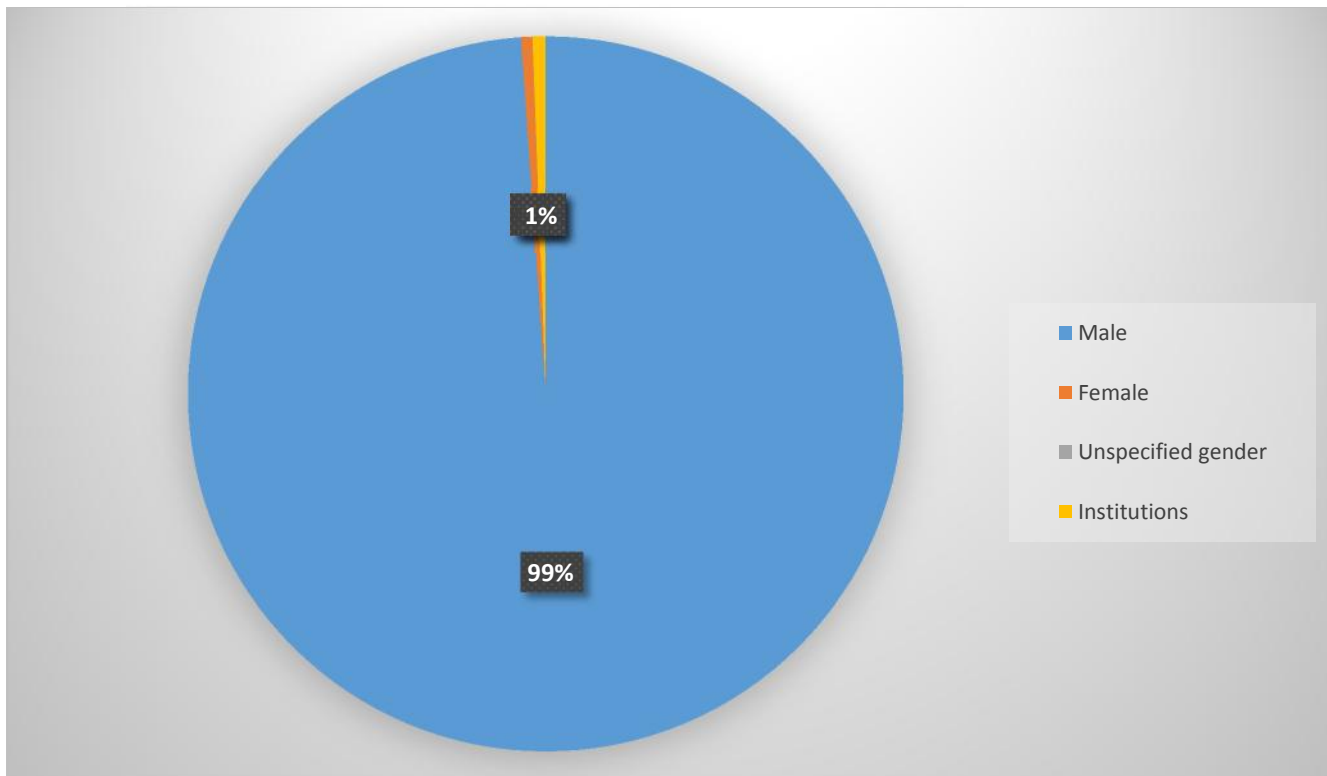


Table 4.6: Female witnesses

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)

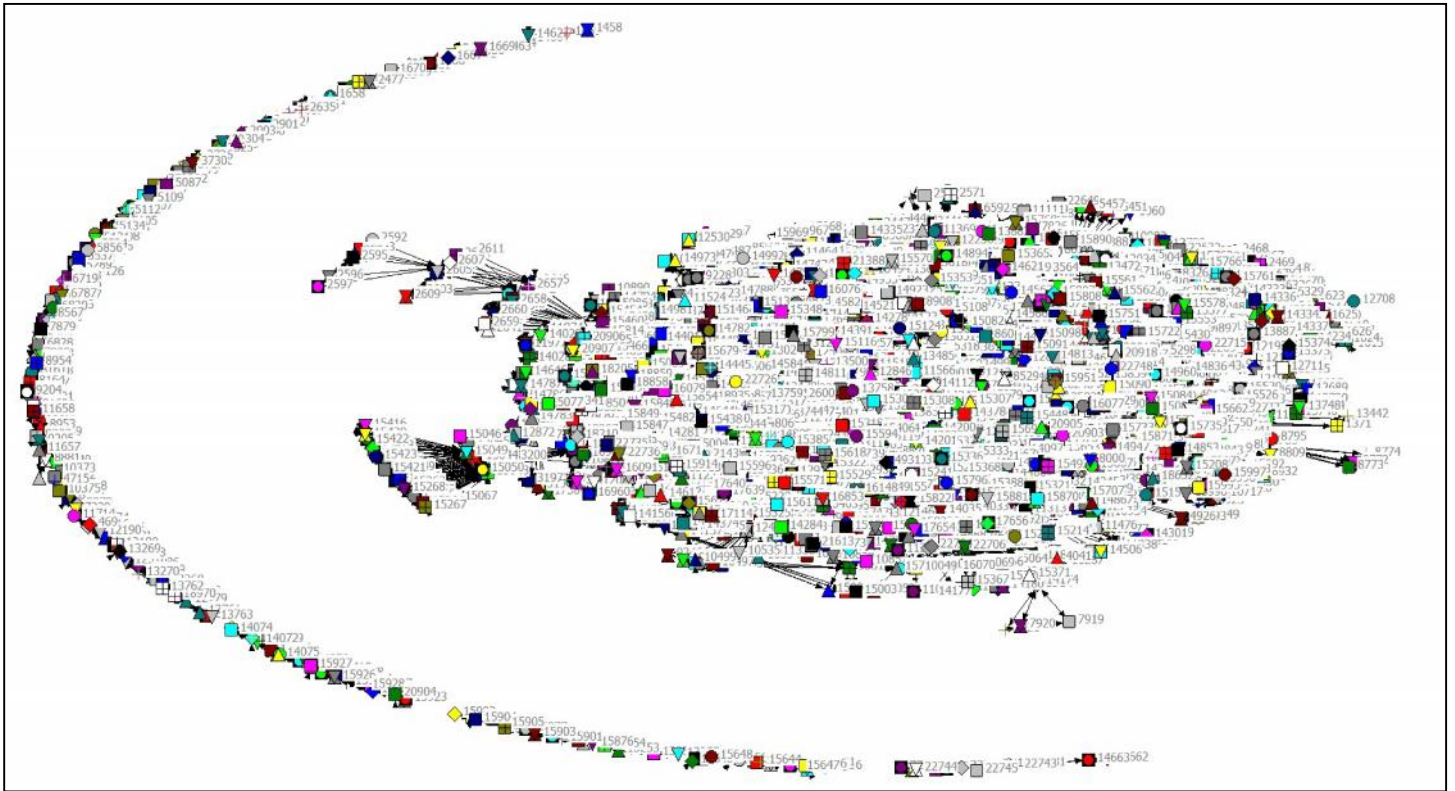


Figure 4.5. All witnesses, specified document types: Gephi (Yifan Hu)

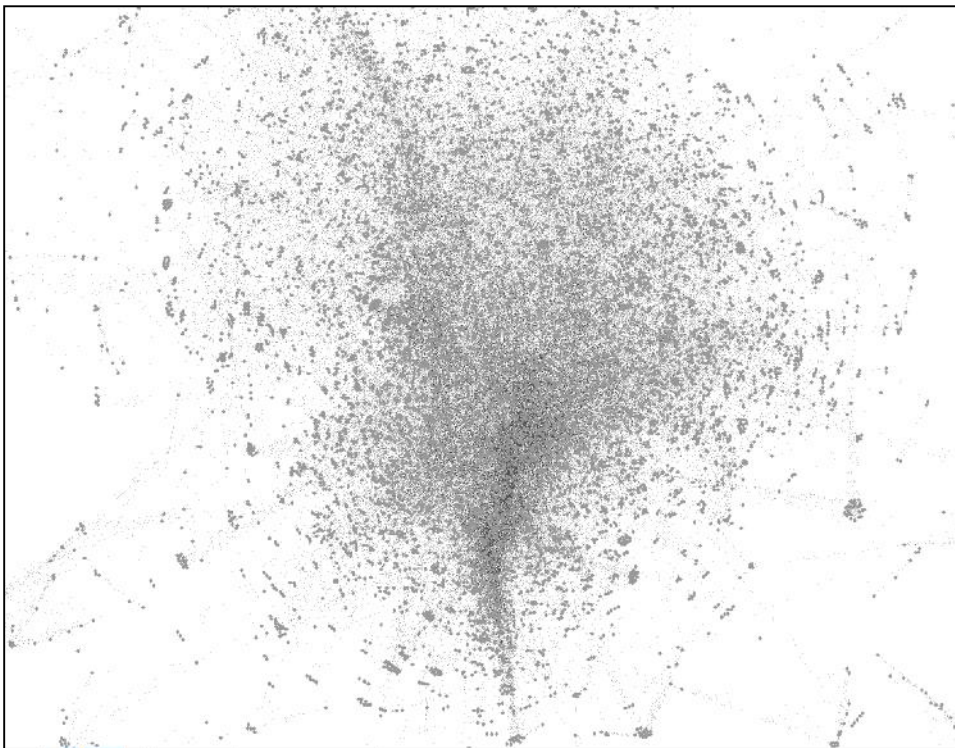
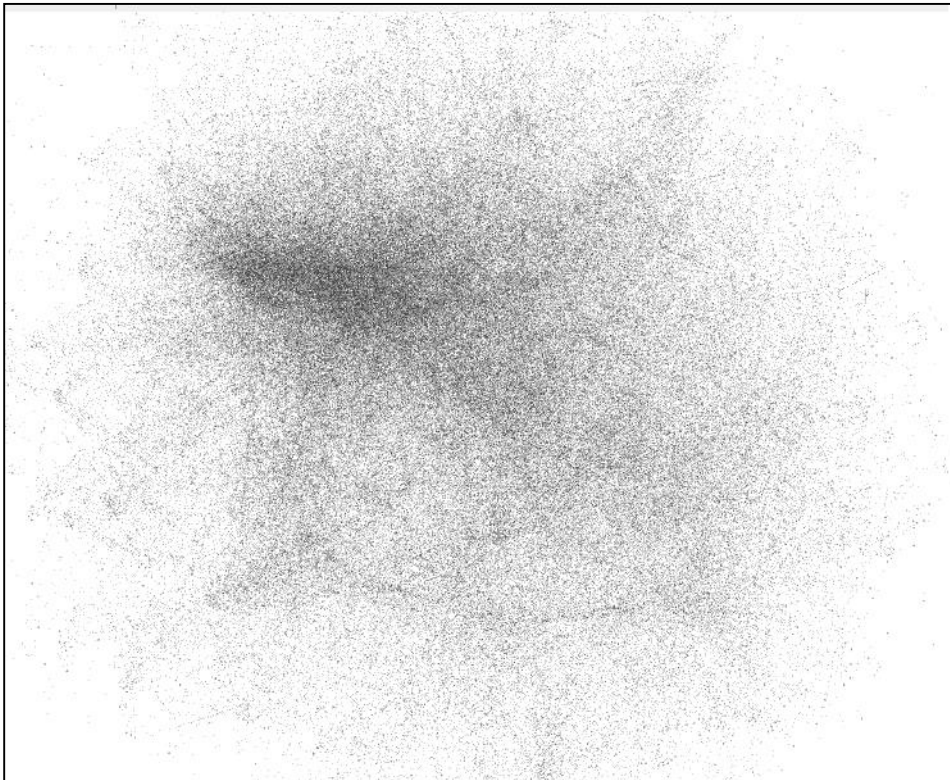


Figure 4.6. All witnesses, specified document types: Gephi (Fruchtermann Reingold)

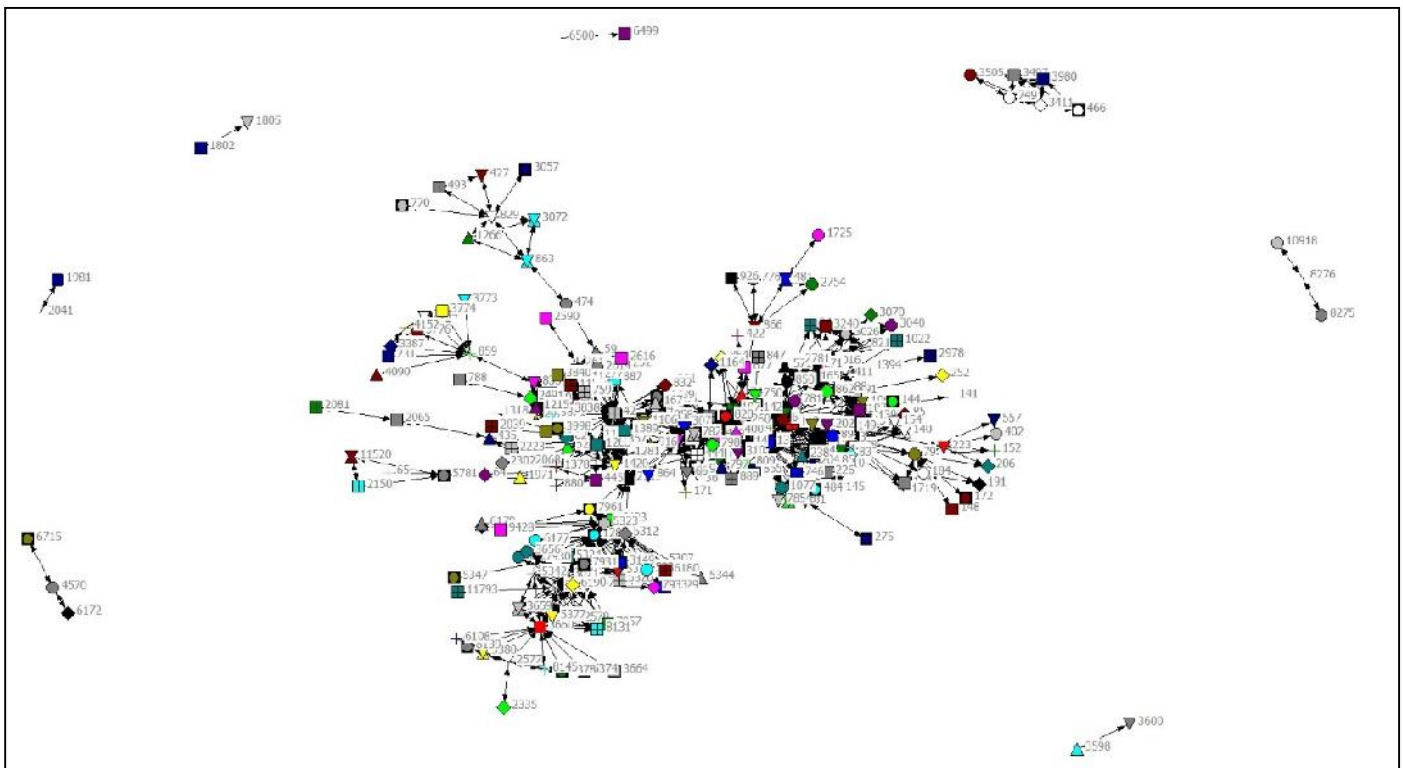


The dataset used for producing these scattershot images of all the witnesses in the five specified document types is useful for creating many of the statistics we will return to later, including lists of the most central people among witnesses and the densities of ego-networks, but as far as useable graphs go, in terms of examining patterns of co-witnesses, it is necessary to raise the threshold of how many times individuals witness 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)

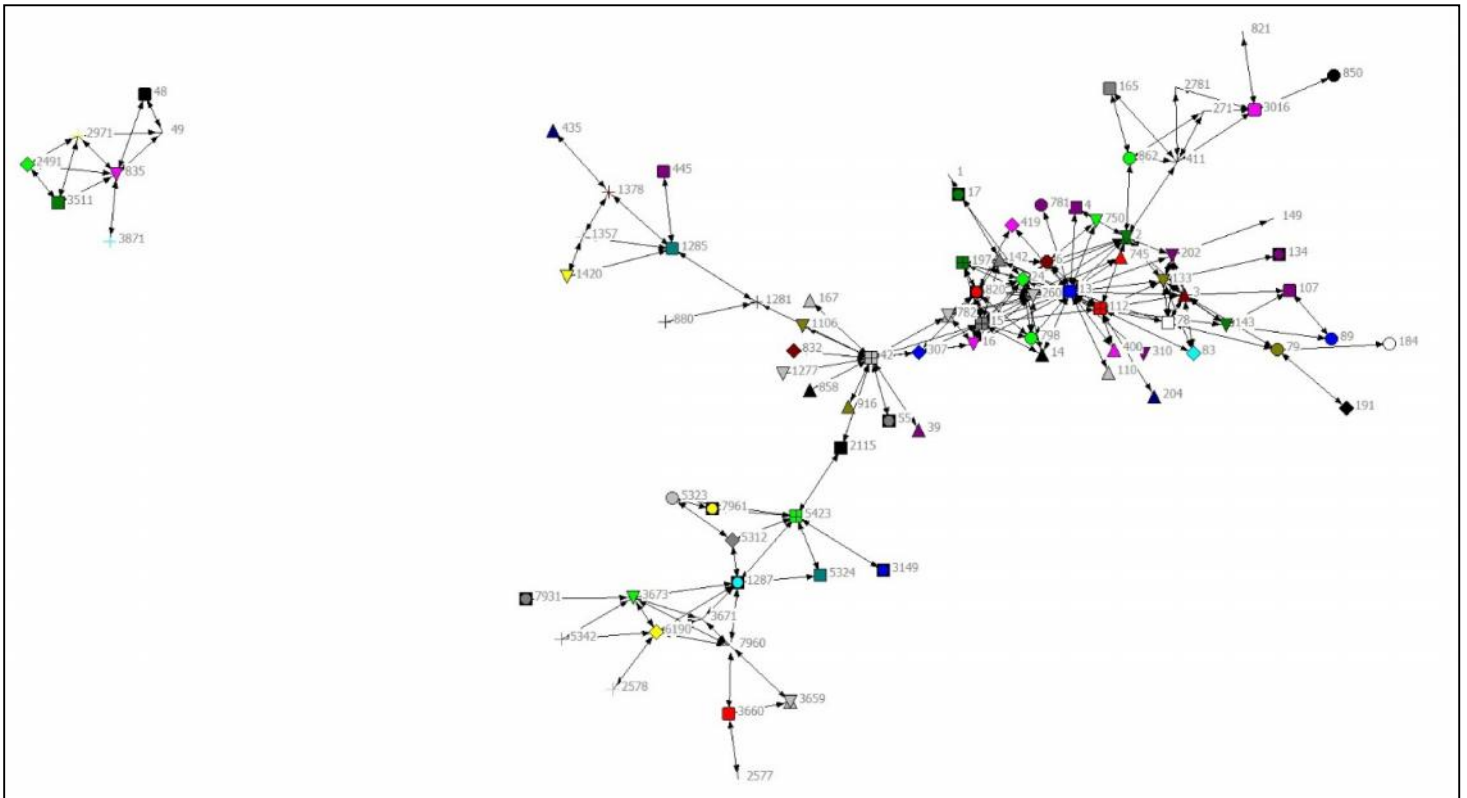
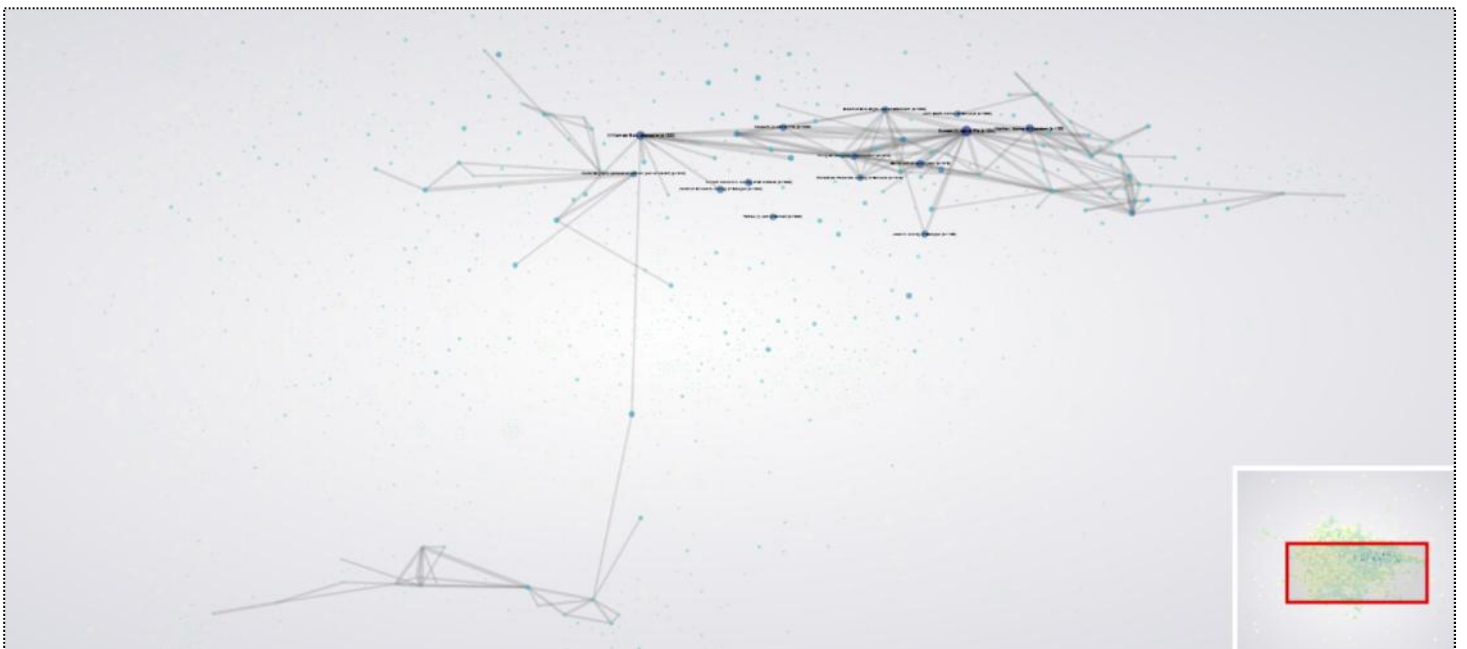


Figure 4.9. All witnesses: more than twenty instances (Gephi)



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

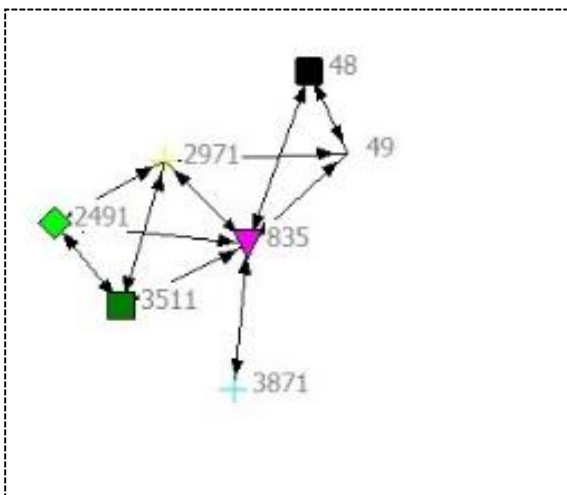
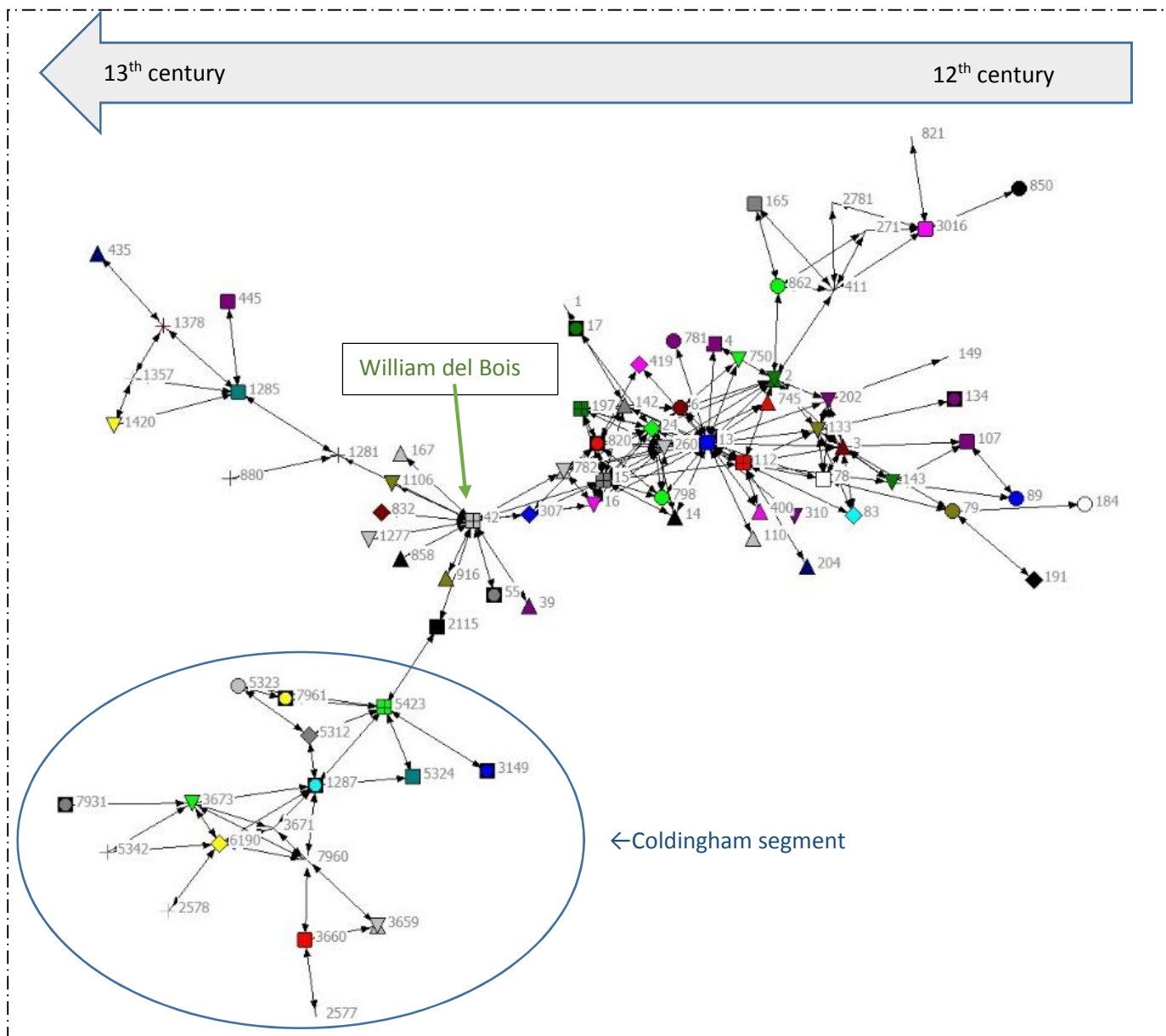


Table 4.7. People in the detached early 13th-century St Andrews segment

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 (& <i>magister</i>)	4	1
3511	Michael, master, clerk, chaplain (fl.1201-1220x25) (St Andrews)	3	0
2491	Stephen of Lilliesleaf, master, clerk, <i>persona</i> (& 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

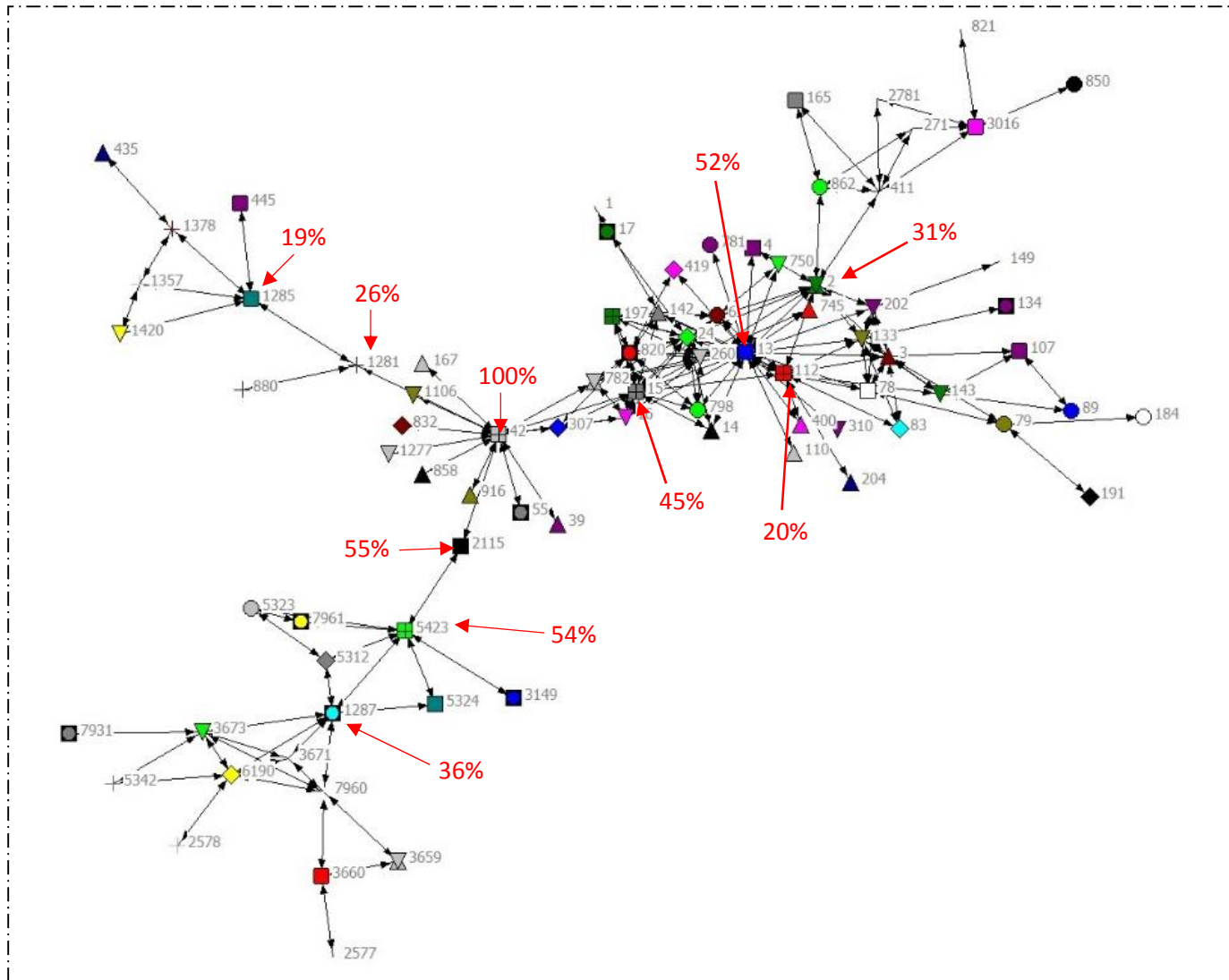


There are 82 people in the main segment of the sociogram of more than 20 co-witnessing acts. There are three main stems of this graph, with Person no. 42 acting as the connector for these three stems. For this reason, William del Bois, king's chancellor (d. 1232) has the highest betweenness centrality 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, Prendergust, 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 Prendergust (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 Prendergust (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.

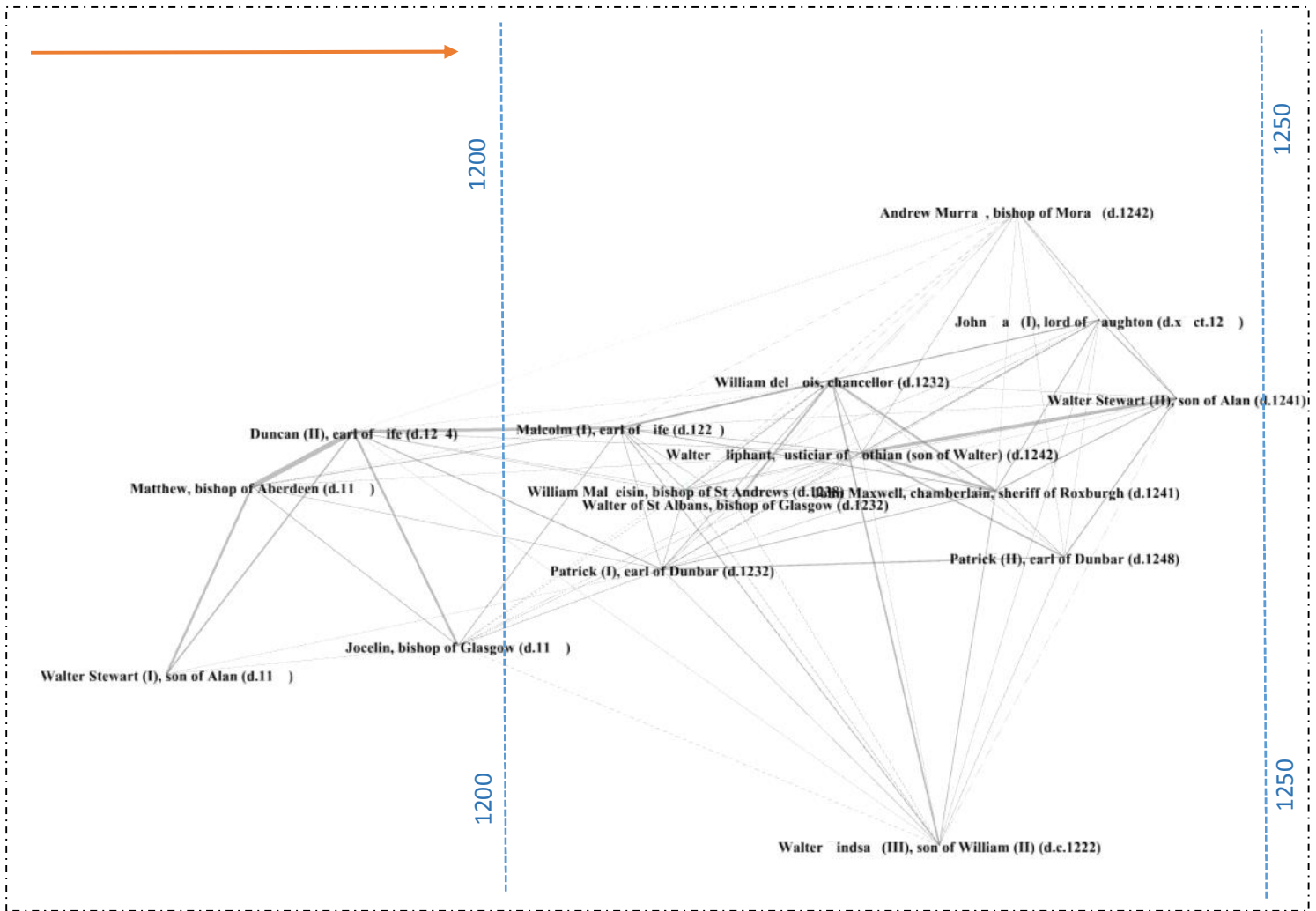
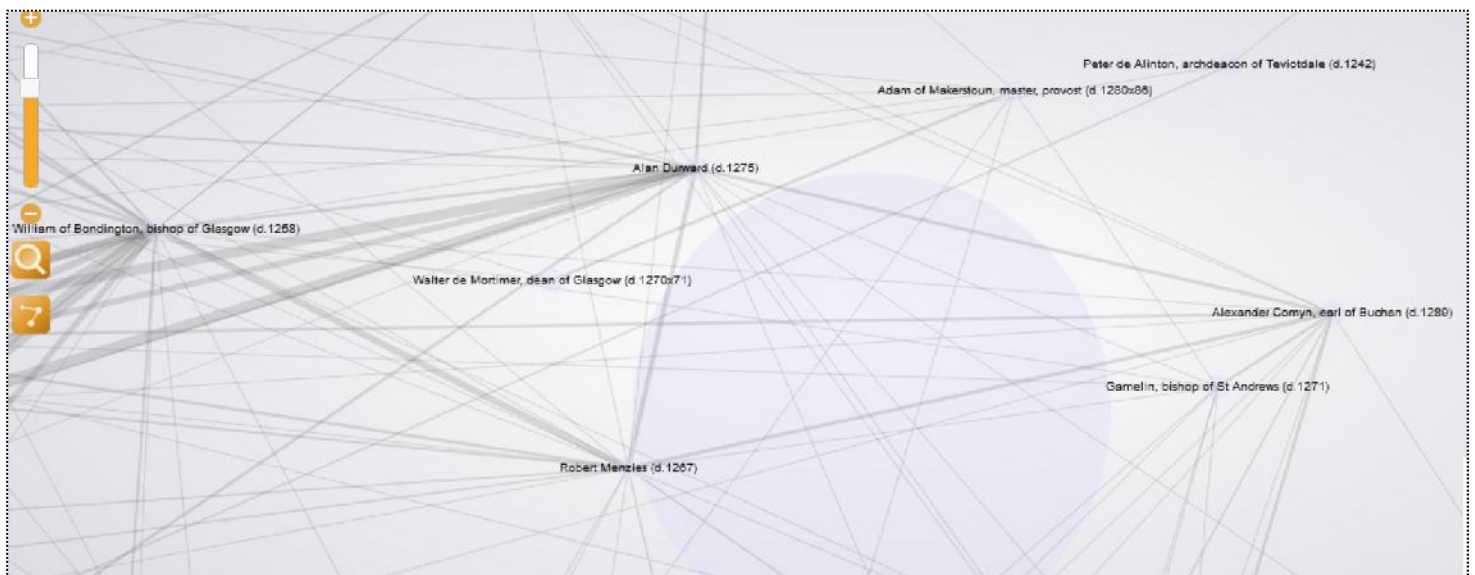


Figure 4.14. Witnesses with betweenness over 250K, close-up on time of Alexander III



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

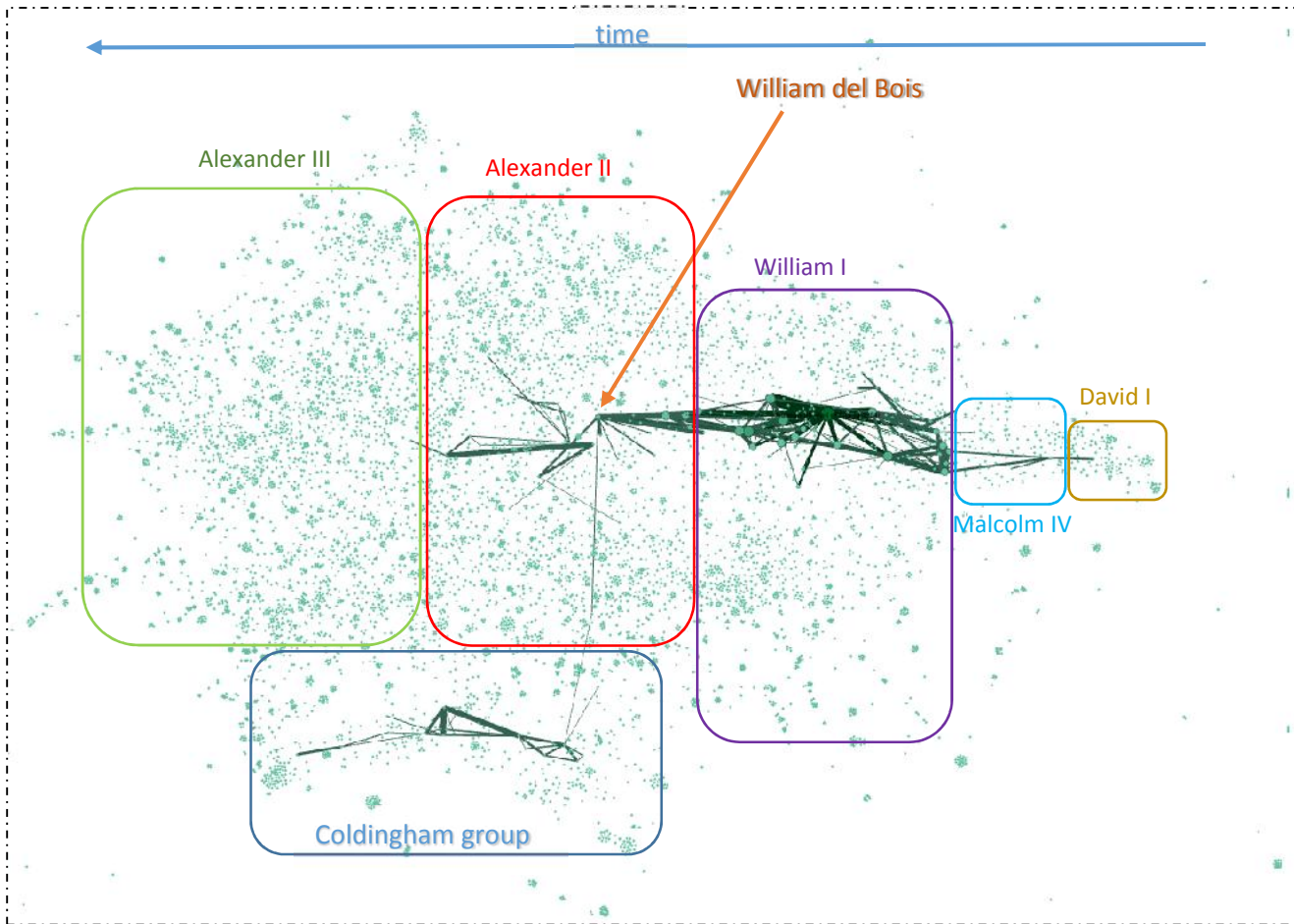
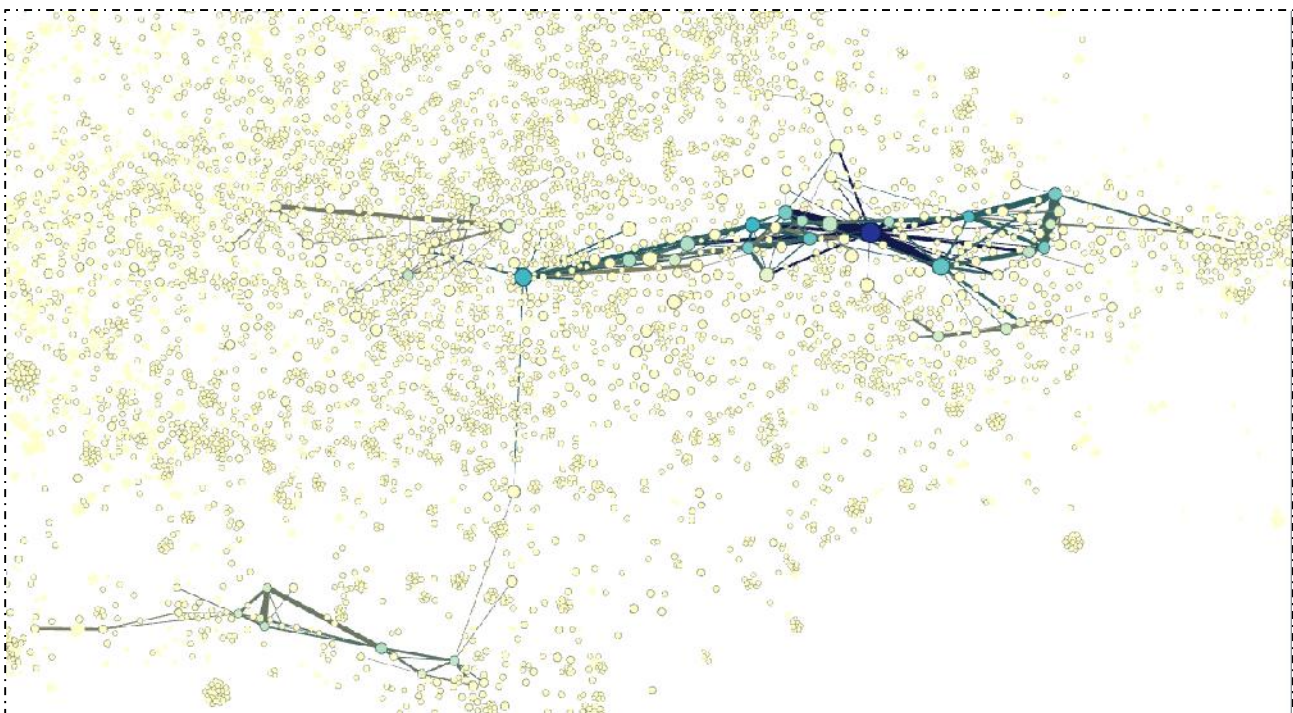


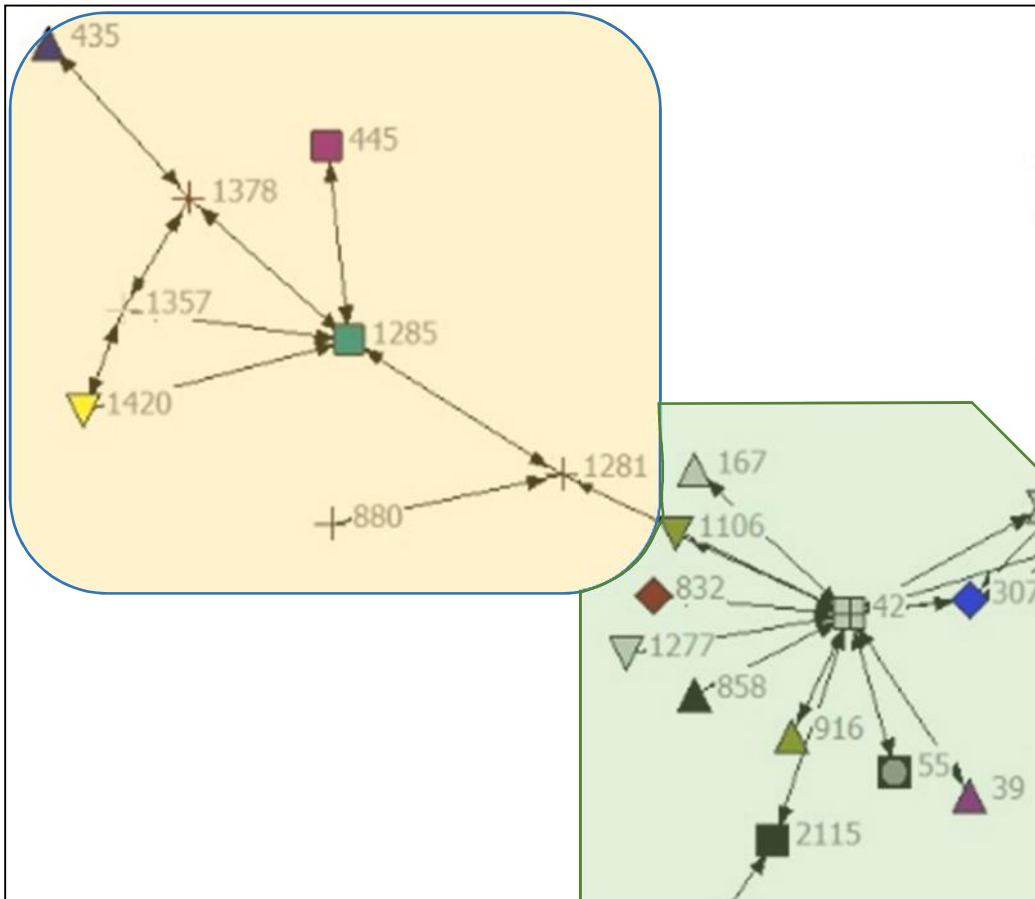
Figure 4.16. All witnesses, with connections of more than 20 shown



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 [III], 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

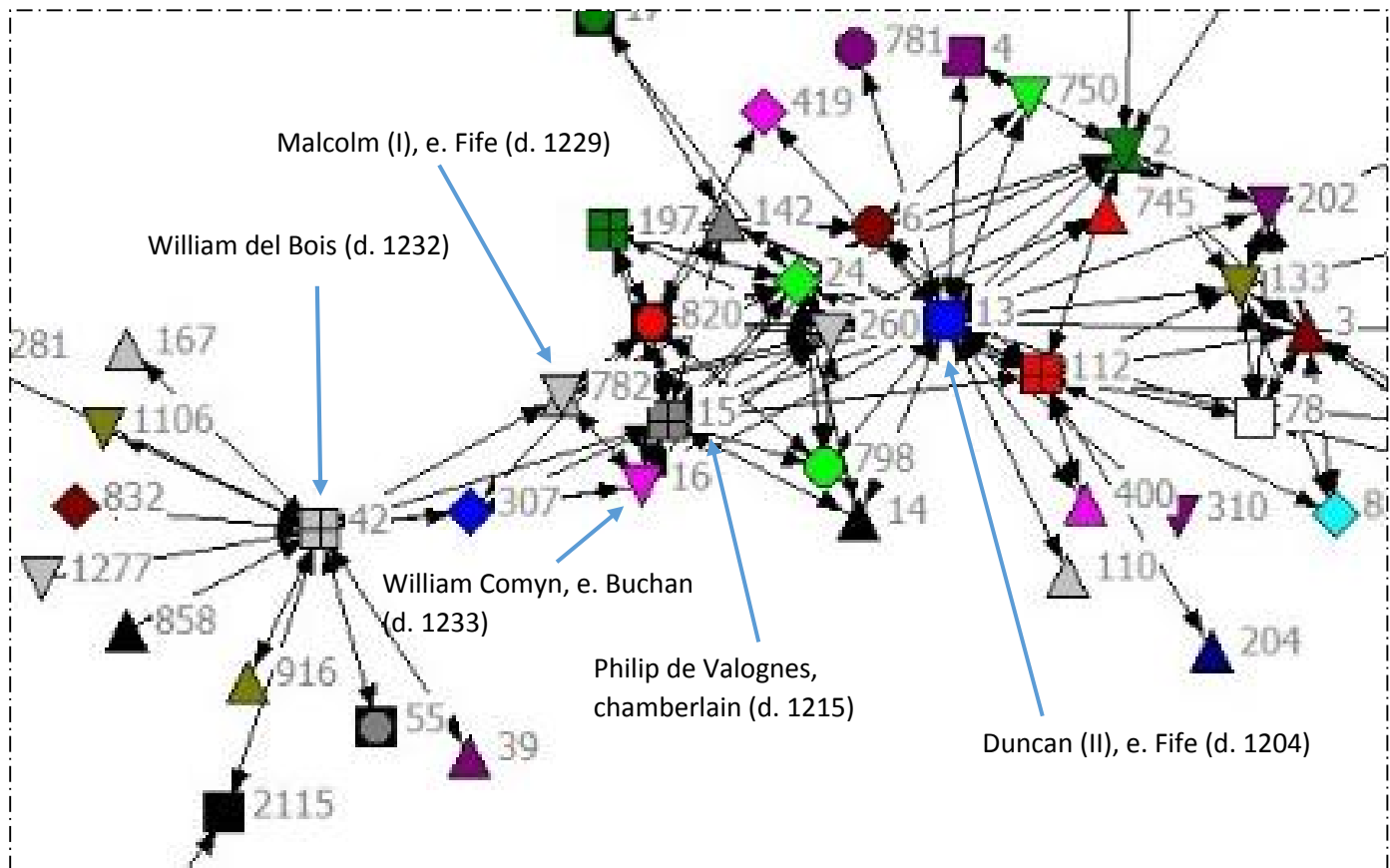
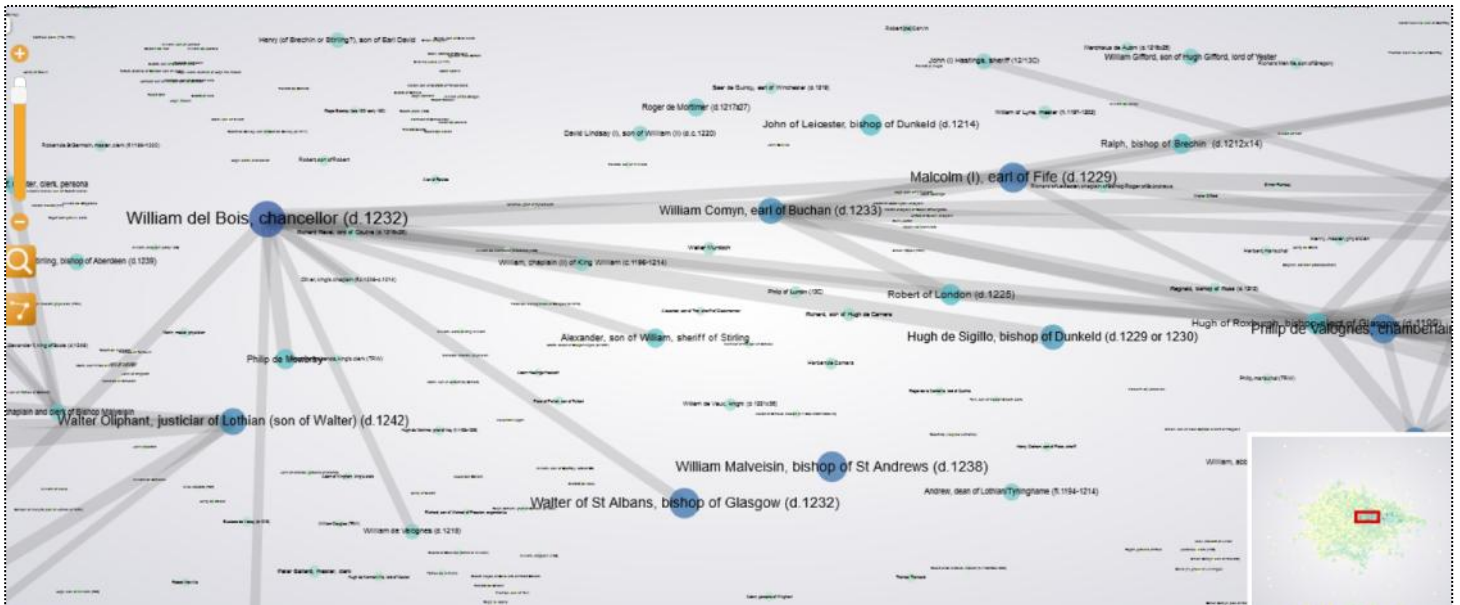


Figure 4.19. Gephi, all witnesses, >20, early thirteenth century



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

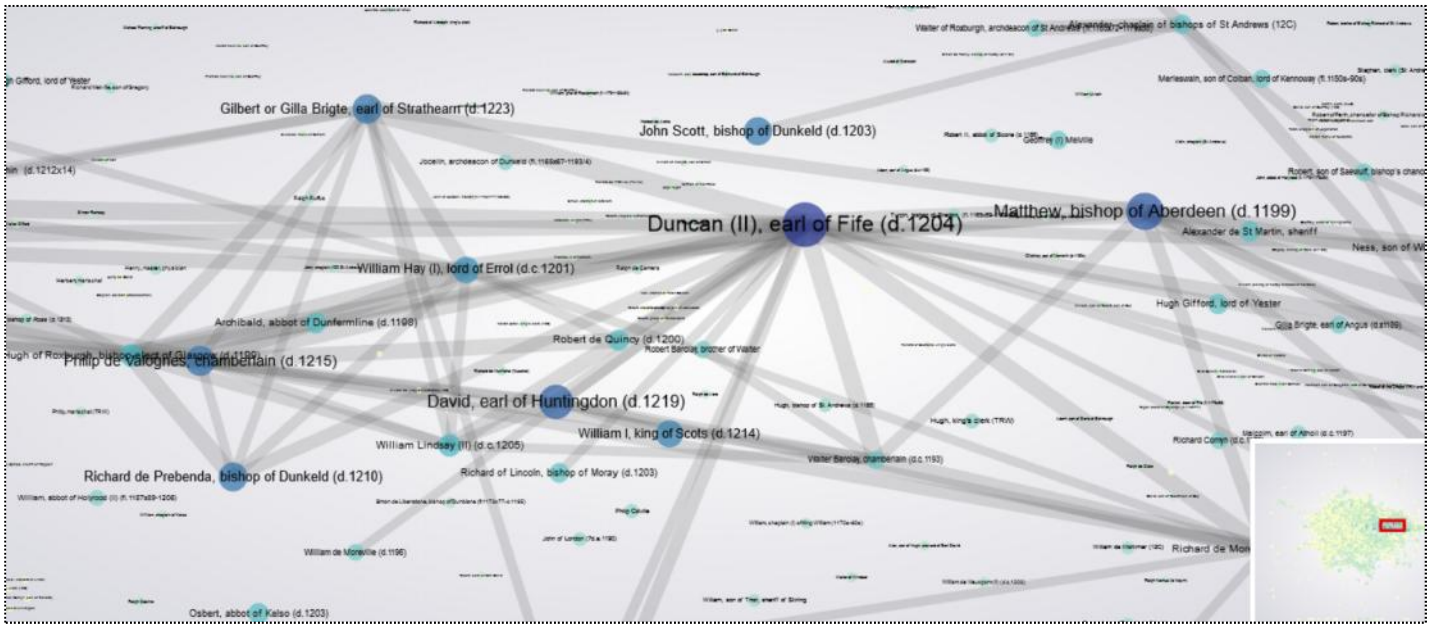
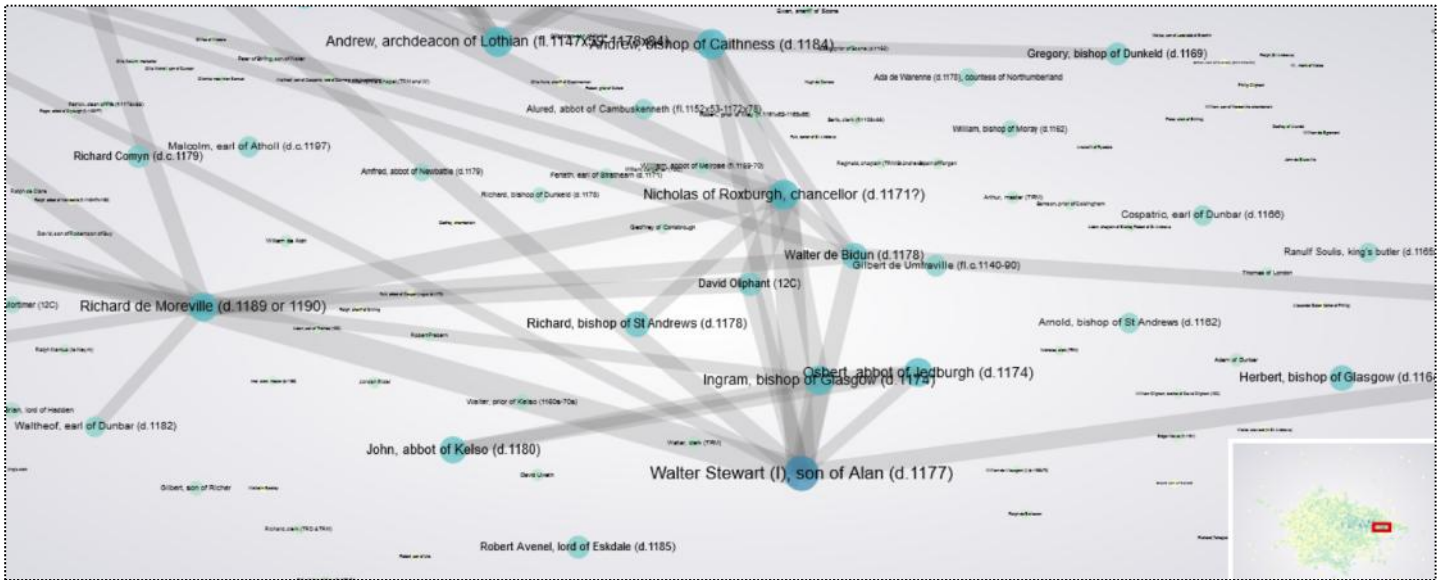


Figure 4.21. Gephi, all witnesses, >20, ca 1180



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

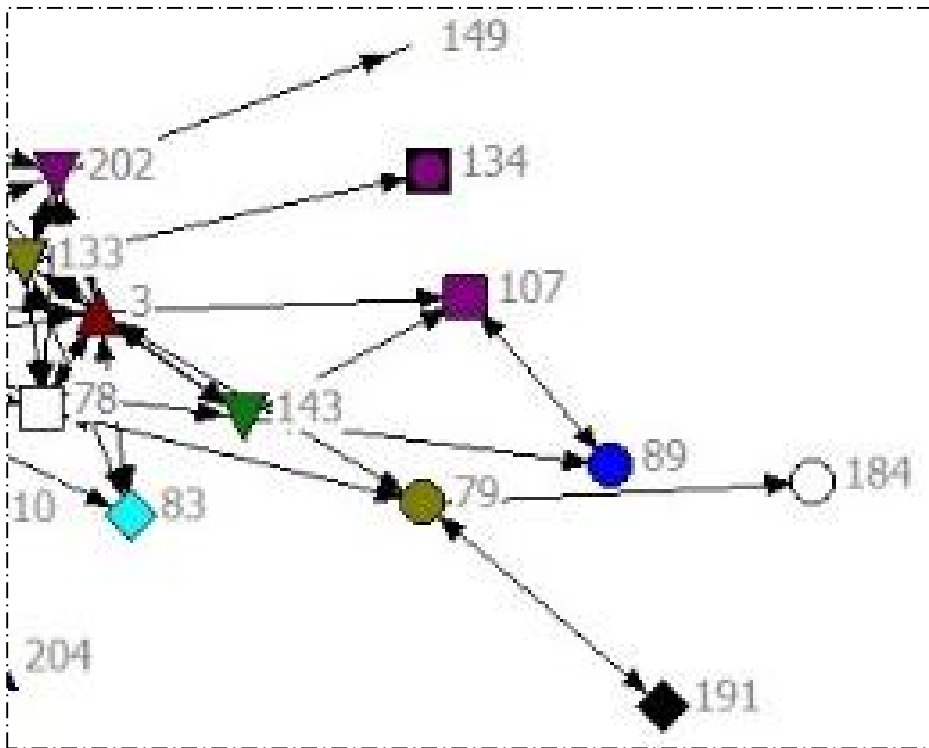


Figure 4.23. Gephi, all witnesses, >20, mid-twelfth century

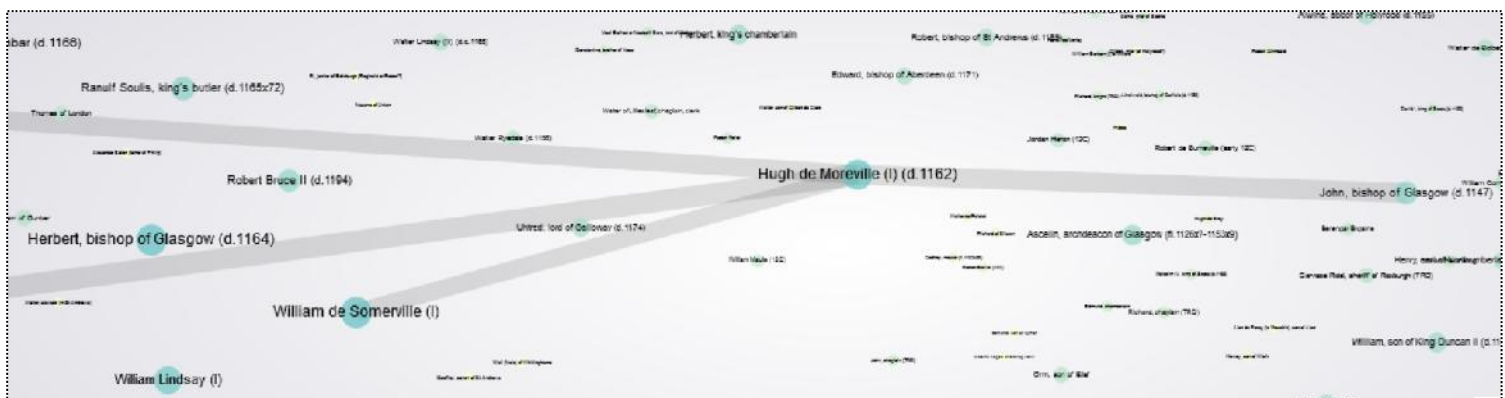
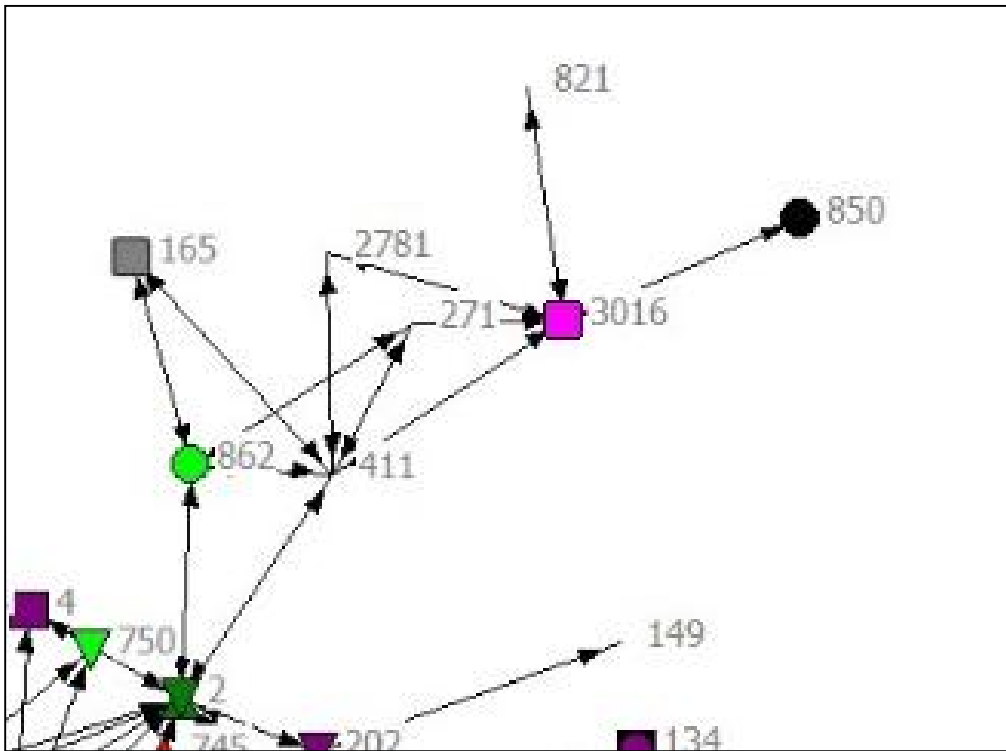


Figure 4.24. Netdraw, all witnesses, >20, twelfth-century ecclesiastics



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

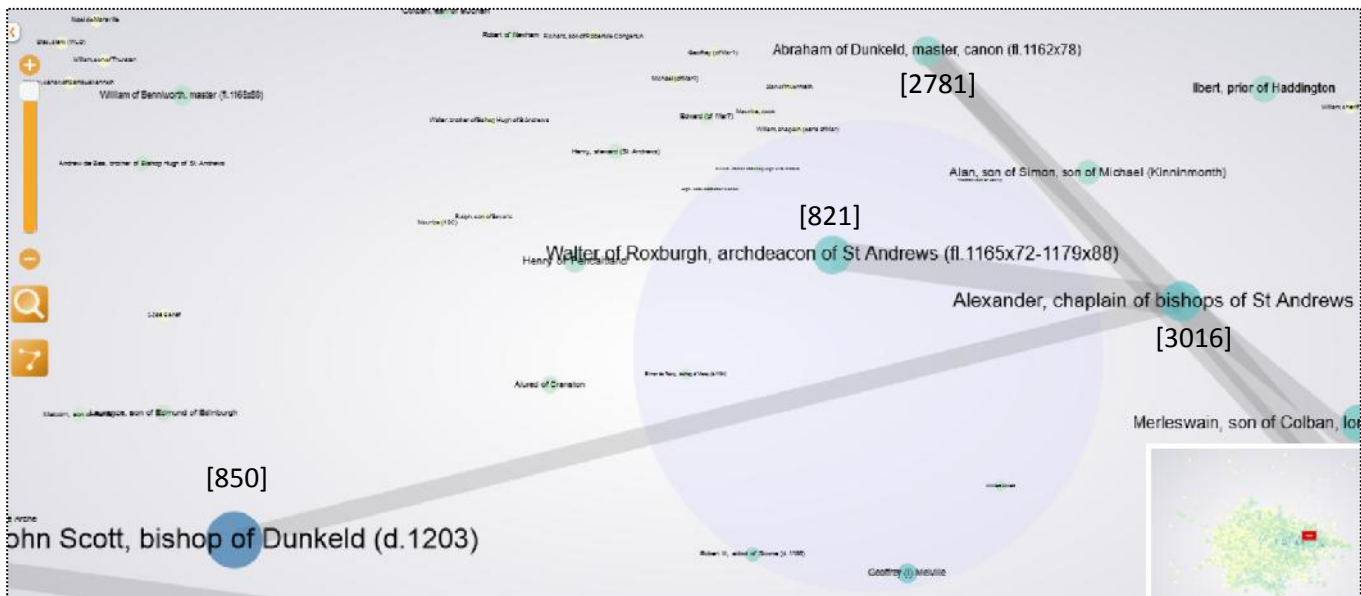


Table 4.10. People in main segment, more than 20 co-witnessing (ordered by degree)

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 Brigitte, 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
<i>Henry of Prendergust (I)</i>	5423	7	1074.5	0.04167	0.001
<i>Alan, son of Cospatric of Swinton</i>	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
<i>Robert, son of Gregory steward of Coldingham</i>	7960	6	234	0.048993	0
<i>Adam of Prenderquest</i>	6190	6	118.5	0.04832	0
<i>William of Mordington</i>	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
<i>Bertram of Little Reston (son of Adam of Little Reston)</i>	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
<i>Elias of Prenderquest</i>	5323	3	0.5	0.019271	0
<i>Adam of Little Reston</i>	5312	3	5.5	0.026297	0
<i>Gilbert of Lumsdaine</i>	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
<i>Gregory of Coldingham, steward</i>	7961	2	0	0.014304	0
<i>Thomas of Nisbet</i>	5342	2	0	0.020045	0
<i>William of Lumsdaine</i>	5324	2	0	0.021332	0
<i>David of Lumsdaine</i>	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
<i>John, son of Elias of Ayton</i>	7931	1	0	0.010023	0
<i>Patrick, son of Adam son of Aldan the steward</i>	3149	1	0	0.009338	0
<i>William of Scremerston, knight</i>	2578	1	0	0.010023	0
<i>Henry of Prendergust (II) knight</i>	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	<i>William of Mordington</i>	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 individuals 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.

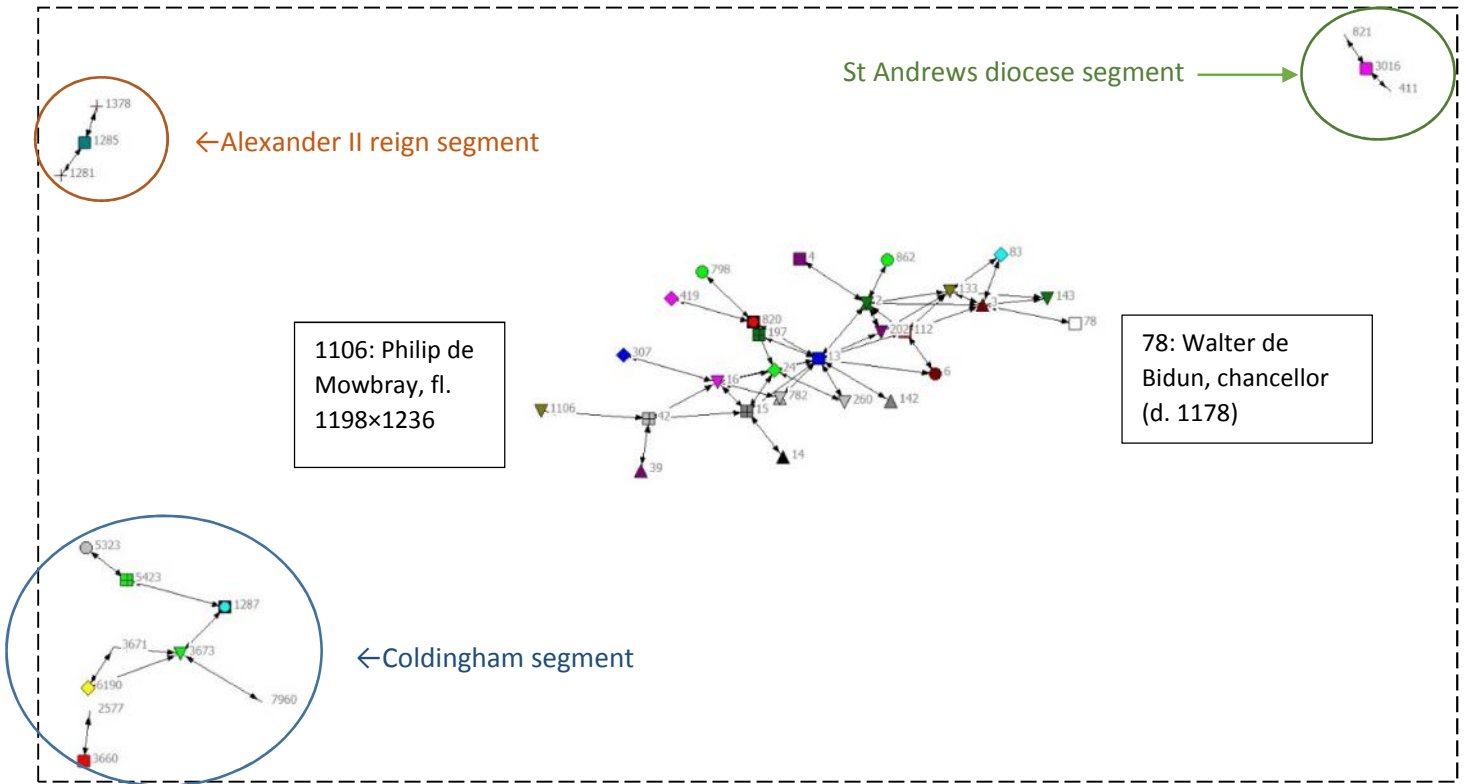


Figure 4.27. Gephi, >30, close-up of time of King Alexander II



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

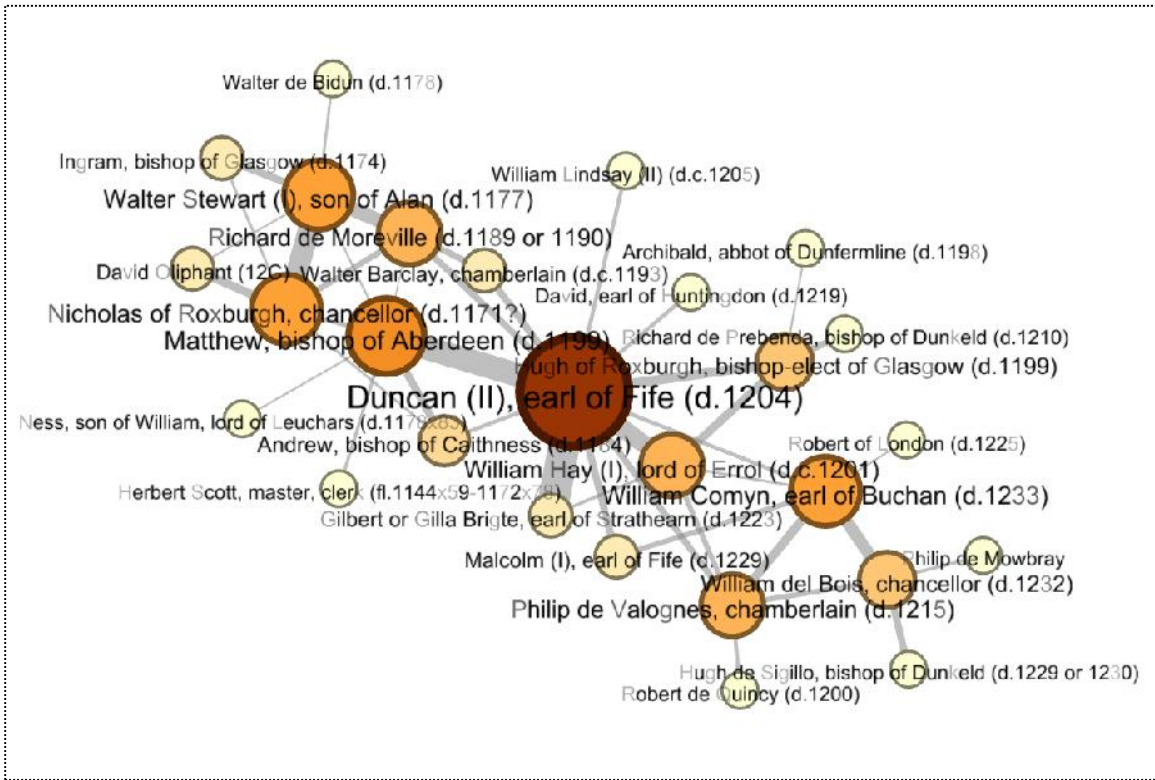


Figure 4.29. Connections of Duncan (II), earl of Fife, >30 witnessing acts

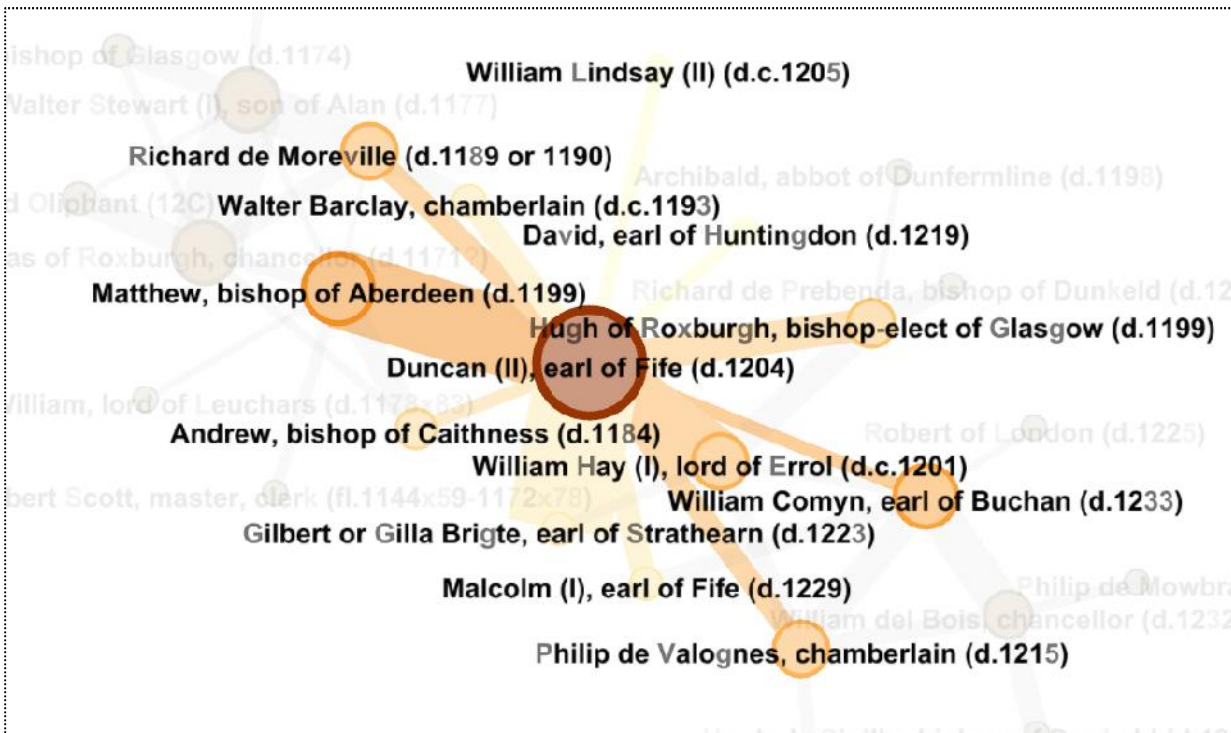
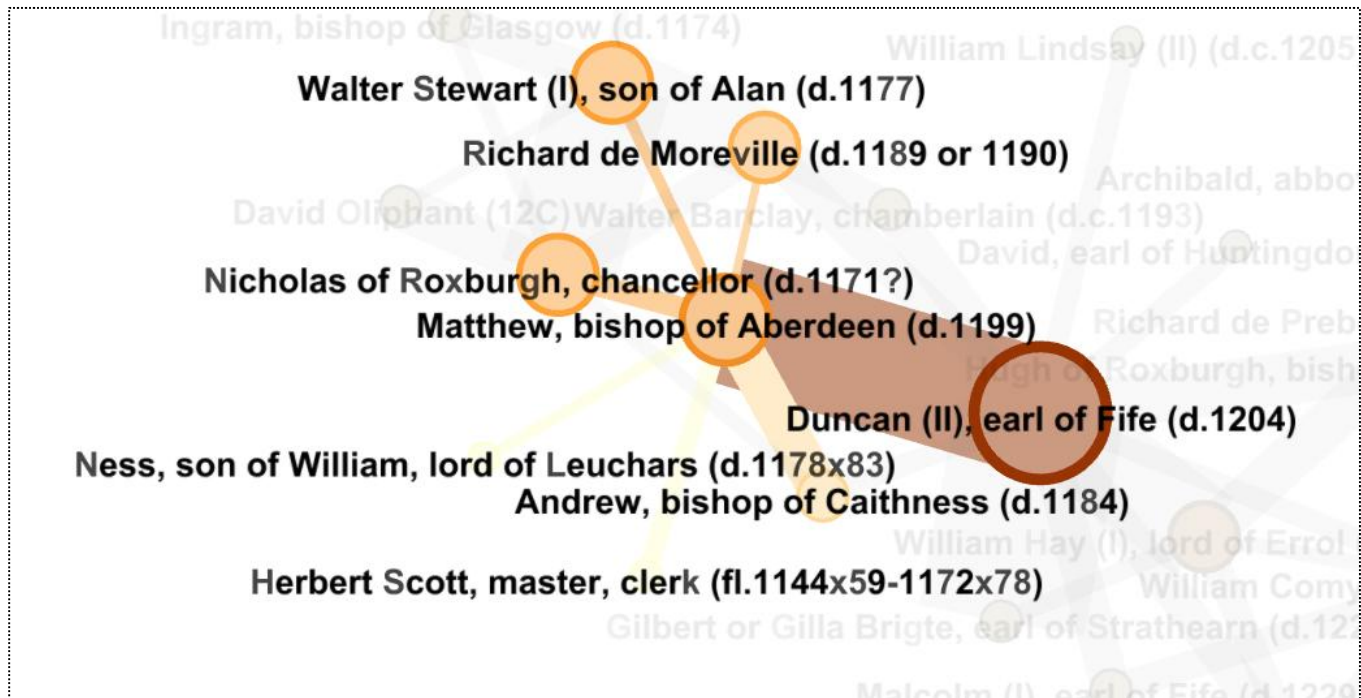
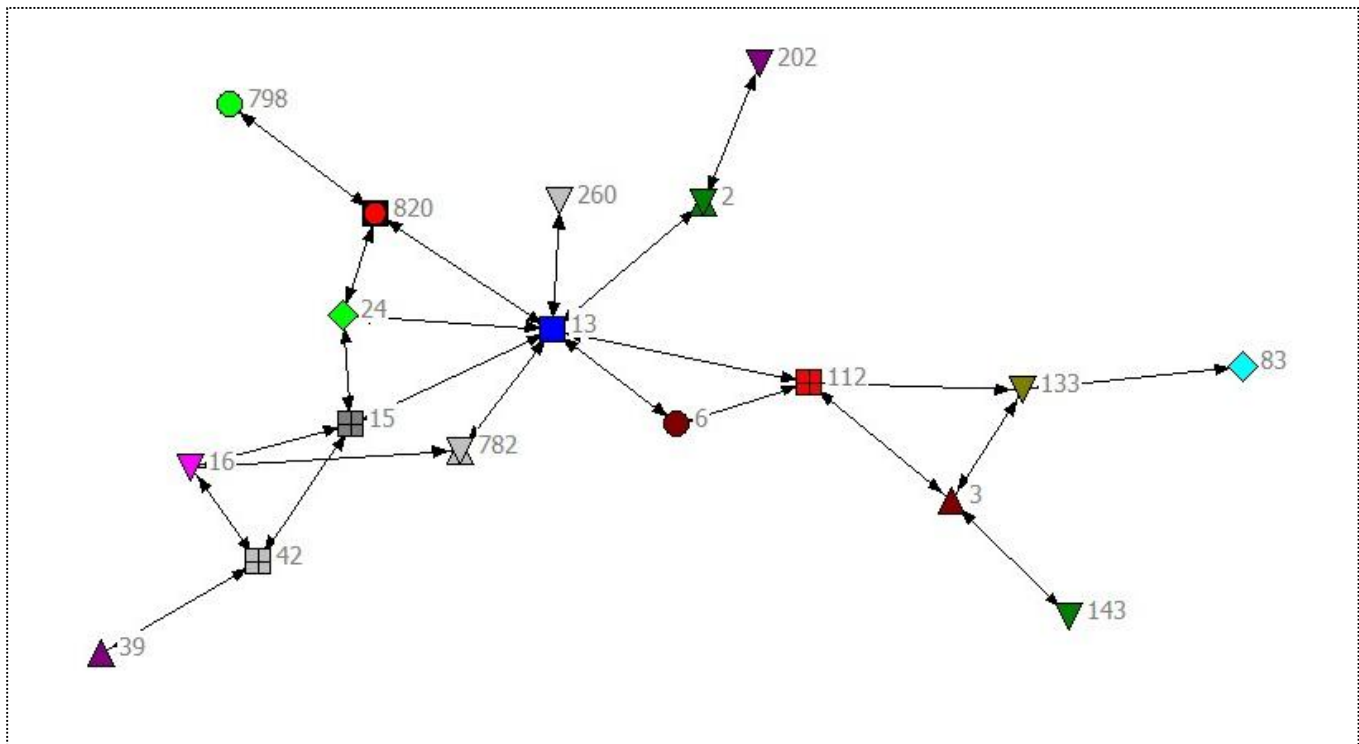


Figure 4.30. Connections of Matthew, bishop of Aberdeen, > 30 witnessing acts



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.

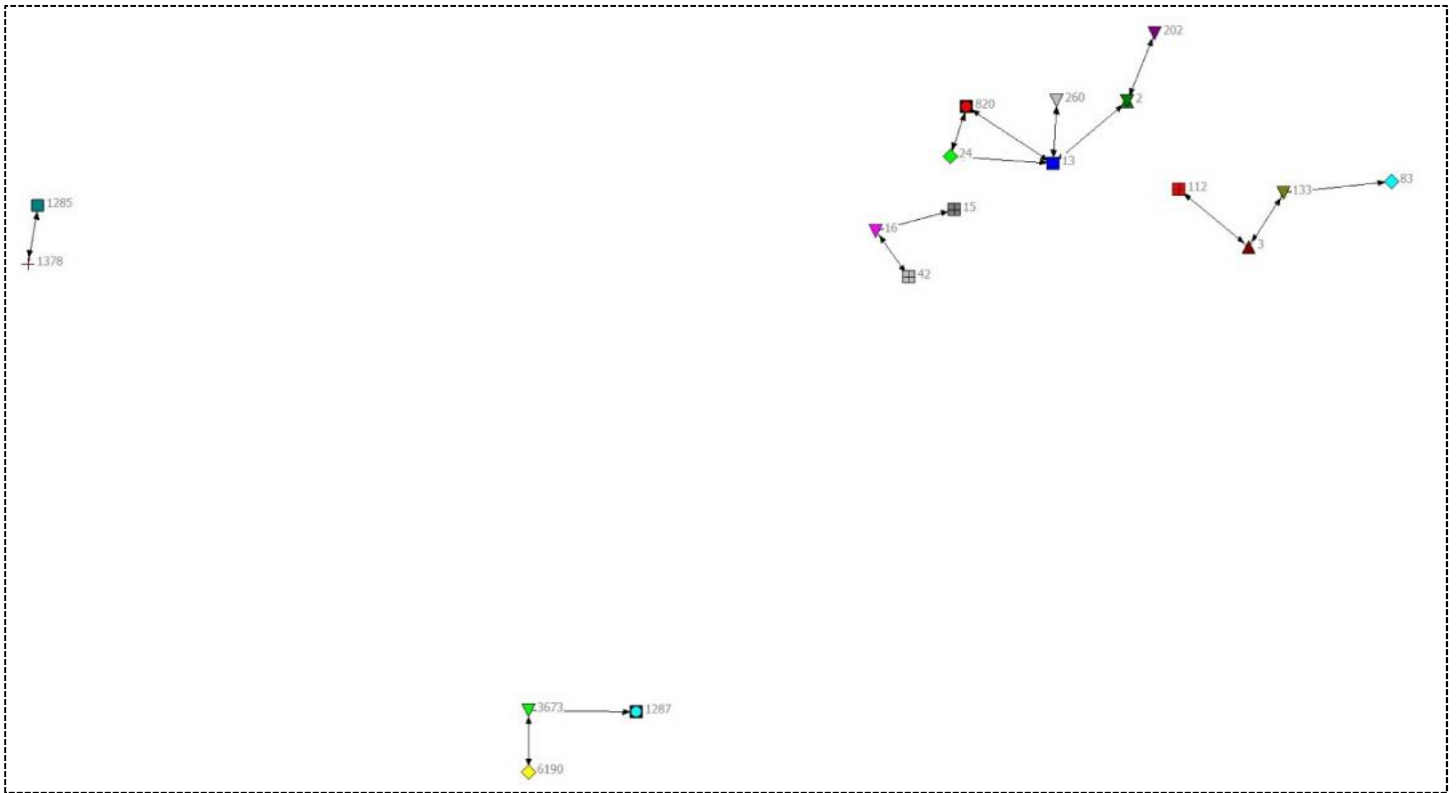
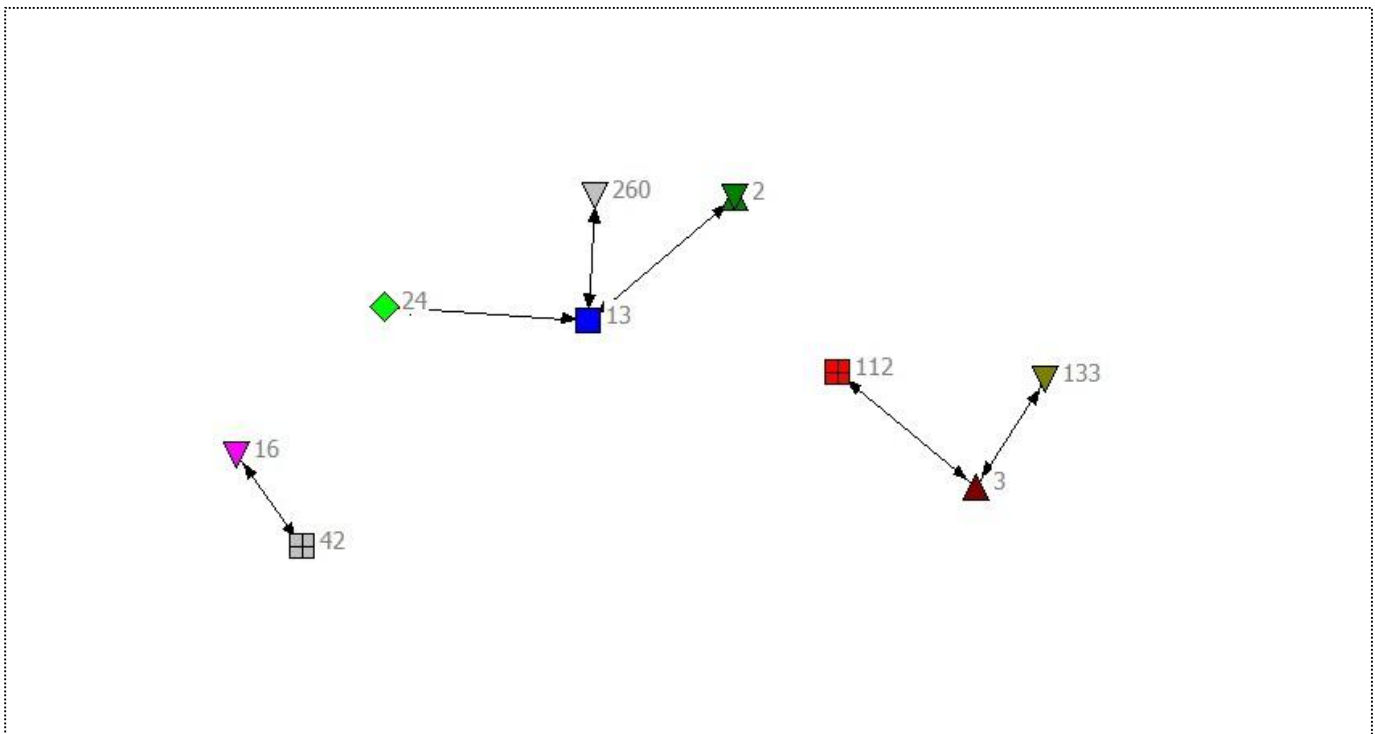


Figure 4.33. More than 45 co-witnessing acts.



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.

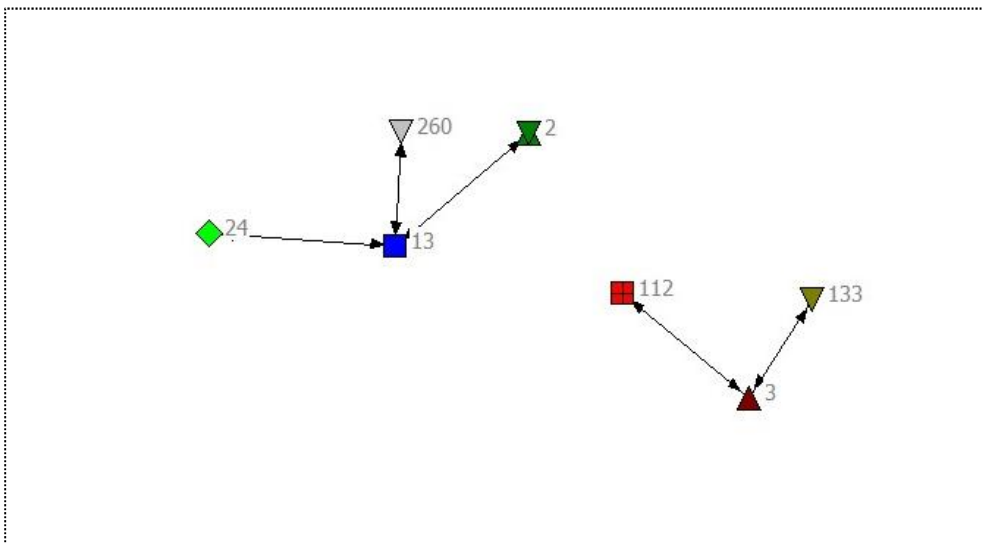


Figure 4.35. More than 55 co-witnessing acts.

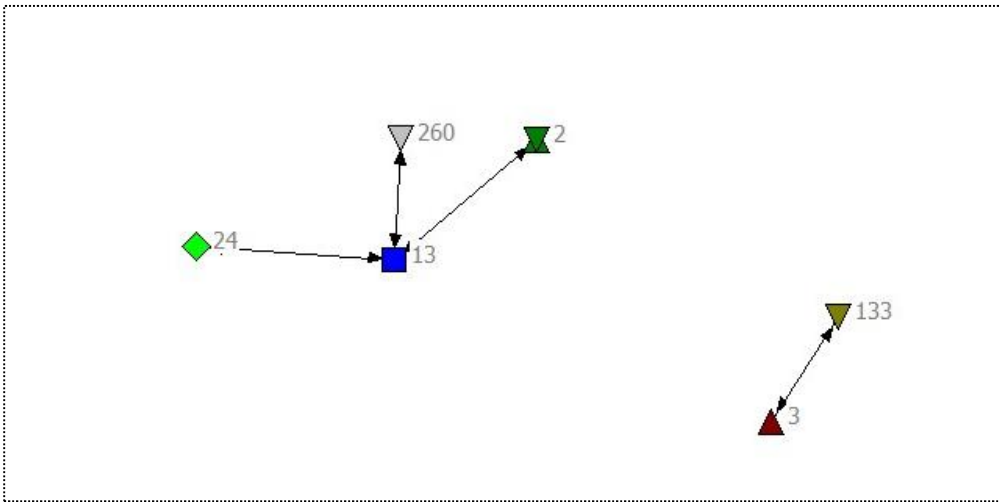


Figure 4.36. More than 60 co-witnessing acts.

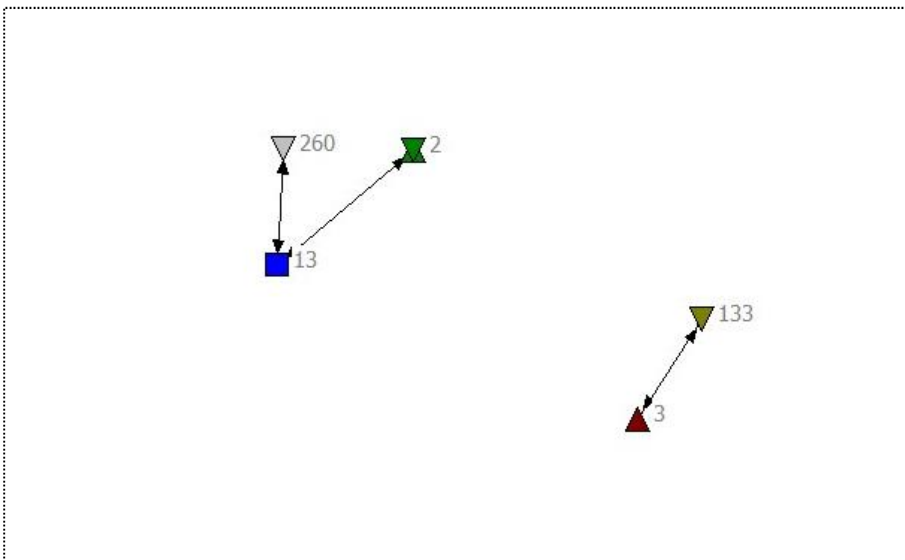


Figure 4.37. More than 65 co-witnessing acts.

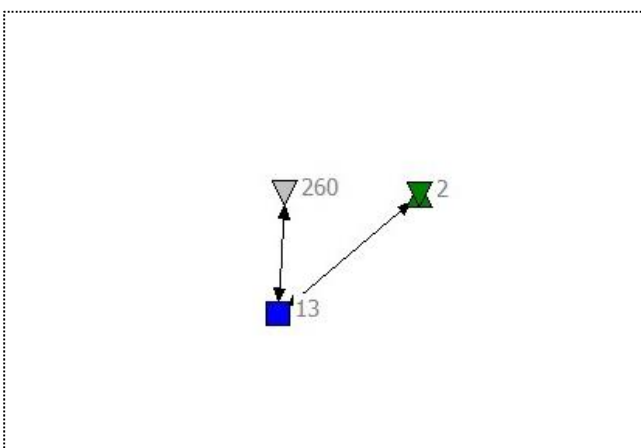


Figure 4.38. More than 70 co-witnessing acts.

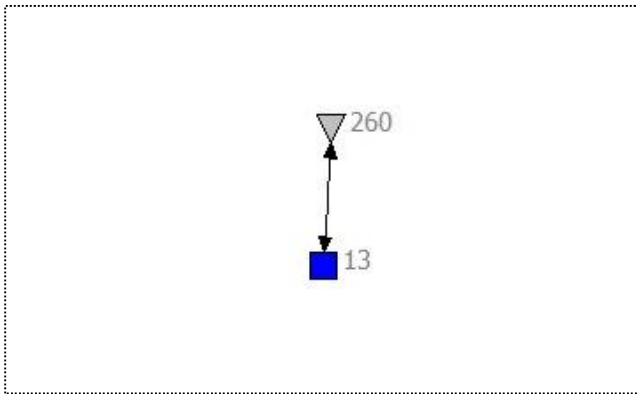


Table 4.12. shows all the (implicit) relationships between co-witnessing pairs who have witnessed together 25 times or more. Of 34 such co-witnessing 'relationships', no fewer than 12 (35%) included [13] Duncan (II), earl of Fife (d. 1204) – these are highlighted in yellow. A number of these also involved 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 Brigitte, 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
<i>William of Mordington</i>	<i>Alan, son of Cospatric of Swinton</i>	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
<i>William of Mordington</i>	<i>Adam of Prendergust</i>	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
<i>William of Mordington</i>	<i>Bertram of Little Reston (son of Adam of Little Reston)</i>	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
<i>Robert, son of Gregory steward of Coldingham</i>	<i>William of Mordington</i>	35
William Hay (I), lord of Errol (d.c.1201)	Gilbert or Gilla Brigitte, 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
<i>Adam of Prendergust</i>	<i>Bertram of Little Reston (son of Adam of Little Reston)</i>	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
<i>Henry of Prendergust (I)</i>	<i>Elias of Prendergust</i>	32
<i>Gilbert of Lumsdaine</i>	<i>Henry of Prendergust (II) knight</i>	32
Richard de Moreville (d.1189 or 1190)	Matthew, bishop of Aberdeen (d.1199)	31
<i>Alan, son of Cospatric of Swinton</i>	<i>Henry of Prendergust (I)</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
<i>Robert, son of Gregory steward of Coldingham</i>	<i>Adam of Prendergust</i>	30
<i>Alan, son of Cospatric of Swinton</i>	<i>Adam of Little Reston</i>	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
<i>Henry of Prendergust (I)</i>	<i>Adam of Little Reston</i>	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
<i>Alan, son of Cospatric of Swinton</i>	<i>Adam of Prendergust</i>	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
<i>Adam of Little Reston</i>	<i>Elias of Prendergust</i>	26
<i>Henry of Prendergust (I)</i>	<i>William of Lumsdaine</i>	26
<i>Alan, son of Cospatric of Swinton</i>	<i>Bertram of Little Reston (son of Adam of Little Reston)</i>	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	<i>William del Bois, chancellor (d.1232)</i>	476	1230
3	2	<i>Matthew, bishop of Aberdeen (d.1199)</i>	475	1190
4	142	David, earl of Huntingdon (d.1219)	411	1210
5	858	<i>Walter of St Albans, bishop of Glasgow (d.1232)</i>	380	1230
6	40	<i>William Malveisin, bishop of St Andrews (d.1238)</i>	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	<i>Jocelin, bishop of Glasgow (d.1199)</i>	356	1190
10	260	Gilbert or Gilla Brigte, earl of Strathearn (d.1223)	354	1220
11	798	<i>Richard de Prebenda, bishop of Dunkeld (d.1210)</i>	347	1210
12	444	Patrick (I), earl of Dunbar (d.1232)	343	1230
13	850	<i>John Scott, bishop of Dunkeld (d.1203)</i>	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	<i>Hugh de Sigillo, bishop of Dunkeld (d.1229 or 1230)</i>	303	1220
20	2115	Walter Lindsay (III), son of William (II) (d.c.1222)	293	1220
21	866	<i>Simon, archdeacon of Glasgow (fl.1165x74-1195x96)</i>	286	1190?
22	1281	John Maxwell, chamberlain, sheriff of Roxburgh (d.1241)	277	1240
(22)	829	<i>Ranulf de Wat, archdeacon of St Andrews (d.1209)</i>	277	1200
24	788	<i>Andrew Murray, bishop of Moray (d.1242)</i>	273	1240
25	400	Alan Stewart, son of Walter (d.1204)	262	1200
26	202	<i>Andrew, bishop of Caithness (d.1184)</i>	260	1180
(26)	445	Patrick (II), earl of Dunbar (d.1248)	260	1240
28	133	<i>Nicholas of Roxburgh, chancellor (d.1171?)</i>	257	1170
(28)	411	<i>Andrew, archdeacon of Lothian (fl.1147x59-1178x84)</i>	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 Brigitte, 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 seventeenth 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	eigencentality	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	<i>Matthew, bishop of Aberdeen (d.1199)</i>	475	0.851917	-
4	798	<i>Richard de Prebenda, bishop of Dunkeld (d.1210)</i>	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 Brigitte, earl of Strathearn (d.1223)	354	0.744801	↑ (3)
8	42	<i>William del Bois, chancellor (d.1232)</i>	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	<i>Hugh de Sigillo, bishop of Dunkeld (d.1229 or 1230)</i>	303	0.687926	↑ (7)
13	40	<i>William Malveisin, bishop of St Andrews (d.1238)</i>	379	0.682593	↓ (7)
14	850	<i>John Scott, bishop of Dunkeld (d.1203)</i>	337	0.675865	↓ (1)
15	745	<i>Jocelin, bishop of Glasgow (d.1199)</i>	356	0.672786	↓ (6)
16	858	<i>Walter of St Albans, bishop of Glasgow (d.1232)</i>	380	0.671745	↓ (11)
17	16	William Comyn, earl of Buchan (d.1233)	320	0.664618	↓ (1)
18	820	<i>Hugh of Roxburgh, bishop-elect of Glasgow (d.1199)</i>	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	<i>Archibald, abbot of Dunfermline (d.1198)</i>	225	0.558259	↑ (27)
25	112	Richard de Moreville (d.1189 or 1190)	245	0.547401	↑ (10)
26	781	<i>Richard of Lincoln, bishop of Moray (d.1203)</i>	208	0.542228	↑ (36)
27	202	<i>Andrew, bishop of Caithness (d.1184)</i>	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	<i>Ralph, bishop of Brechin (d.1212x14)</i>	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

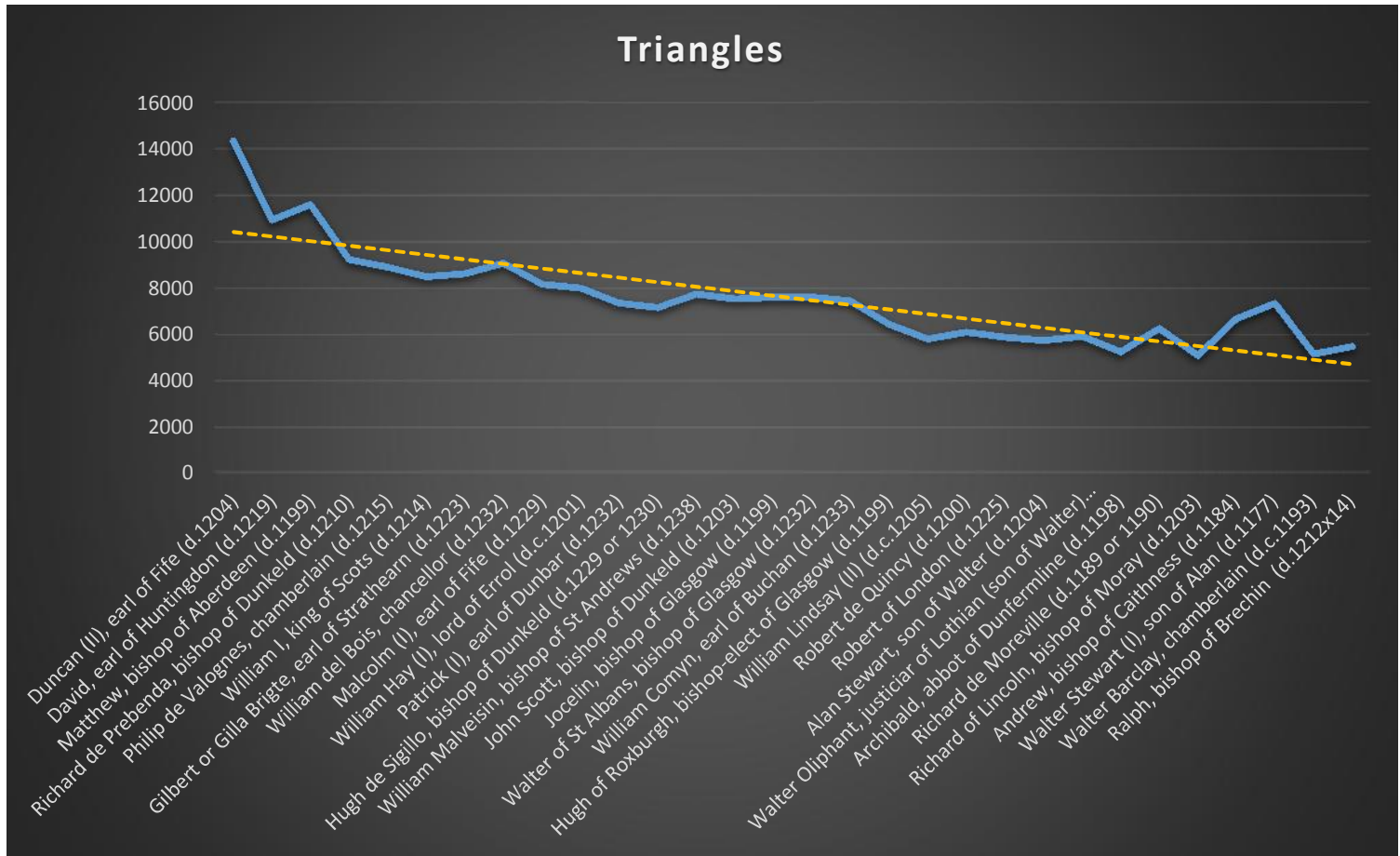
78	Walter de Bidun (d.1178)	0.448021711	44.8	208	83	2.51
3	Walter Stewart (I), son of Alan (d.1177)	0.533774	53.4	316	124	2.548
820	Hugh of Roxburgh, bishop-elect of Glasgow (d.1199)	0.618468	61.8	255	99	2.576
24	William Hay (I), lord of Errol (d.c.1201)	0.70904	71	310	120	2.583
1285	Walter Oliphant, 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 Prendergust (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 Brigitte, 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 Prendergust	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 Brigitte, 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

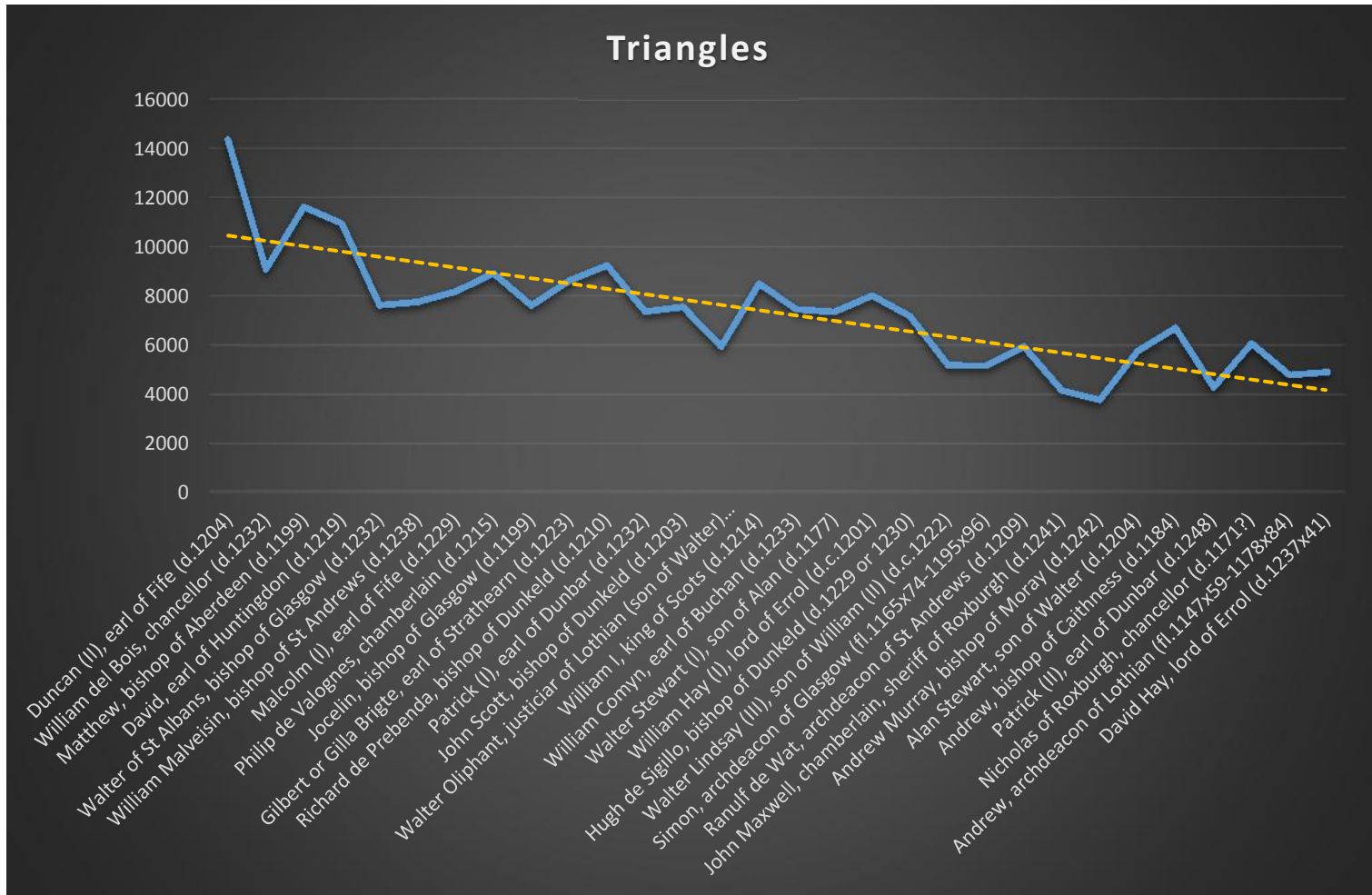
776	John of Huntingdon, master, official of Glasgow (fl.1179x1208)	0.351003034	35.1	251	35	7.171
1719	William Lindsay (I)	0.300258701	30	174	24	7.25
1204	Gilbert of Stirling, bishop of Aberdeen (d.1239)	0.339442338	33.9	168	23	7.3
965	Thomas Colville 'Scot', lord of Keresban (d.1219)	0.362518493	36.3	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/Tynninghame (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