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Sagas and genre: A case for application of network analysis to manuscripts preserving Old Norse-Icelandic saga literature

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Abstract

This study applies statistical approaches to the analysis of the genre relationships of Old Norse-Icelandic literature in order to expand our understanding of the relationships between works, their transmission, and their possible modes of reception, as manifested in the extant manuscripts. This article contributes to the ongoing discussion of the genre boundaries of Old Norse-Icelandic literature and presents an alternative method of engaging with this material in the form of computer-assisted analysis, i.e. data visualization and network analysis. Using data collected from major online databases of Old Norse-Icelandic manuscripts, we present the most complete to date network of co-occurrences in manuscripts of works belonging to a number of literary genres. The present study empirically demonstrates the manifoldness of the connections between the Old Norse-Icelandic works which transcend traditional scholarly genre boundaries. The study identifies two main communities within the network: a community of romances, or works of narrative fiction, which includes mainly legendary sagas (*fornaldarsögur*) and chivalric sagas (*riddarasögur*), and a community of historicizing narratives, or pseudo-history, which includes mainly sagas of Icelanders (*Íslendingasögur*) and kings' sagas (*konungasögur*).

1 Introduction

For decades leading scholars in the field of Old Norse-Icelandic studies have been pointing to the manuscript context as a key for understanding the genre classification of Old Norse-Icelandic literature. The frequent co-occurrence of certain works in manuscripts is interpreted as evidence for close associations of these works in regard to either their production, reception, or both.[1] Not infrequently, however, scholars arrive at contradicting conclusions regarding the genre boundaries of Old Norse-Icelandic literature when analysing manuscripts that preserve this literature. These contradicting conclusions, discussed in detail in Section 2.1, may be a result of the limitation of manual data collection, processing, and analysis. The analysis and interpretation of the manuscript context in which literary works appear require processing of a significant amount of data, which arguably lies outside the ability of a single researcher using traditional hermeneutic methods. According to the recent estimates, around 10,000 Icelandic manuscripts survive until today, and roughly 900 of them can be dated to the Middle Ages (Jónsson, 2021). While the proportion of manuscripts containing sagas among these codices is unknown, there have been attempts to list all manuscripts containing works belonging to various genres of Old Norse-Icelandic literature, for example, chivalric sagas, *riddarasögur* (Kalinke and Mitchell, 1985) and legendary sagas, *fornaldarsögur* (Driscoll, 2018), each listing hundreds of codices. For comparison, Stephen Mitchell (1991) exemplifies his argument about manuscript context of the legendary sagas by references to three manuscripts, while Ármann Jakobsson (2012) mentions around twenty medieval manuscripts, but discusses very briefly only a selected handful of the mentioned codices.

Taking a point of departure in the disagreement among scholars regarding the genre boundaries, and considering the great number of extant manuscripts which preserve Old Norse-Icelandic sagas, we have turned towards computational methods of data gathering and visualization to contribute new insights into

the ongoing discussion of the genre classifications. Following the assumption that manuscripts can give us insight into the production and reception of literary works, we believe that a comprehensive overview of their co-occurrences in extant manuscripts can reveal patterns of transmission, which will allow us to better understand the genre affiliations of Old Norse-Icelandic literature in its historical context. For this purpose, we have decided to apply the network analysis methods, which have previously been successfully applied by Hall and Parsons (2013) for studying of a single genre of Old Norse-Icelandic literature, i.e. chivalric sagas or *riddarasögur* and by Blobel (2015) in explorations of genre affiliations of texts preserved in medieval manuscripts (pre-dating 1540) catalogued in the online catalogue *Handrit.is*. In the recent years, this approach to manuscript transmission has gained interest also outside the Nordic circles, as demonstrated by, for example, Riva's (2019) study.

What sets this study apart from the previous scholarship is its scale and scope. By scale we mean the amount of data initially collected from various sources, which to the best of our knowledge consists of all the data that are currently digitally available for Old Norse-Icelandic manuscripts produced from the Middle Ages until the twentieth century. By scope, we mean thematic demarcation of the dataset in order to explore Old Norse-Icelandic sagas, rather than the entirety of Icelandic literary production, but also lack of chronological demarcation, which gives us insight into transmission history of Old Norse-Icelandic texts throughout centuries. The main research questions leading this study are the following: Can we analyse the transmission of Old Norse-Icelandic literature as a network of works connected by their material records (manuscripts)? If so, does the network show tighter connections between texts that belong to the same scholarly genre classification? In other words, does the network analysis confirm the existing scholarly consensus regarding genre?

Our main hypothesis is that the manuscript context of selected texts should reflect their genre affiliation. Explicitly, we expect that a text belonging to a particular genre should appear most frequently with other representatives of the same genre. So, if a borderline-case saga appears most frequently with certain types of texts in extant manuscripts, we can assume that the community which produced and preserved these manuscripts considered these co-occurring texts as generically related to each other. By application of network analysis we hope to gain insight into relationships between texts in extant manuscripts and problematize the validity of analytical generic distinctions existing in Old Norse-Icelandic studies.

The article is divided into three main sections. Section 2 is devoted to presentation of the dataset and methodology used in this study, including the description of data collection and processing. Section 3 is devoted to the interpretation of the network, from both philological and statistical perspectives. The final section presents the main findings and draws perspectives for further research.

2 Dataset and methodology

2.1 Old Norse-Icelandic sagas and their manuscripts

Iceland, a distant island in the middle of the North Atlantic, is home to a remarkable body of medieval literature in vernacular (written in the West Norse language). While various types of literature were produced on the island in the Middle Ages, it was the saga literature that became the island's trademark for the outside world for the centuries to come and it is this category of literature that is under investigation in this study. Icelanders started writing sagas down in the thirteenth century, but many of them drew their content from pre-existing oral narratives. Furthermore, what might be surprising to those not very familiar with the history of Icelandic literary tradition, Icelanders continued to copy medieval texts by hand well into the modern period. They also continued to compose new texts in the style derived from the medieval narratives well into the nineteenth and twentieth century.

Traditionally, scholars distinguish the following types of sagas: *Íslendingasögur* (the sagas of Icelanders), *konungasögur* (kings' sagas), *fornaldarsögur* (legendary sagas), *riddarasögur* (chivalric sagas), *biskupasögur* (bishops' sagas), *heilagra manna sögur* (sagas of holy people), etc., with each category (corpus or genre) having its more or less defined boundaries.[2] At the same time, there has been a significant amount of scholarly discussion on the definitions and delimitations of genre, with many sagas being borderline cases.

This is especially clear when the legendary sagas (*fornaldarsögur*) and chivalric sagas (*riddarasögur*) are discussed. Traditionally, the thematic division establishes the boundaries between the legendary sagas, which are set in the North, and the chivalric sagas are set outside the North on courts of exotic kings and rulers. While this thematic distinction is not unproblematic in itself, for example, because of various exotic travels that appear in legendary sagas, it becomes even more complected when codicological evidence is taken into account, leading scholars to contradicting conclusions. According to Mitchell (1991, p. 21), 'the notion that the *fornaldarsögur* represented a particular category of saga in the minds of medieval Icelanders is suggested by the codicological evidence, for the *fornaldarsögur*

are frequently bound together in manuscripts in such a way as to prefigure the modem perception of them as a genre.' According to Driscoll (2005, p. 193), however, the codicological evidence suggests that 'the *fornaldarsögur* and indigenous *riddarasögur*, both medieval and post-medieval—should be subsumed under a single heading. Manuscripts from the medieval period onwards freely mix the various "types" together.'[3]

Despite these ongoing discussions, scholars use both terms as shortcuts to refer to certain groups of narratives and everyone in the field knows, more or less, what to expect from them, but probably only few would agree which borderline examples belong where. As Lavender (2015) aptly observed, many legendary sagas circulated together in scholarly communities of early modern Scandinavian antiquarians and philologists and different works established the core of the corpus. Traditionally, however, the establishment of the corpus is associated with Carl Christian Rafn's (1829–30) publication of three-volume collection called *Fornaldar sögur Nordrlanda eptir gömlum handritum* ('Sagas of ancient times in the Northern lands according to old manuscripts'). While Rafn's collection consists of thirty-one works, the recent research project devoted to the legendary sagas, the *Stories for all time* project, included thirty-five works in their database, demonstrating that the boundaries of this corpus can be considered rather fluid (Driscoll, 2018). Despite the expansion of the corpus by the project, there are still some works, which appear to have all the features of traditional *fornaldarsögur*, but which consistently remain outside the corpus. These include, for instance, *Bragða-Ölvis saga*, an early modern *rímur*-based narrative (i.e. a prose adaptation of an older poem) which frequently appears together with other legendary sagas in extant manuscripts, and *Hrings saga og Tryggva*, a narrative which has all the features of a typical legendary saga but which was not included in Rafn's collection and therefore became rather unknown to modern non-scholarly audiences (Guðmundsdóttir, 2018).

On the other hand, the previous scholarship has shown that some other works which are traditionally considered as members of the *fornaldarsögur* group upon close examination appear to have much in common with some *riddarasögur*, so romances or chivalric literature (Kalinke, 1990). This generic fluidity of *riddarasögur* and *fornaldarsögur* in the Middle Ages has been confirmed through application of network analysis to medieval manuscripts catalogued in *Handrit.is* conducted by Blobel. Blobel's study has demonstrated, that in the analysed pre-1540 manuscripts catalogued in *Handrit*, *riddarasögur* and *fornaldarsögur* can be grouped together with *Íslendingasögur* into one category of 'secular narratives' (Blobel, 2015, p. 33).

In order to gain insight into complete—or as complete as it is possible based on digital resources—transmission history of Old Norse-Icelandic sagas from the Middle Ages until today, we do not apply any chronological demarcation for manuscript production. Thus, our dataset includes medieval codices, early modern transcriptions produced for antiquarians and scholars, as well as modern manuscripts from late nineteenth or early twentieth century produced by common people and lay scholars. Among the oldest manuscripts in our dataset is, for example, Copenhagen, Den Arnamagnæanske Samling, AM 45 fol., which is a fourteenth-century parchment manuscript preserving sagas of the Norwegian kings, while among the youngest is Reykjavik, Landsbókasafn Íslands, Lbs 1491 4to, which is a paper manuscript from the beginning of the twentieth century consisting of 800 pages and preserving various legendary sagas.

It is known that the number of post-medieval and early modern manuscripts is much higher than the number of extant medieval codices and fragments. In the case of the *fornaldarsögur*, for example, we can observe a significant increase in the number of codices produced in the seventeenth and eighteenth century when compared to the sixteenth century (Driscoll, 2019, pp. 10–11). These numbers not only can be a result of better survival rates for the younger manuscripts, but also they can be a result of the increase in production of manuscript copies of medieval texts in the post-medieval period. This is not only due to increased literacy and the use of paper—cheaper material for production of manuscripts than parchment—but also due to increasing antiquarian interest in Old Norse-Icelandic literature in Scandinavia. From the late-sixteenth and early-seventeenth century Old Norse-Icelandic literature became an important historical source for Danish and Swedish antiquarians and historiographers (Skovgaard-Petersen, 1993; Jensson, 2019; Kapitan, 2022). This scholarly interest created a need for transcripts of medieval texts and that in turn influenced production of manuscripts in Iceland. That is why the early modern and modern copies will always weigh heavily on any analysis of all extant manuscripts of Old Norse-Icelandic literature.[4]

The notion of the instability of manuscripts as artefacts is also an important factor not only in ours, but also in any dataset that analyses manuscripts in their current form. As Stegmann (2016) has recently demonstrated, Icelandic manuscripts did not necessarily keep their original form throughout centuries, as, for example, around 53% of paper manuscripts in the Arnamagnæan Collection (hosted today in Copenhagen and Reykjavik) were rearranged at least once. Therefore our interpretation of the context in which literary texts appear today is more likely to give

us insight into early modern and modern scholarly understanding of these texts, rather than the original scribe's or commissioner's understanding. While available catalogues sometimes register information about potential changes in the physical form of a manuscript, this is not done consistently. Due to this lack of consistent cataloguing practice, which takes into account codicological evidence, our network represents relationships between texts in the context of the current state of the manuscripts that preserve these texts, or even more precisely in the current state of the catalogues, rather than in the original context of their production.[5]

2.2 Data sources

This project relies on the datasets that are freely available online. Manuscripts preserving Old Norse-Icelandic literature are dispersed in various libraries around the world, mainly in Europe and North America and there is no single resource that contains data about all these manuscripts. There are, however, various digital projects which aim at gathering information about Old Norse-Icelandic manuscripts regardless of administrative boundaries and which deliver the core data for our research. In order to obtain as complete an overview as possible, we compiled data from four major online repositories related to Old Norse-Icelandic texts and their manuscripts: *Handrit*, *Old Norse Prose Register* (ONP), the *Stories for all time* project, and the *Skaldic Project*.

The largest one is *Handrit* (handrit.is), a digital union catalogue of Icelandic manuscripts held mainly at the National Library of Iceland, the Árni Magnússon Institute for Icelandic Studies in Reykjavik, and the Arnamagnæan Institute in Copenhagen. It is an extremely rich resource containing facsimiles of the manuscripts together with catalogue records of these manuscripts in Extensible Markup Language (XML), describing their contents, physical features, origin, and provenance according to the Text Encoding Initiative (TEI) Guidelines (Driscoll, 2011; Sverrisdóttir *et al.*, 2012). At the time of our experiments, *Handrit* contained XML-based descriptions of 9,137 manuscripts.

The second largest source of data was the *Register* (Index) of the *Dictionary of Old Norse Prose* (onp.ku.dk), which contains information on almost 5,000 manuscripts and charters containing Old Norse prose texts in tabular format. The information is generally based on printed editions, supplemented with information gained from close collaboration with manuscript scholars over many decades. The data are considered very reliable and consistent, and have been updated and corrected continually since its first publication in 1989. The focus of the index is on text-critically independent witnesses of the prose works and it therefore omits a very large number of later manuscripts and information about poetic works. It nevertheless provides a valuable supplement to *Handrit* with hundreds of manuscripts from collections not covered by *Handrit*.

Another very reliable source of data was the digital catalogue of the *Stories for all time* project (henceforth *FASNL*), which is a thematic catalogue devoted exclusively to the manuscripts preserving the legendary sagas.[6] At the time of our experiments, it contained XML-based descriptions of 818 manuscripts held at twenty-three libraries in Europe and North America. The descriptions are conformant to the Text Encoding Initiative Guidelines. The catalogue uses the authority list for the legendary sagas, but other works are catalogued following more or less the same principles as *Handrit*. Texts that can be found in the catalogued manuscripts are encoded with msItem elements, which contain uniform titles. Each msItem has a class attribute that refers to a given text's genre affiliation. Descriptions of manuscripts held at the three partner institutions of *Handrit* were initially based on the *Handrit* descriptions and then adjusted, standardized, and expanded for the purposes of the project. Therefore these files were compatible with the same processing workflow as *Handrit* but needed to be resolved and given priority where overlapping with *Handrit*.

Finally, the database of the *Skaldic Project* (skaldic.org), provided the framework for the initial handling of the data used in the present study. The Skaldic database focuses on Old Norse-Icelandic poetic corpus and its relationship to the prose corpus. Its structure was compatible with the project's aims of aggregating and analysing data from various sources and its flexible web application could be extended to assist in the cleaning of the data, therefore it was introduced as an intermediate step in preparation of the final dataset. Queries written in structured query language (SQL) could build and analyse the hundreds of thousands of potential connections between texts and manuscripts so that the authors could quickly identify issues with the imported data. This process of data cleaning is further discussed in the following section.

2.3 Data cleaning

In order to prepare our data for network visualization which would illustrate the genre affiliation of various works as represented in the catalogues together with the co-occurrence of these texts in the manuscripts we needed two tables. The first one was a simple list of works (or 'uniform titles'), which will be treated as nodes in the network, and attributes that reflects their genre affiliation ('class'), so the nodes can be sorted accordingly to their genre. The second one was a table of edges, in which each work was connected to other

works it co-occurs with in the manuscripts, and the number of manuscripts that this co-occurrence appears was reflected as weight of the connection. So if two works appear together only in a single manuscript, the edge's weight equals to 1.

In order to generate such tables automatically from the Skaldic Project database, we needed to resolve number of issues with the heterogenous dataset we have created. Data from the *Dictionary of Old Norse Prose*, which had previously been imported some 10 years earlier, were updated with the latest information from the Index. This provided a consistent reference point for the cleaning of further data. The *Handrit* and *FASNL* data were first imported as raw XML, prioritizing the *FASNL* data when overlaps occurred. They were then processed using the libxml library to find the relevant information: siglum/shelfmark, dating, and location. The manuscript shelfmarks were normalized automatically to the same format as those of the existing dataset. The resulting shelfmark was used to search for the same manuscript in the existing dataset and update the information accordingly, or where not found, to create a new record for that manuscript.

A major challenge with the data imported from *Handrit* was that the manuscript contents described in the XML files do not refer to an external authority list, so we had to rely on the 'uniform title' encoded in the XML files to find different manuscripts of the same work. The uniform titles, however, are quite often far from uniform, with various spelling variations and versions of the same title. These were imported into a separate table and a series of automated normalizations applied. Manual normalization was performed through the web interface, which involved updating and checking the links to the skaldic database's table of text titles (Fig. 2). The resulting table of normalizations can be used for future updates from these and other sources.

Finally, the genre classification of the works catalogued in *Handrit* manuscripts, which is represented as a class attribute on msItem elements, are highly heterogenous. Not infrequently, a single work can be assigned different classes in different manuscript descriptions, or contain more than one value. This means that the same work could be classified as a *fornaldarsaga* in one manuscript description, but as an *Íslendingasaga* in another, or as both in yet another. We have made an editorial decision that each work can belong only to a single genre (have only one value of the 'class' attribute). This allowed us to assign the most frequently assigned genre (class value) for a work consistently across the corpus. The genre classifications in the *FASNL* files had been manually cleaned up and standardized by Timothy Rowbotham, who checked all the works that had more than one class attributed in the initial dataset. Clean classes were then applied to the table of texts, resolving any remaining inconsistencies deriving from varying classification within the datasets originating from *Handrit* and *FASNL*. The cleaned data were then imported into the original structure of the skaldic project, resulting in a data model as shown in Fig. 1, indicating one-to-many relationships. From this structure we needed to extract a table of nodes and a table of edges in order to import into the Gephi software (see section 2.4).

An SQL query first extracted the text nodes into a table, limiting the genre designation to the types which lie at the interest of the present study. These are sagas of Icelanders and related short stories, kings' sagas and related short stories, legendary sagas and related short stories, and romances. Eddic poems, *rímur*, and legal works played a role of a control group.[7] Only works classified according to these categories were included in the resulting dataset. The edges table was generated by linking each row in the text table—via the manuscript item table—to all manuscripts containing the text. Then each of these manuscripts was linked to all of the other texts found in the manuscripts table. The results were grouped according to pairs of nodes, with the number of manuscripts containing both texts forming the weighting for each edge.

The fast results allowed us to identify and resolve some issues with the result set. Some duplicate results were found due to incorrect resolution from the different data sources and instances where one work appeared more than once because it was broken up by other works. In cases when two texts were catalogued as a single work (or single msItem), for example, the two closely related legendary sagas, *Völsunga saga* and *Ragnars saga loðbrokar*, they were excluded from the dataset, but they were included when catalogued separately. Skaldic poems were excluded, even when appearing in the texts that lie within the scope of this project, as these are mainly recorded within the other works and not as individual items. Keeping our research questions in mind, we excluded compilations of

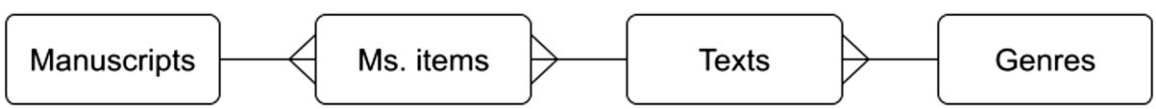

Figure 1. Relational model of texts and manuscripts used by the network analysis

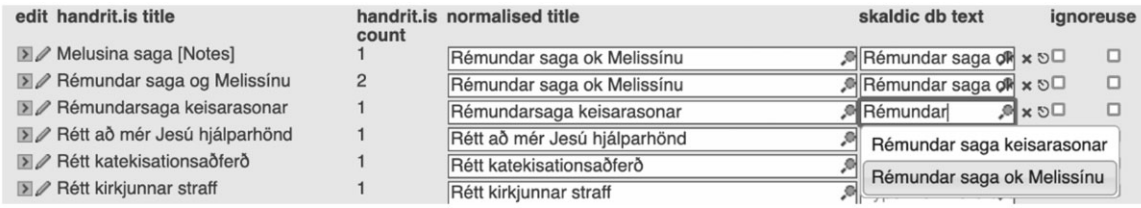

Figure 2. Data cleaning interface: linking titles in XML catalogues to the database

multiple copies of the same text, such as Copenhagen, Den Arnamagnæanske Samling AM 34 fol., where eight transcripts of the same text were put together, or single-text codices, which would not contribute anything to our discussion.

2.4 Creating the network

As already mentioned, the present study follows Hall's (2013) way of modelling the data, rather than Blobel's (2015), so only one type of nodes is allowed in the network and these are the literary works (or uniform titles of these works as registered in the digital manuscript catalogues). The co-occurrences of literary works in manuscripts are represented as undirected edges that create connections between these works. Between each pair of works only one edge was allowed, but the number of manuscripts in which two works appear together were summed together into the edge's weight, creating the input format for edges as represented in Table 1. From the first row of the table, we learn that *Adónías saga* and *Áns saga bogsveigis* appear together in three manuscripts and from the second that *Adónías saga* and *Bevers saga* appear together in six manuscripts.

Since the study's aim was to examine whether texts belonging to the same genre appear frequently together in the manuscripts, i.e. whether they will be grouped together in the network, each text was assigned a feature called 'handrit_class' (Table 2). 'Handrit_class' was derived from the TEI conformant XML manuscript descriptions available on *Handrit* and *FASNL*. It reflects the generic classification of the text that is represented as an attribute value of msItem elements, according to the TEI Guidelines (TEI Consortium, 2020). It is worth to note that our classification in 'handrit_class' is solely dependent on the classification applied in the existing catalogues and we did not use any independent classification of works we analysed, nor tried to determine whether the existing classification is accurate or not.

To visualize the collected data, we used a free open-source network visualization software, Gephi (https://gephi.org) which includes a number of inbuilt features which allow users to interact with the visual representation of the data, 'manipulate the structures, shapes and colours to reveal hidden patterns' (https://gephi.org/features, last accessed 28 November 2022 see also Bastian *et al.*, 2009). We assigned colours to nodes according to their class value, so all texts in the same genre were coloured in the same way. This resulted in a network of 153,963 edges and 1,518 nodes, which did not lend itself useful for visual presentation and interpretation. Therefore, the decision was made to limit the visualization to connections that appear more than twice. This was done partially to avoid the hairball effect of the visualization, but also because from the perspective of the present study's aim, trying to evaluate the co-occurrences of texts in manuscripts and their relationship to generic associations of these texts, we assumed that it is more important to focus on more frequent connections. This way we arrived at the network including 350 works (nodes) at 4,797 connections (edges).[8]

Figure 3 presents three ways of visualizing relationships within this network. In this network, the nodes are coloured in the following way:

- legendary sagas (*fornaldarsögur*) are rendered as pink nodes,
- late legendary sagas (*fornaldarsögur síðari tíma*) and *fornaldarsögur*-related short tales (*þættir*) are red,
- sagas of Icelanders (*Íslendingasögur*) and related *þættir* are green,

Table 1. Basic data format for edges

Source	Target	Type	Weight
Adónías saga	Áns saga bogsveigis	Undirected	3
Adónías saga	Bevers saga	Undirected	6
Adónías saga	Bærings saga fagra	Undirected	3
Adónías saga	Clarus saga	Undirected	3

Table 2. Basic data format for nodes

Label	handrit_class
Alvíssmál	edd
Amalíu saga keisaradóttur	riddst
Ambáles saga	forns
Ambrósíus saga ok Rósamundu	riddst

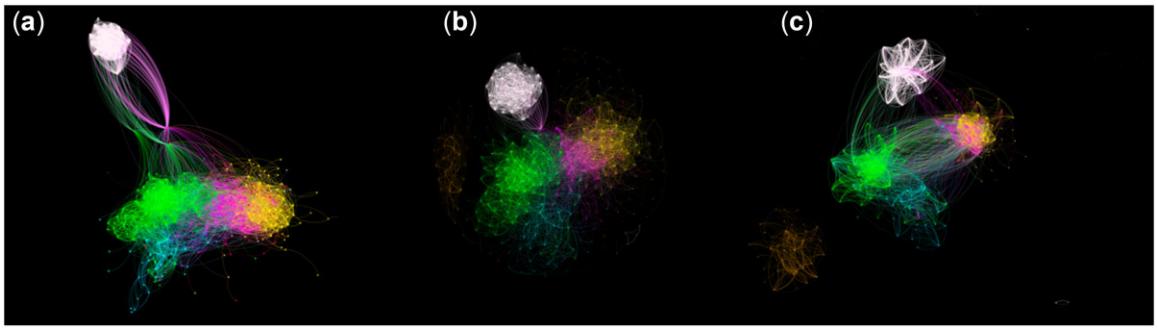

Figure 3. Main part of the network of Old Norse-Icelandic texts that appear together more than twice in catalogued manuscripts (nodes coloured by genre), generated with ForceAtlas 2 (**a**), Fruchterman Reingold (**b**), and OpenOrd (**c**) layouts. The relative positioning and meaning of the colour coding is discussed in the following text

- kings' sagas (*konungasögur*) and related *þættir* are blue,
- chivalric sagas (*riddarasögur*) are yellow
- late chivalric sagas (*riddarasögur síðari tíma*) and *þættir* are orange,
- Eddic poems are white,
- legal texts are brown,
- and *rímur* are grey.

The first visualization (Fig. 3a) is generated with ForceAtlas2 layout, which is a force-directed layout that simulates a physical system, in which nodes repulse each other while edges attract the nodes they connect (Jacomy *et al.*, 2011, 2014). Here, the main saga cluster is visible with multiple interconnections, while the legal texts and *rímur* are peripheral and stay outside the view. The Eddic Poetry, on the other hand, is clearly intra-connected, but also inter-connected to the saga part. Within the saga cluster, the works that are classified as members of a particular class tend to appear in a close proximity to each other. So that the green *Íslendingasögur* group together on one side of the network, while the yellow *riddarasögur* appear on the opposite side. Meanwhile, the pink *fornaldarsögur* stretch themselves from *riddarasögur* all the way to *Íslendingasögur* and *konungasögur*.

The second visualization (Fig. 3b) is generated with Fruchterman Reingold layout, which, among other things, aims at distributing nodes evenly within the frame, making edge lengths uniform and reflecting inherent symmetry (Fruchterman and Reingold, 1991). Here, the group of sagas appear to be somewhat divided into subgroups, on one side there are *Íslendingasögur* and *konungasögur* and related stories, while on the other side we have legendary sagas and romances. Eddic poems are grouped together, while legal texts are spread on the peripheries of the network. The third visualization (Fig. 3c) is generated with OpenOrd layout, for drawing large-scale undirected graphs, which uses an edge-cutting strategy to encourage clustering of the nodes (Martin *et al.*, 2011). Here, the internal divisions within saga group are most clearly visible. *Íslendingasögur* separate themselves from *konungasögur*, but *fornaldarsögur* and *riddarsögur* remain together. At the same time, some of the legal texts create their own cluster, not connected to the sagas, while Eddic poetry clusters closely together, but its connections to both *Íslendingasögur* and *fornaldarsögur* are still visible.

3 Interpreting the network

3.1 Network and philology

Already by the visual observation of the network visualizations on Fig. 3, we can suggests that to a certain extent the traditional genre classifications can be observed in the network, as *Íslendingasögur* appear in close proximity to other *Íslendingasögur*, *fornaldarsögur* to other *fornaldarsögur*. At the same time, it has to be emphasized that the numerous cross-genre edges between, for example, family sagas, and kings' sagas, or legendary sagas and romances suggest the great fluidity of these categories. There is no clean cut between, for example, *fornaldarsögur* or *riddarasögur*, not mentioning the less common subclassifications into *fornaldarsögur síðari tíma* and *riddarasögur síðari tíma*, which basically disappear from the bigger picture and mix themselves freely among the representatives of the two main corresponding categories (*fornaldarsögur* and *riddarasögur*). This indicates that the analytical categories applied in the modern catalogues, such as late legendary sagas or late chivalric sagas, do not correspond to the ethnic genre classifications, as represented by the extant manuscripts. The content matter seems to play a more significant role in influencing texts' groupings than the time of texts' composition.

Besides this general observation of the topography of saga literature, the network provides us with

interesting insights which we can analyse from a traditional philological perspective. What is obvious from only a glimpse on the network is the clear separation of Eddic poems (white nodes) from the large colourful cluster of saga literature, as the poems create strong interconnections with themselves. What is even more interesting, however, is the nature of the texts that create connections between the Eddic poems and the saga literature. Mainly three texts are responsible for these connections: *Egils saga Skalla-Grímssonar*, *Bergbúa þáttur*, and *Hervarar saga og Heiðreks*. All these texts have strong poetic components.

Hervarar saga contains a great deal of poetry which in the modern period has at times been considered part of the Eddic poetry genre (Heusler and Ranisch, 1903). *Hervarar saga*'s metrical form and themes are close to that of the Poetic Edda (Burrows, 2017), and its connection with the cluster of Eddic poems in the network is therefore understandable. It is worth noting, that there are other *fornaldarsögur* that could be expected to find themselves in a similar position, especially *Völsunga saga*, but they are not observed to do so in our network. Perhaps their connections to other prose works are stronger than those to poetry.

Bergbúa þáttur consists largely of a poem of twelve stanzas known as *Hallmundarkviða*, describing what appears to be volcanic activity and the activities of mythological beings: giants and possibly gods (Wills, 2022). The form of this poem (*dróttkvætt*) does not belong to the Eddic genre, but the interest in gods and giants shows a strong thematic connection that explains its observed position in the network. *Egils saga Skalla-Grímssonar* is an *Íslendingasaga* about the life and family of the warrior-poet Egill, son of Skalla-Grímur (Simek and Pálsson, 2007, pp. 70–2). Egill's poetry, recorded largely in his saga, has been well-known for many centuries. It includes multiple occasional stanzas (*lausavísur*) as well as some longer poems in many manuscripts. These poems do not have a close relationship in either metre or theme with the Eddic poems, but may show compilers' interest in collecting longer poems from an early period.

While the connection between poetic works and prose works that contain many poetic sections could potentially be expected, it is quite surprising to see how strong the connection of these sagas to the poetry is. Therefore, it is important to consider whether these connections are not in fact a result of cataloguing practice rather than reflect the actual state of the manuscripts which presumably contained both poetry and prose in a single volume. From a practical point of view, it is easy to imagine that manuscripts that contain only poetic passages from sagas mixed together with Eddic poems were catalogued in this way so that the poems appear under the uniform title of the saga, rather than under the title of the individual poem. The skaldic project database contains the most comprehensive catalogue of poetic contents of manuscripts, but this is largely focused on individual stanzas. These data were not used in our study, only references to whole poems. Egill Skalla-Grímsson's longer poems, for example, such as *Sonatorrek*, are generally found in the dataset only when they are preserved separately from the saga (such as in Scotland, Edinburgh, Advocate's Library, Adv 21 4 7), reflecting a common cataloguing practice.

Besides these fairly straightforward observations, the connections between texts visualized in the network allow us to explore more ambiguous relationships between texts and consider their implications for texts' genre affiliations. This includes, for example, the areas in which *konungasögur* dominate, but many short stories (*þættir*) appear. Even though the blue nodes representing kings' sagas dominate, in their close proximity appear various texts belonging to three different genres. We have texts classified as legendary sagas (class 'fas', pink nodes), for example, *Tóka þáttur*, short kings' tales (class 'konth', blue nodes), for example, *Hálfdanar þáttur svarta*, and short tales of Icelanders (class 'islt', green nodes), for example, *Þorsteins þáttur uxafóts*. What is interesting about these texts, is that they all were incorporated in a fourteenth century codex known as Flateyjarbók (Reykjavik, Stofnun Árna Magnússonar, GKS 1005 fol.), and most of the short tales were incorporated into Flateyjarbók-redactions of *Óláfs saga Tryggvasonar hin mesta* and *Óláfs saga helga*. It seems that for the pre-modern scribes and commissioners these texts were closely related to the kings' sagas, and should be read in their broader literary context, rather than the legendary sagas or the sagas of Icelanders, as the modern classifications suggest.[9]

Finally, the network proved itself a useful tool for noticing potential errors in the dataset, which without the visualization were not likely to be observed. In one area of the network, there are frequent connections between the sagas of Icelanders (*Íslendingasögur*, green nodes) and kings' sagas (*konungasögur*, blue nodes), but there is also a single red node in this area suggesting that there is one late legendary saga (*fornaldarsaga síðari tíma*) which is frequently co-occurring in this more 'historical' context.[10] The text in question is *Þorsteins saga Geirnefufóstra*, which is a young saga of Icelanders, not a legendary saga. It was even included in the popular edition of the sagas of Icelanders published in the middle of the past century (Jónsson, 1953, pp. VIII, 401–53.).

The class attribution of this text in the catalogues can be interpreted as a simple error, or actually as a result of conscious decision based on secondary

literature. There seems to be scholarly disagreement regarding genre affiliation of this text. In the Lexicon of Old Norse Literature (*Lexikon der altnordischen Literatur*), the entry for *Þorsteins saga Geirnefjufóstra* reads as follows: 'Þorsteins saga Geirnefufóstra ist eine vermutl. erst im 18. Jh. verfaßte Saga im Stil der Fornaldarsögur' (Þorsteins saga Geirnefufóstra is a saga presumably composed in the style of a fornaldarsaga at the earliest in the eighteen century, Simek and Pálsson, 2007, p. 391). This suggests that the story was most likely composed no earlier than in the eighteenth century and that it is in style of legendary sagas. Conversely, Guðni Jónsson writes in his introduction to the edition of *Íslendingasögur* that the saga was written in the nineteenth century by a known author: 'Þorsteins saga Geirnefjufóstra gerist á 10. öld að miklum hluta í Noregi, Grænlandi og víðar, en Fljótamenn í Skagafirði koma þar við sögu. [. . .] sagan, sem nú er til og hér prentuð í fyrsta sinn, er samin af Gísla Konráðssyni snemma á 19. Öld' (The events of Þorsteins saga Geirnefjufóstra take place mostly in Norway, Greenland and in other places in the tenth century, but the men of Fljót in Skagafjörður are also mentioned in the saga [. . .] the saga that exists today and is printed here for the first time was composed by Gísli Konrádsson early in the nineteenth century). So the contents of the saga fit the bill for *Íslendingasögur*, but its style is more *fornaldarsaga*-like. The position of the story in the network indicates that the communities producing and circulating manuscripts of *Þorsteins saga Geirnafjufóstra* considered it more similar to *Íslendingasögur* and *konungasögur*-related materials, than to *fornaldarsögur*, and therefore put it together with these type of texts in manuscripts. This also speaks in favour of Guðni Jónsson's classification of this text as a *Íslendingasaga*.

This section illustrated that already simple visual observation of the network, in which pre-existing attributes determined colouring of the nodes, proves itself useful in exploration of relationships between texts and allows us to ask further questions. However, the strength of network analysis does not lie in hermeneutic observations of the network, but in its potential for statistical explorations, which are the subject of the following section.

3.2 Network and statistics

In the opening paragraph of the previous section, we have suggested that the multiple cross-genre edges visible with a bare eye reveal that the analytical categories applied in the modern catalogues, such as late legendary sagas or late chivalric sagas, do not correspond to the ethnic genre classifications, as represented by the extant manuscripts. In order to evaluate this statement, it is necessary to apply computational methods of network assessment, which allows us to understand the topography of the network. One of the methods is the application of modularity statistic, 'which attempts to assess the number of distinct groupings within a network' (Cherven, 2015, p. 189). Using Gephi's in-built function 'Modularity' (with the following parameters: 'Randomize: On, Use edge weights: On, Resolution: 1.5'), we identified fourteen communities within the network.[11] Figure 4a–c presents three visualizations of the network, generated with different layouts. Here, unlike in the previous visualizations on Fig. 3, nodes are coloured by their modularity class.[12]

Even though fourteen communities have been distinguished in the network, modularity Classes 2, 3 (bright green nodes visible on Fig. 4b and c), 5, and 13 are all small communities of legal texts, while modularity Classes 6–12 are all small communities of *rímur*. Thus, there are three large communities in our network:

1) Modularity Class 0 (magenta nodes on Fig. 4a–c) consisting of texts classified mainly as *fornaldarsögur* (and *fornaldarsögur síðari tíma*) and *riddarasögur* (and *riddarasögur síðari tíma*), but also two *konungasögur*, two *konungaþættir*, one set of *rímur*, and one *Íslendingasaga*;
2) Modularity Class 1 (cyan nodes on Fig. 4a–c) consisting of Eddic texts and one legendary saga;
3) Modularity Class 4 (white nodes on Fig. 4a–c) consisting of mainly *Íslendingasögur* and *þættir*, *konungasögur* and *þættir*, but also some *fornaldarsögur* and *þættir*, three sets of *rímur*, and one *riddarasaga*.

The first community (modularity Class 0) is an intriguing one, consisting of 120 works across different genres of Old Norse literature, presented in Supplementary Materials (nodes_modularity). While *fornaldarsögur* and *fornaldarsöugr síðari tíma* together with *riddarasögur* and *riddarasögur síðari tíma* dominate in this group, there are couple of exceptions. One text classified as *Íslendingasaga* appears in this group, *Ármanns saga og Dalmanns*. Even though, *Ármanns saga* is included in Guðni Jónsson's edition of *Íslendingasögur*, it is worth to emphasize, that it is a nineteenth century creation. Just as in the aforementioned case of *Þorsteins saga Greinefufóstra*, the transmission context of *Ármanns saga og Dalmanns* indicates that it was treated in a similar way as most of legendary sagas and romances. In a similar manner, we should interpret the appearance of *konungasögur* and *konungaþættir* in this group (*Jómsvíkinga saga*, *Ynglinga saga*, *Hákonar þáttur Hárekssonar*, and *Hróa þáttur)*. Finally, the single set of *rímur* that appears in this group, *Gríms rímur og Hjálmars*, is the

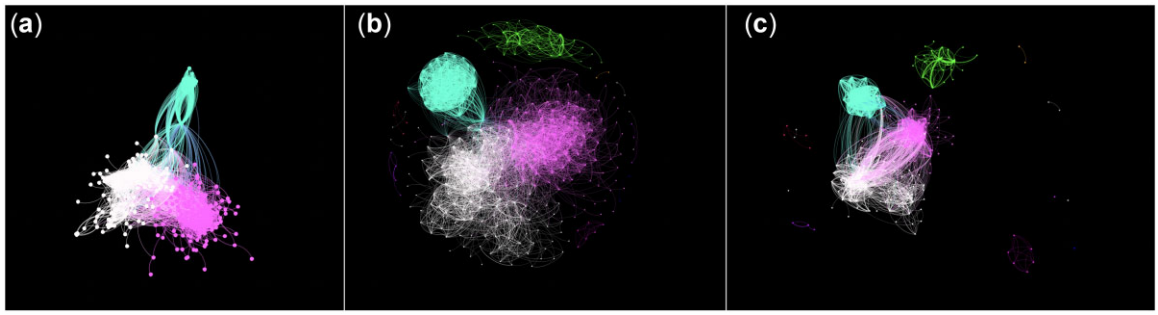

Figure 4. Main part of the network of Old Norse texts that appear together more than twice in catalogued manuscripts, nodes coloured by their modularity class—generated with ForceAtlas 2 (**a**), Fruchterman Reingold (**b**), and OpenOrd (**c**) layouts

sole set of *rímur* to be ever included in an early modern edition of legendary sagas. Due to its legendary subject matter, it is not surprising that it groups together with other texts included in this group.[13] Considering the nature of the works in this community, they can be best classified as romances, or works of narrative fiction which describe deeds of knights and heroes from the distant past.

The second community (modularity Class 1) is the most predictable of the three communities distinguished, as it contains almost exclusively Eddic poems, which just like legal texts and *rímur* were included in the present study as a control set. What is, however, interesting in this community is the presence of a single legendary saga, *Hervarar saga og Heiðreks* in addition to thirty-nine poems. On the one hand, it could be predicted, due to the high number of poetic stanzas this saga contains, which apparently frequently co-occur with Eddic poems, as discussed in Section 3.1. On the other hand, it is a quite typical representative of the legendary sagas, many of which contain stanzas, so one would expect it to belong the community with other representatives of this genre. Therefore, in order to understand *Hervarar saga*'s behaviour, modularity resolution has been changed to increase the number of communities and examine to which community this text belongs. With parameters 'Randomize: On, Use edge weights: On, Resolution: 0.4', twenty smaller communities have been identified. In this scenario, *Hervarar saga* groups appears in a small community together with *riddarasögur*. That *Hervarar saga* clusters neither with Eddic poetry, nor with *fornaldarsögur* is a quite unexpected behaviour and it cannot be explained at this stage without further examination of its manuscript tradition.[14] Overlooking the presence of *Hervarar saga* in this group, the most accurate classification for this community is Eddic poetry.

The third community (modularity Class 4) consists of an eclectic collection of 124 works, including mainly *Íslendingasögur* and related *þættir* and *konungasögur* and related *þættir*. Here we find works such as *Njáls saga* and *Egils saga*, but also *Óláfs saga Tryggvasonar hin mesta* and *Kntlinga saga*, as well as works classified as *fornaldarsögur*, such as, *Huldar saga hinnar miklu*, *Af Upplendinga konungum*, *Ragnarssona þáttur*, *Norna-Gests þáttur*, *Tóka þáttur, Helga þáttur Þórissonar*, and *Sörla þáttir*. The presence of *þættir* in this community corroborates the observations described in Section 3.2. Furthermore, three sets of *rímur* (*Skáld-Helga rímur, Óláfs ríma Haraldssonar, Fjósaríma*) appear in this group, together with one text classified as a *riddarasaga* (*Hrings saga og Skjaldar*). Finally, the aforementioned young *Íslendingasaga*, *Þorsteins saga Geirnefjufóstra*, which in the catalogues appears as *fornaldarsaga síðari tíma*, belongs to this community of texts. Due to the subject matter of the works included in this community, dealing with Norwegian kings and stories describing life in Iceland in the early days of the settlement, they can be best classified as historicising narratives, or pseudo history.

Leaving aside the communities within the network, another interesting finding that resulted from computational explorations is the identification of pairs of texts which appear to be strongly connected. Usually, when there is a particularly strong association between two texts, there is also an obvious literary historical explanation behind their relationship, as the strongest connections in the network tend to be well-known examples of textually strongly related texts. Moreover, these are usually also very popular texts that are preserved in a high number of manuscripts, thus their connections appear as the strongest. Due to the high number of overlapping connections in this part of the network, the visualization from Fig. 3 is not very helpful. The frequent connections become clear though filtering the dataset by edges' weights (Table 3).

Within our final network of 350 nodes and 4,797 edges, which includes only pairs of texts that appear together more than twice, the strongest connections occur between three sagas about Norwegian

Table 3. Texts with the strongest connections in the network

Source	Target	Type	Weight
Gríms saga loðinkinna	Ketils saga hœngs	Undirected	58.0
Gríms saga loðinkinna	Qrvar-Odds saga	Undirected	48.0
Ketils saga hœngs	Qrvar-Odds saga	Undirected	48.0
Jónsbók & réttarbætr	Kristin réttur Árna biskups	Undirected	41.0
Ragnars saga loðbrókar	Vǫlsunga saga	Undirected	35.0
Réttarbætr Eiríks Magnússonar	Réttarbætr Hákonar Magnússonar	Undirected	32.0
Gautreks saga	Hrólfs saga Gautrekssonar	Undirected	31.0

warriors from the ninth century: *Ketils saga hœngs*, *Gríms saga loðinkinna*, and *Örvar-Odds saga* (Simek and Pálsson, 2007, pp. 128–9, 224–5, 287–8.). These texts belong to the group of sagas called *Hrafnistumannasögur*, which are connected by the genealogy of the main characters. Ketill hængur Hallbjarnarson, the protagonist of *Ketils saga* is the father of Grímur Loðinkinni, the protagonist of *Gríms saga*, who in turn is the father of Örvar-Oddur, the protagonist of *Örvar-Odds saga*.[15] The genealogical connections between contents of the texts appear to play an important role also in transmission of other texts. In the top ten of the strongest connections in the network, we also have a pair of *Völsunga saga* with *Ragnars saga loðbrókar* as well as a pair of *Gautreks saga* with *Hrólfs saga Gautrekssonar*.

Völsunga saga and *Ragnars saga loðbrókar* are two *fornaldarsögur* which are often found together in manuscripts, possibly also due to the genealogical relations between some of the characters (Simek and Pálsson, 2007, pp. 308–9, 426–7). *Ragnars saga* can be seen as a sequel to *Völsunga saga*, as Áslaug, the daughter of Sigurður Fáfnisbani, the main protagonist of *Völsunga saga*, became a wife of Ragnar, the main protagonist of *Ragnars saga*. Similarly, *Gautreks saga* and *Hrólfs saga Gautrekssonar* are also two *fornaldasögur* with significant genealogical connection (Simek and Pálsson., 2007, pp. 106–7, 194–5.). *Gautreks saga* can be seen as a prequel to *Hrólfs saga Gautrekssonar*, as it takes its title from Gautrekur, a legendary king of Götaland and father of Hrólfur, the main protagonist of *Hrólfs saga Gautrekssonar*.

The next most common example of co-occurrence in the manuscripts, just after the three *Hrafnistumannasögur*, is a pair of legal texts grouped under the uniform titles 'Jónsbók & réttarbætur' and 'Kristinréttur Árna biskups'. While *Kristinréttur Árna biskups* and *Jónsbók* are known to be preserved together in manuscripts, because of their common origin at the end of the thirteenth century, it requires further analysis of the manuscript descriptions to reveal what the uniform title 'Jónsbók & réttarbætur' implies, in order to provide an interpretation of these relationships.[16]

Another interesting aspect of the network, that can be explored with Gephi, is the comparison of degrees of texts in different sub-groups. Degree is the number of edges that connect a given node with other nodes (cf. Cherven, 2015, pp. 185–7). The network's average degree equals to 27. Across the entire network, 45% of all texts have higher degree than average, and 54% lower; exactly one text has degree 27. The five texts with highest degree, meaning texts that are connected to the highest number of other texts are *Hervarar saga og Heiðreks* (102), *Egils saga Skalla-Grímssonar* (102), *Hálfdanar saga Eysteinssonar* (90), *Áns saga bogsveigis* (84), and *Hrólfs saga kraka* (83). This is quite surprising, as one would not expect these long narratives being connected to so many other texts, due to a simple fact that they take a lot of space in manuscripts. One would rather expect shorter texts to have higher degree, as many short stories can fit into an average size manuscript. At the same time, it suggests that these texts could be transmitted in manuscripts with a wide array of other texts. This certainly holds true for *Egils saga* and *Hervarar saga*, which frequently appear together with Eddic poems. If we analyse various classes (or genres) of texts, we can observe that the subgroup with the highest average degree is Eddic poetry (average degree 36) and only 2% of texts classified as Eddic poetry have lower degree than network's average (27), confirming the expected transmission pattern for these texts, i.e. many short poems co-occur in manuscripts in various constellations.

4 Main findings and further research

The previous section presented only a fraction of possibilities that the application of network analysis for manuscript studies can give to expanding our understanding of historical works of literature. Analysing these works in their wider manuscript context helps us to understand their pre-modern reception and provides us with valuable insights into the genre classification of Old Norse-Icelandic literature. While there are some indications that the scholarly boundaries are not completely irrelevant, as after all there are patterns of

co-occurrences that cannot be overlooked, such as that *Íslendingasögur* tend to group together with other *Íslendingasögur* or that *fornaldarsögur* group with other *fornaldarsögur*, it has to be emphasized that the numerous cross-genre edges suggest the great fluidity of these categories.

The main contribution of the present study to scholarship is that it empirically demonstrated the manifoldness of the connections between the Old Norse-Icelandic texts which transcend traditional scholarly genre boundaries applied to this corpus. Through statistical analysis of the network, we identified two main communities within the saga literature analysed. The first one can be described as community of romances, or works of narrative fiction, and it includes mainly *fornaldarsögur* and *riddarasögur*, while the second one can be described as pseudo-history, and it includes mainly *Íslendingasögur* and *konungasögur*. It seems that for the producers and users of these manuscripts, the distinction occurred on the axis of some sort of historicity of the texts versus their fantastic and entertaining values.

The third large community consisted of Eddic poems, which were included in the dataset as a control group, just as legal texts and *rímur*, which could be expected to reveal patterns of transmission detached from that of saga literature. It is worth emphasizing, however, that the Eddic poetry appeared as connected to saga literature due to its connections with *Hervarar saga* mainly, but also *Egils saga* (both texts being also among the texts with the highest degree in the network). Furthermore, some of the sets of *rímur* appeared within the two communities described above, for example, *Óláfs ríma Haraldssonar* within the pseudo-historical community (together with *konungasögur*), and *Gríms rímur og Hjálmars* within the community of narrative fiction (together with *fornaldarsögur*). This challenges the way scholars traditionally look at Old Norse literature, emphasizing distinction between prose and poetry. It suggests that the subject matter of a literary work could possibly overweight its literary form when it comes to putting texts together in manuscripts.

While the identification of the community of narrative fiction corroborates to a certain extent earlier research results on the relationships between manuscript context and genre, such as that *fornaldarsögur* and *riddarasögur* are very closely related, the pseudo-historical community draws totally different picture. Using categories introduced by Blobel (2015), the works examined in this study belong to 'secular narratives' and 'stories of Norwegian kings'. While Blobel observed more or less clear distinction between 'secular narratives' and 'stories of Norwegian kings' in the medieval manuscripts, this distinction cannot be equally clearly observed in our network, which includes all manuscripts regardless of their date of production. This might suggest, that the distinction between *konungasögur* and the rest of secular saga literature existed in the Middle Ages, but with time it started evolving and blurring out, so that *Íslendingasögur* separated themselves from *riddarasögur* and *fornaldarsögur* and instead joined *konungasögur*. On the other hand, to the best of our knowledge, the dataset used in Blobel's study is not freely available, so it was impossible for us to reproduce his results and analyse his network with various modularity resolutions.

To summarize our observations in relation to our initial research questions, we can conclude that there is definitely some potential in analysing transmission of literary works as networks of works and manuscripts, but the results will only be as good as datasets used. In our study we focused on aggregating data from various sources to provide macro-scale analysis on the corpus of Old Norse-Icelandic sagas. Even though the network presented here delivered interesting insights into the transmission of saga literature, further work is needed to exploit the potential of the application of computer assisted methods for Old Norse-Icelandic manuscript studies. For instance, modelling of all the data currently available for Icelandic manuscripts without generic or chronologic demarcations would be the most exciting one, but also extremely time consuming when it comes to cleaning of the data and creating valuable analytical categories for different types of works. At the same time, the network provides us also with a good starting point for further philological analysis of certain areas in which texts belonging to different genres appear together. In-depth analyses of the two main communities identified here would be especially welcomed.

Supplementary data

Supplementary data are available at *DSH* online.

Author contributions

Katarzyna Anna Kapitan (Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Software, Supervision, Validation, Visualization, Writing—original draft, Writing—review and editing). Tarrin Wills (Conceptualization, Data curation, Investigation, Methodology, Resources, Writing—original draft, Writing—review and editing).

Notes

1. Despite the important scholarly discussions on the definitions of terms 'text' and 'work', in this study, we do not distinguish between the two in any systematic matter. What were are actually working with are titles of msItems, according to the TEI Guidelines for cataloguing manuscripts in XML (TEI Consortium, 2020). Therefore, we allow

ourselves to use 'text' and 'work' interchangeably. The present article adheres to the Modern Icelandic orthography in its prose, but the raw data use the Old Norse orthography, hence the discrepancy between the saga titles as listed in tables and Supplementary Materials and in the prose of the present study.

2. For an introduction to various types of Old Norse literature, see McTurk (2005); for more recent publications, see, for example, Jakobsson and Jakobsson (2017) and Bampi *et al.* (2020); for introduction to the history of Icelandic literature, see, for example, Einarsson (1961) and Jónsson (1923); for a discussion of genre in Old Norse literature, see, for example, Andersson (1975), Harris (1975), Lönnroth (1975), and Quinn (2006), but also the most recent overview prepared also with network analysis in mind by Blobel (2015, pp. 2–6).
3. For examples of other studies in which manuscript evidence is brought up when discussing various genres, see, among others, Ashman Rowe (1993), Guðmundsdóttir (2001, p. cxlvii), Cormack (2005), Gunnell (2005), and Jakobsson (2012).
4. It is worth noting that due to the continuity of Icelandic manuscript production until the twentieth century, the present study does not use any distinction between medieval manuscripts and post-medieval manuscripts and instead focuses on the entire corpus. In our initial experiments, we used various watersheds for the dates of manuscripts' production to examine whether the clustering of texts changed depending on the time on manuscripts' production, but they did not have any clear influence on the general clustering within the network, see also Kapitan *et al.* (2017).
5. Even though a study applying our methodology to contents of reconstructed codices would be highly desirable, this remains outside the scope of our study. First of all, because Stegmann's (2016) catalogue contains descriptions of 114 manuscripts mainly from sixteenth and seventeenth centuries, which establishes a small portion of all known Icelandic manuscripts. Moreover, her webpage http://chopandchange.nfi.ku.dk/ is currently down and it is only partially available through the Wayback Machine (accessed 28 November 2022).
6. The catalogue previously available on fasnl.ku.dk in 2022 was migrated to fasnl.net. To the best of our knowledge no change has been introduced to the dataset.
7. The original list of nodes consisted of all texts catalogued in the respective catalogues and they were grouped into 129 categories (class attribute has 129 possible values). We were mainly interested in the texts classified in *Handrit* as fas, forns, fornth, isl, islt, kon, konth, ridd, riddst, but we also included edd, rimur, law as control groups. The list of class values can be found by following this link https://handrit.is/manuscript/list/keyword/ridd and changing the last part with the corresponding class value. Note that recently some updating of the authority lists on *Handrit* took place, but the scope and extend of these changes is unknown to us.
8. To assure possibilities for reproducing our experiment, we attach CSV flies for edges and nodes in the Supplementary Materials, as networkEdges_4797.csv and networkNodes_360.csv.
9. The preliminary analysis of *þættir* has been conducted by Timothy Rowbotham (University of York), who is currently working on a full analysis of the *þættir* and their relationships to other Old Norse texts. For existing studies of *þættir*, see, for example, Ashman Rowe (2004) and Anshman Rowe and Harris (2005).
10. *Konungasögur* and *Íslendingasögur* are sometimes treated as historical sources, while *fornaldarsögur* remain on the spectrum of literary fiction.
11. The result of this calculation: 'Modularity: 0.598, Modularity with resolution: 1.050, Number of Communities: 14'.
12. Spreadsheet nodes_modularity.xlsx in Supplementary Materials includes lists of works and their modularity classes.
13. There is increasing interest in the influence of printed edition on manuscript culture of Iceland, see, for example, Kapitan (2021b). Moreover, Ermenegilda Müller is currently working on a PhD thesis at the University of Iceland which aims to examine the earliest printed editions of Icelandic sagas and their cultural significance.
14. Only the oldest portion of the *Hervarar saga* tradition has been already studied, see Love (2013).
15. The relationships between these works have recently been subject of investigation, see Ellyton (2021).
16. The same holds true for the relationships between *Réttarbætr Eiríks Magnússonar* and *Réttarbætr Hákonar Magnússonar*, which appears to be a problem with the underlying data. By exploring online interface developed by Tarrin Wills https://skaldic.org/m.php?p=npil we can find all the manuscripts which preserve these texts together and discover the catalogue entries for these codices not always provide information, which *réttarbætr* can be found there. Compare, for example, the description of AM 31 8vo https://handrit.is/en/manuscript/view/da/AM08-0031 with AM 128 4to https://handrit.is/en/manuscript/view/is/AM04-0128 (last accessed 28 November 2022).

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