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Timber as a Marine Resource: Exploitation of Arctic Driftwood in the North Atlantic

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Abstract

The North Atlantic islands of the Faroe Islands, Iceland and Greenland have always been relatively poor in terms of native timber resources, due to their cold climate and exposed topography. Nevertheless, timber was vital to the material culture of the Norse settlers of these islands, and driftwood often met this need. As in subarctic Norway, where trees are also scarce, driftwood use and ownership were prescribed in medieval law codes. Historical documentary evidence shows that wealthy landowners bought driftwood rights as valuable assets, and ethnohistorical sources reveal a wide range of local and regional customs related to driftwood exploitation. However, driftwood was an unstable resource, and its delivery depended on a range of unpredictable factors related to climate and ocean currents. There is also ongoing debate regarding the

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relative importance of imported timber, which is for example often referenced in the Icelandic sagas. The use of driftwood is difficult to demonstrate through macroscopic, microscopic, or (geo-)chemical analysis. Similarities in the microscopic anatomy of boreal wood taxa preclude definitive provenancing through taxonomic analysis, and material traces of immersion in seawater are often either impermanent or ambiguous, especially in archaeological wood remains. This paper presents a comprehensive review of current historical and archaeological research on the exploitation of driftwood timber in the Medieval North Atlantic and explores potential future directions in this field. Furthermore, it asserts that this line of research should be pursued with some urgency, as anthropogenic climate change threatens both driftwood delivery and the preservation of archaeological wood remains.

Keywords

archaeology – history – sagas – Iceland – Greenland – Norway – construction – boatbuilding

1 Introduction

Ójá, elsku vinurinn;	Oh yes, dear friend,
Fjörurnar eru fullar af	The shores are full of
Klumbum og drumbum,	Lumps and stumps,
Hnyðjum og hnúgum,	Clubs and knots,
Kyljum og rótum,	Knobs and roots,
Spýtjum og sprekum,	Planks and pieces,
Ásum og súlum,	Beams and pillars,
Röftum og rám,	Rafters and frames,
Keflum og mori,	Logs and small fragments,
Kubbum og trjám.	Blocks and trees.

ÞORVALDUR JAKOBSSON, Furufjörður á Ströndum, Iceland, 1883
KRISTJÁNSSON 1980: 270, transl. DAWN ELISE MOONEY 2016

Timber has always been a vital resource in Scandinavia. The region's dense forests provided wood not just for domestic and industrial fuel, but also for construction, boatbuilding, and the production of all manner of objects, from containers and utensils to weapons and art pieces. However, at the northern- and westernmost fringes of the Norse world, wood was less abundant. The latitude, climate, and topography of subarctic Norway and the North Atlantic

islands of the Faroe Islands, Iceland, and Greenland mean that few trees grow there, and those that do are often small and twisted. Although such trees rarely provide wood suitable for construction or the production of larger objects, the inhabitants of these areas still relied on wood for these purposes. These needs were met by driftwood: long, straight logs, mostly of conifer wood, driven onto the North Atlantic coasts by Arctic Ocean currents.

From the Viking Age and earlier through to Early Modern times, timber was a dynamic and unpredictable marine resource in these regions. Driftwood is still an important raw material today, although it is predicted that the loss of sea ice due to anthropogenic climate change will stop the delivery of driftwood to Iceland within the next 40 years (Kolář *et al.* 2022). In the past, the variable supply of driftwood engendered unique wood acquisition strategies. This adaptability and resilience is explored in this paper through the analysis of a variety of sources: historical, documentary, ethnological, literary, and archaeological. We use ethnohistorical accounts to inform our insight into past driftwood use; while we acknowledge the time-depth between these sources and our archaeological evidence, we believe it is still reasonable to draw parallels between the two due to significant environmental and cultural continuity. We focus on Iceland, which boasts the greatest breadth of information on past driftwood exploitation, but also consider material from subarctic Norway and Greenland in particular. In collating this information, we aim to present one key aspect of the resourceful and varied timber exploitation strategies employed in Norse society, and highlight the importance of considering these strategies in all studies of Norse wooden objects. Translations from Old Norse, Icelandic, and Norwegian are by the lead author unless otherwise stated.

2 The Study Area

This paper mainly deals with the North Atlantic islands in the Medieval Period (ca. 790–1450 CE), although, as mentioned above, we also use ethnohistorical sources from as late as the 20th century CE. In this paper, we consider the 'North Atlantic' to encompass Iceland, Greenland, and the Faroe Islands, although we acknowledge that the Hebrides, Orkney, Shetland, and Newfoundland could also be included (Mooney *et al.* 2022a). All of these regions were colonised by Norse settlers during the Viking Age (ca. 790–1066 CE). Many of these settlers came from densely forested areas, where woodlands with large timber trees, such as *Quercus* sp. (oak) and *Pinus* sp. (pine), provided the single most important raw material for construction and daily life in a largely aceramic society.

However, when Norse settlers arrived on the North Atlantic islands, the forests they encountered were different from those of their homelands. In response to the colder climate and more exposed topography of the islands, woodlands were generally relatively low-growing, and trees suitable for the production of large, straight posts and planks were very rare. The woodland flora was also different: *Betula pubescens* (downy birch) was the only forest-forming tree taxon, with occasional *Sorbus aucuparia* (rowan) and *Populus tremula* (aspen) in Iceland, *Sorbus groenlandica* (Greenland mountain ash) and *Alnus alnobetula* (alder) in Greenland, and possibly *Corylus avellana* (hazel) in the Faroe Islands, although the latter's presence is uncertain (Vickers *et al.* 2005). In addition, the islands are home to various shrub and dwarf taxa, including *Betula nana* (dwarf birch); various species of *Salix* (willow); Ericaceae including *Calluna vulgaris* (heather), *Empetrum nigrum* (crowberry), and *Vaccinium* spp. (blueberry/cranberry); and *Juniperus communis* (juniper), the region's only native conifer taxon. This woodland and shrub vegetation was vulnerable to disturbance: for example, clearance and grazing in Iceland led to a decline in woodland cover from 25–40% before colonisation to a low of 1% in the mid-20th century CE (ÞH Jónsson 2005; Erlendsson & Edwards 2010; Dugmore *et al.* 2014; Eysteinsson 2017).

The traditional narrative of the environmental impacts of the Norse in the North Atlantic blames the settlers for this mismanagement and assumes an immediate and sharp decline in wood availability, when in fact the picture is much more nuanced (for a more detailed discussion of this, see Mooney *et al.* 2022b). The Norse would not have been unfamiliar with the low-growing, birch-dominated woodlands and heathlands of this area, as they had encountered similar environments in northern Norway. Therefore, we contend that archaeological, historical and ethnographic sources from this region, comparable to the modern Norwegian counties of Nordland and Troms og Finnmark, can be compared to material from the North Atlantic islands in a holistic analysis of northern wood exploitation strategies. In both these regions, the limited wood available from local forests was supplemented by significant quantities of driftwood arriving on the coasts.

3 Driftwood Delivery in Subarctic Norway and the North Atlantic

Driftwood is any dead tree or part thereof transported by ocean currents. Such wood is mostly transported to the sea by rivers, where it is known as '(large) instream wood'. Tree death through various causes, including normal aging, bank erosion, landslides, wildfires, storm events, and insect or fungal activity,

can lead to the introduction of wood into river systems (Wohl & Iskin 2021). In modern times, logging also contributes significantly to large wood in rivers; timber transported along rivers by rafting is easily lost and swept out to sea (Hellmann *et al.* 2017). Some driftwood may be transported only a short distance before it is deposited on beaches near the estuary of the river from which it originates. The northern coasts of North America, for example, see significant delivery of wood from local rivers, which has been extensively exploited by indigenous populations (Lepofsky *et al.* 2003; Alix & Brewster 2004; Alix 2005; Shaw 2012; Steelandt *et al.* 2015). However, this paper mostly focuses on Arctic driftwood, which is transported over much greater distances.

Wood can only remain buoyant for a certain amount of time, depending on its porosity, and conifer wood is generally more buoyant than wood from broadleaf trees (Häggblom 1982; Hellmann *et al.* 2017). Large wood entering the ocean in temperate and tropical regions sinks relatively quickly to the seafloor, and these 'wood falls' create important marine habitats, which are threatened by declining wood input from rivers (Wohl & Iskin 2021). However, wood from the largely coniferous boreal forests transported into the Arctic Ocean can remain afloat long enough to be incorporated into sea ice. This enables wood from the taiga to be transported to shores across the circumboreal region (Fig. 1).

The dominance of coniferous trees, especially of the genera *Pinus* (pine), *Larix* (larch), and *Picea* (spruce), in boreal forests leads to challenges in provenancing Arctic driftwood. Many of these taxa have large distributions, and similarities in their microscopic wood anatomy preclude provenancing through traditional taxonomic analysis (Mooney, Pinta & Guðmundsdóttir 2022). However, differences in growth conditions across the potential source regions of Arctic driftwood allow for the provenancing of driftwood through dendrochronological analysis. Analysis of samples from Iceland, Greenland, the Faroe Islands, and Svalbard has shown that the majority of driftwood in these regions originates from the Yenisei River Basin in central Siberia (Eggertsson 1993; Johansen 1998; Hellmann *et al.* 2017). In northern Norway, a small but significant additional quantity of driftwood originates from the Pechora River Basin and the White Sea region (Johansen 1998). Input of driftwood from the Dvina-Pechora river catchments has also been noted in Svalbard, and in both Greenland and Iceland, small quantities of driftwood from the Mackenzie and Yukon Rivers of North America have been observed (Eggertsson 1993; Johansen 1998; Hellmann *et al.* 2017).

Wood that enters the Arctic Ocean from these rivers is not always washed up as driftwood. Even after being incorporated into sea ice and melted out again, wood may well sink before it reaches shore. For Arctic driftwood to

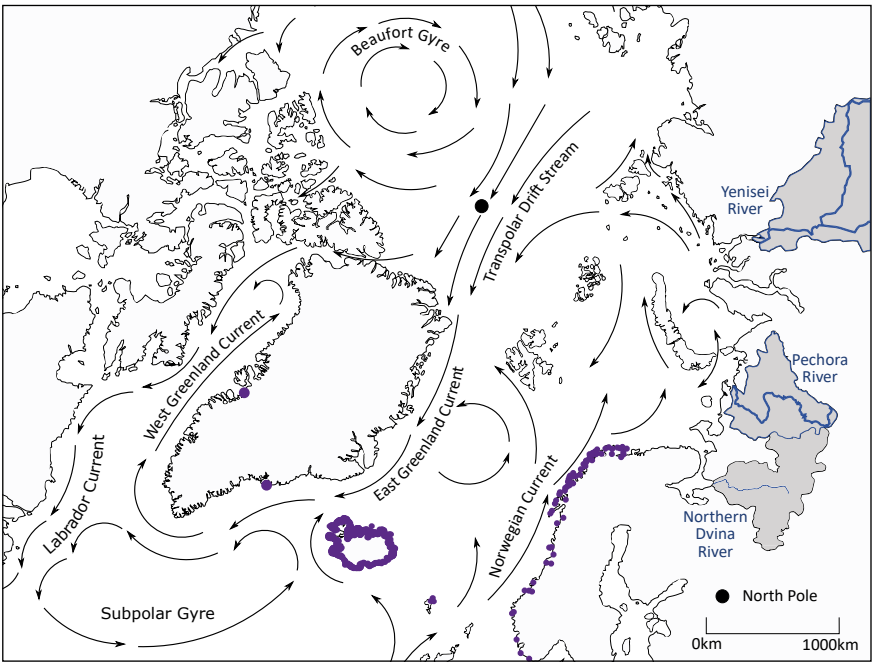

FIGURE 1 Map of the North Atlantic and Arctic showing the river catchments that are the main source of Arctic driftwood, and the ocean currents that transport driftwood. Purple dots indicate locations of driftwood delivery in Norway, Iceland, the Faroe Islands, and Greenland, according to documentary and ethnohistorical evidence. BY DAWN ELISE MOONEY AND TORBJØRN ALM, AFTER MOONEY *ET AL.* (2022A), WITH ADDITIONAL INFORMATION FROM KRISTJÁNSSON (1980) AND DANISH GEODATA AGENCY (2020A,B)

reach the coast of northern Norway, it must first cross the Norwegian Current (Fig. 1), a branch of the Gulf Stream that flows northwards along the Norwegian coast and on towards Svalbard. Therefore, the largest quantities of driftwood arrive on beaches after storms and strong winds, particularly from the northwest (Alm & Johansen 2009). In Iceland, where wood is transported directly from the Arctic Ocean via the Transpolar Drift Stream and the East Greenland Current (Fig. 1), good driftwood years are often linked to incursions of drift ice (J Jónsson 1967; ÁG Jónsson 2020). Historical annals from Iceland often show a link between winters with sea ice and large quantities of driftwood, although this is not always the case, and there seems to be much variation both around the country and from year to year. Stormy weather also plays a role in 'loosening' driftwood from sea ice and enabling it to be transported to shore. A lack of fast ice, which can prevent driftwood from easily washing ashore, is

also related to good driftwood delivery (Hole & Macias-Fauria 2017). Strong onshore winds were also important in Iceland (Kristjánsson 1980: 247–250), and presumably also in Greenland and other North Atlantic islands.

The long, straight trunks of conifer timber arriving as driftwood in these regions were a marked contrast to the native wood, and while the latter was used as fuel, driftwood was generally of greater value in construction and boatbuilding. Additionally, the taxonomic composition of Arctic driftwood is so distinct from that of the native flora of the North Atlantic islands that identifying the species of wood used in an artefact or structure provides a strong indication of whether it is native, imported, or drifted (Malmros 1994; Mooney 2016b). This method of provenancing has been used extensively on archaeological material in the North Atlantic, and is discussed further below. However, we will first explore the evidence for driftwood use in historical and literary sources from the region.

4 Historical Evidence for Driftwood Use and Management

4.1 *Early Historical Sources*

In the earliest description we have of northern Norway, the 9th century CE account of the voyages of Ohthere, nothing is said of wood. All the land to the north of Hålogaland is described as an empty wasteland with no permanent habitation (Bately 2007). The indigenous population probably made significant use of the driftwood here, as did the Sámi from the Medieval Period to the recent past (Berg 2001; Sjølie 2013). However, this under-researched topic is beyond the scope of this paper.

The earliest primary historical source regarding the Norse North Atlantic diaspora is *Íslendingabók*, written in the 12th century CE by the Icelandic priest Ari *hinn fróði* (the Wise) Þórgilsson (ÍF I). The book provides a succinct history of Iceland from the arrival of the first settler, Ingólfur Arnarson, in 874 CE up to the nation's official conversion to Christianity in 1000 CE. It is in *Íslendingabók* that we find the iconic statement about the pre-settlement landscape of Iceland: *Í þann tíð var Ísland viði vaxit á milli fjalls ok fjöru* (at that time, Iceland was wooded from the mountains to the shores) (ÍF I: 5). However, while these twelve words continue to inspire investigations of the Norse relationship with wood resources in Viking Age Iceland (Mooney *et al.* 2022b), driftwood is not mentioned once in *Íslendingabók*.

Early sources describing Greenland are similarly vague with regard to driftwood. The 13th century CE text *Konungs skuggsjá* (The King's Mirror), which

includes descriptions of the 'marvels' of Norway, Iceland, and Greenland, does not mention driftwood at all (Larson 1917). In Ívar Bárðarson's 14th century CE *Det gamle Grønlands beskrivelse* (Description of Greenland), it is recorded that all the drift rights (including wood but also *hvalreki* or drift whales, i.e., whales found beached or drifting at sea, which were exploited for their meat, blubber, bone and baleen) around the head of Ketilsfjörður belonged to the parish of Árósskirkja (Mathers 2009: 79). This area has numerous islands and islets/skerries, and may have been a good driftwood catchment area. *Grænlandsannál* (the Greenland Annal), a 17th century CE source most likely derived from medieval sources, states that driftwood could be obtained in *Norðurseta* (the northern hunting ground, around the modern-day Disko Bay area) (Halldórsson 1978).

The earliest references to driftwood in the Norse textual sources are found in *Landnámabók* (ÍF I), which dates to the 12th century CE and gives a detailed account of the settlement of Iceland, including the names of the first settlers and where they settled. Although it is of debatable historicity (Friðriksson & Vésteinsson 2003), *Landnámabók* nonetheless offers accounts of the Icelandic settlement that are worth considering in light of the importance of driftwood.

A common element in these accounts is the practice of casting the *ǫndvegissúlur* (high-seat pillars to be used in the settler's *skáli* or longhouse) overboard and building a house where they washed ashore. The classic example of this is that of Ingólfur Arnarson, Iceland's legendary first settler, whose high-seat pillars washed ashore in Reykjavík (ÍF I: 42–45), but several other cases are also known (e.g., ÍF I: 124, 302, 311–312, 317). A twist on the trope occurs in *Egils saga Skallagrímssonar*; when Skallagrím's father Kveld-Úlfur dies on his journey to Iceland, his last wish is that his coffin be cast overboard and Skallagrím build his house on the nearest suitable land to where it washed ashore (ÍF II: 71, Chapter 27). The motif is also reversed in the tale of Hallsteinn Þórólfsson, who, on settling in Þorskafjörður, made sacrifices to Thor so that he would send wood to make his high-seat pillars. Thor obliged, and shortly after, there drifted to shore a huge tree trunk large enough to make high-seat pillars for all the farms in the area (ÍF I: 164). Lastly, the trope is subverted in the case of Kráku-Hreiðar, who, instead of casting his pillars overboard, asks Thor to guide his ship to land (ÍF I: 232).

The practice of following floating wooden objects to shore, be they high-seat pillars, beams (*setstokkar*, ÍF I: 371), boats, or coffins, has led some to cast the Icelandic settlers as early oceanographers aiming consciously to map ocean currents (Stefánsson 1962; Scigliano 2009). This is perhaps misleading: the Norse were a seafaring people who relied on a deep understanding of the patterns of movement of water and wind, and to simplify this expertise as 'oceanography' is to undermine the importance of experience and embodied

knowledge. The maritime know-how of the Norse was more comparable to Polynesian wayfinding (*cf.* Buente *et al.* 2020) than to modern scientific pursuits. Knowing where coastal currents transport flotsam might also indicate a good route to shore, a place where seals and walruses might haul out to rest, or where driftwood or drift whales might be washed ashore. All these properties could have added value to a land claim.

4.2 *Medieval Law Codes*

The importance of driftwood can also be seen in the legislation of its ownership and use. The most comprehensive description of the laws relating to driftwood in the study area is found in *Grágás*. This collection of medieval Icelandic laws derives from two manuscripts: *Konungsbók*, written around 1260 CE, and *Staðarhólsbók*, from around 1280 CE. The laws presented in these two manuscripts are in some cases virtually identical, in some cases complementary, and in others contradictory. This suggests that the two books were based on the same initial source material and that legal opinions later diverged. The laws of Commonwealth-period Iceland were based on the west Norwegian *Gulatingsloven* and were instituted at the first meeting of the *Alþing* (the Icelandic parliament) in 930 CE (ÍF I: 8). These were passed down orally through the office of the *lögsögumaður* or lawspeaker, until they were recorded in writing around 1117 CE (Lárusson 1958; Dennis *et al.* 1980, ÍF I: 23). This leaves a gap of over a century between the first codification of the Icelandic laws and the manuscripts comprising *Grágás*. It is likely that laws were modified and added to during this period, and that editorial changes and additions were made in the writing of the manuscripts. This is the most likely reason for the divergence between the two extant versions. The main translation of *Grágás* used here (Dennis *et al.* 1980, 2000) derives from *Konungsbók*; however, references to material from *Staðarhólsbók* are also included below (marked as 'Add. XX').

The laws in *Grágás* operate on the principle that in cases where land was owned, ownership included rights to all the drift that landed on the coast of the property. This also applied to coastal resources other than timber, such as whales, seals, and fish. This ownership was only relinquished if the drift rights were removed from the land by gifting, sale, or payment (Gr. Ch. 209). Each landowner had a unique driftwood ownership mark; they would carve this onto timber that washed ashore on their property in order to identify it as belonging to them, even if it then drifted out to sea again and washed ashore on a beach belonging to another (Fig. 4). If a landowner found wood with another's mark on their beach, the laws stipulated that this landowner send word to the original owner as soon as possible (Gr. Ch. 209, Add. 440).

A fine of three marks (one mark being a weight of eight ounce-units, equivalent to forty-eight ells of homespun cloth or *vaðmal*) was imposed upon anyone who took driftwood amounting to less than three ells (an ell being approximately the length of a person's forearm). However, if the timber stolen amounted to three ells or more, the landowner could decide what charge to bring (Gr. Ch. 209). Exceptions to this were possible: if people rowing along the coast sustained damage to their vessel or oars, they had the right to take driftwood from the nearest shore for the necessary repairs, as long as they announced this at the next settlement and repaid the landowner for the value of the wood (Gr. Ch. 211, Add. 440). This mirrors another exemption for travellers, namely, for the repair of sleds and horse tack using timber from another's woodland (Gr. Ch. 199).

As boundaries on the sea cannot be as clearly demarcated as on land, an arbitrary distance was set to indicate how far the drift rights of landowners stretched offshore from their beach. This is given as being:

> the range at which an unsplayed fish can be seen on a boat's side: that is to be a codfish of such a size that when splayed it is an ell wide across the brisket. Such a fish is called a gildingr. That fish has to be visible on a boat's landward side, seen from the shore on the line where the tide goes out farthest.
>
> Gr. Ch. 211, trans. DENNIS *et al.* 2000

Beyond this distance, any person had the right to salvage and claim ownership of any floating timber they might find, and to tow it to shore. If this person towed the timber to another person's beach, which was also a drift shore, they would then have to remove the timber within three nights or face a fine (Gr. Ch. 211, Add. 440).

Further laws existed governing the use of driftwood where drift shores were included in the rented property of tenants. Tenants were allowed to take sticks up to an ell long from the shore, and wood to repair any household implements. However, if the tenant wished to use the driftwood to make new household implements, this would be permitted, but these implements had to remain on the property if the tenant moved away (Gr. Ch. 220).

It is clear from these laws that Icelandic driftwood was deemed to merit careful control, and that there could be severe punishments for its misuse. Although the laws in *Grágás* are said to be based on *Gulatingsloven*, the latter contains little legislation on the use and ownership of driftwood. Norwegian laws related to driftwood are less explicit than those in Iceland; rather, they

either were not codified or do not survive. The extant medieval laws derive from southwestern Norway, where driftwood was scarce and of little importance. Whatever laws existed in Viking Age and medieval northern Norway have been lost. They are far more likely to have included detailed provisions regarding the right to collect driftwood. However, northern Norway being a sparsely populated and 'marginal' area, these laws seemingly had little influence on later laws for the entire country.

In *Gulatingsloven* it is stated that all drift goods on common land belonged to the king (Larson 1935: 124), while ownership of drift goods otherwise followed land ownership. In areas covered by *Gulatingsloven* and *Frostatingsloven*, this is more likely to have been relevant for goods and materials from shipwrecks than natural driftwood. This pattern, indicating a highly centralised society, also applied to Norse Greenland: Ívar Bárðarson recorded that remote resource regions were generally controlled by the bishop, and even on 'common' land, permission was needed from the bishop to access resources (Mathers 2009; Guðmundsdóttir 2021).

The judicial review of land rights in Finnmark, Norway (Norges offentlige utredninger (NOU) 1993), deals with various resources and devotes a separate chapter to the subject of driftwood. It is assumed that the old Norwegian laws and practices related to driftwood were similar to those of the Norse settlements in Iceland and the Faroes. Thus, at least theoretically, driftwood found at sea belonged to the finder, whereas stranded driftwood belonged to whoever owned the shore. Nonetheless, it seems that the finder was often allowed to keep stranded driftwood, at least outside the major driftwood beaches. Additionally, large coastal stretches in Finnmark (where only a tiny fraction of the land is privately owned) remained open for everyone, and were at most regulated by traditional views regarding who had the right to collect driftwood there. These folk practices are discussed further below.

The details of the laws governing driftwood in *Grágás* bear some similarity to those relating to the ownership of drift whales in *Gulatingsloven* (Larson 1935: 126–127) and *Frostatingsloven* (Larson 1935: 396–397). The Icelandic laws were likely partially based on these ownership rules, but they may also have formalised some established customs already existing in Iceland and Norway (*cf.* Bratrein 2009) along with legal practices from northern Norway. The application of these laws in Greenland is also unclear, except that in *Grœnlendinga þáttr*, a matter is settled *eftir grœnlenzkum lögum* (according to the laws of the Greenlanders) (ÍF IV: 279). This implies that while some rulings were probably made according to laws shared with Iceland, others were made in a manner specific to Greenland. Laws are also often based on individual cases (Lárusson

1958; Dennis *et al.* 1980; Karlsson 2000). Therefore, we can consider all these stipulations as insights into what landowners perceived to be a threat to their resources and the penalties considered to be just.

The laws presented in *Grágás* remained in use until around 1271 CE, after which a new law code, *Járnsíða*, came into use. *Járnsíða* was short-lived, however, and in 1281 CE, a new set of laws, *Jónsbók*, was introduced (Karlsson 2000). However, while both these law codes set out changes to the Icelandic constitution, laws governing the use and control of driftwood remained largely unchanged (*cf.* Dennis *et al.* 1980, 2000; Bernharðsson *et al.* 2005; M Jónsson 2005). As *Grágás* provides the most comprehensive information, we have focused on this rather than reiterating similar edicts presented in each of the three medieval law codes.

4.3 *Land Registers, Property Deeds and Other Documentary Sources*

The longevity of the laws relating to driftwood use are, in Iceland, mirrored by ownership rights, which in many cases were established in the Medieval Period and retained until the 20th century. As mentioned above, ownership of drift was originally tied to land ownership; however, it could be dissociated from the land by gifting, sale, or payment. The importance of driftwood can be observed in the way high-status farms and ecclesiastical institutions built up 'portfolios' of drift rights over time. For individual landowners, this practice can be traced through documents preserved in *Diplomatarium Islandicum* or *Íslenzkt Fornbréfasafn* (DI), a collection of Icelandic letters and documents dating from 1170 to 1590 CE. Of particular interest are *máldagar*, deeds detailing the property owned by high-status farms, and *rekaskrár*, surveys compiling the drift rights owned by ecclesiastical institutions. In some cases, such as the powerful church farm of Vatnsfjörður við Ísafjarðardjúp, these rights were established early. The farm's drift rights are the same in documents from 1327 CE (DI II: 618–621), 1397 CE (DI IV: 133–136) and 1509 CE (DI VIII: 286–288), as well as in later land registers (see below). For farms in regions marginal for pastoral farming, such as Vatnsfjörður, control of remote resources, including driftwood, was critical in establishing and maintaining socioeconomic power.

In addition to detailing property rights, DI also contains court rulings including punishments for the misuse of such resources. Examples include a case from 1519 CE, when Guðmundur Ingjaldsson was fined five marks for taking driftwood and drift whales from others' beaches on the southwest coast (DI VIII: 682–684), and the case of Halldór Brynjólfsson, who in 1492 CE was fined 30 marks for the unlawful taking of drift from several beaches (DI VII: 108–111). These accounts can be compared to the laws regarding driftwood, as outlined

above; in these two cases, the amount of wood taken was greater than three ells, and the plaintiff chose to seek a financial penalty (*cf.* Gr. Ch. 209).

The documents preserved in *Diplomatarium Islandicum* mostly relate to high-status (generally ecclesiastical) farms and institutions, either directly or through their authority in legal matters. They list the resources owned by these properties, but provide little detail on their quality or use. For this, we must look to *Jarðabók Árna Magnússonar og Páls Vídalíns* (JÁM), compiled in 1702–1714 CE as a population and livestock census. The survey also recorded environmental resources and external resource rights for both occupied and abandoned farmsteads, following a standardised methodology that varied little across the country. Unfortunately, records for the eastern part of the country were lost in the Copenhagen fire of 1728 CE, but the work remains invaluable for the discussion of resource ownership and exploitation in post-medieval Iceland.

An analysis of references to driftwood in records from 8 of the 17 counties covered by the extant volumes of JÁM is presented here (Supplementary material available online at https://doi.org/10.5281/zenodo.7451316) and summarised in Table 1. The data are derived from the counties of Rangárvallasýsla (JÁM I), Borgarfjarðarsýsla (JÁM IV), Snæfellssýsla (JÁM V), Ísafjarðarsýsla (JÁM VII), Strandasýsla (JÁM VII), Skagafjarðarsýsla (JÁM IX), Eyjafjarðarsýsla (JÁM X), and Þingeyjarsýsla (JÁM XI). The ownership status of driftwood at farmsteads in the counties studied is presented in Fig. 2. A distinction is not made between ownership of driftwood on one's own land and ownership of drift rights on someone else's land. As Fig. 2 shows, the proportion of farms with driftwood ownership ranges from around 10% in Borgarfjarðarsýsla, Ísafjarðarsýsla, and Eyjafjarðarsýsla to as high as 50% in Strandasýsla. This has much to do with location. The best driftwood beaches in Iceland face north and/or west and are located on exposed coasts. While such beaches abound in Strandasýsla, the majority of farms in Borgarfjarðarsýsla and Eyjafjarðarsýsla are inland, and although most in Ísafjarðarsýsla are coastal, the sheltered nature of the county's deep, narrow fjords is not optimal for driftwood delivery.

Figure 2 also shows the ownership of driftwood at these properties. In some cases, this was uncertain: this means either that driftwood was mentioned without ownership being specified, or — in a few cases — that the owners/tenants of the property were unsure of the ownership of the driftwood. In many cases, the driftwood was owned by the farm in question, while in others, the drift rights were owned at least partially by other farms or ecclesiastical institutions, or split between several owners in the case of particularly productive beaches. Gísli Pálsson (2018: 22) has used this information to map the networks of rights to the collection of driftwood and drift whales in JÁM, showing how

TABLE 1 Summary of references to driftwood in Jarðabók Árna Magnússonar og Páls Vídalíns from eight Icelandic counties

	Rangárvallasýsla	Borgarfjarðarsýsla	Snæfellsnessýsla
JÁM volume	I	IV	V
Total farms	561	295	308
Driftwood delivery			
Good	4	9	11
Moderate	0	6	17
Poor	2	3	20
Mention only	64	4	6
Ownership of drift			
Subject farm	34	9	8
Other farm(s)	0	4	3
Church(es)	26	0	0
Mixed	10	1	1
Unclear	0	8	42
Uses of driftwood			
Fuel	0	0	0
Household	1	3	0
Charcoal	0	0	0
Other	0	1	0
None	69	18	54

church farms and former monasteries in particular collected rights to collection and farms both within their parishes and further afield.

All of the driftwood beaches recorded in JÁM, along with their level of productivity, have previously been mapped (Kristjánsson 1980: 205; Kolář *et al.* 2022: 2), and this mapping is therefore not reproduced here. Instead, Fig. 3 presents an overview of the reported driftwood delivery at farmsteads in the eight counties surveyed here. In some cases where good driftwood supply is noted, it is also qualified as being unreliable, only arriving rarely, or most often having been better in the past than it is now. This is likely to be the result of two factors. Firstly, one of the reasons for the compilation of JÁM was to determine the value of properties and, therefore, how much tax landowners should pay. Remote resources, such as driftwood, would have been reported by the

County					Total
Ísafjarðarsýsla	Strandasýsla	Skagafjarðarsýsla	Eyjafjarðarsýsla	Þingeyjarsýsla	
VII	VII	IX	X	XI	–
401	138	535	526	198	2962
8	15	12	9	24	92
8	18	10	10	8	77
1	20	12	9	7	74
15	16	14	6	11	136
15	21	23	10	15	135
2	1	1	0	2	13
3	4	1	0	11	45
10	10	2	4	3	41
2	33	21	20	19	145
2	8	0	0	21	31
10	26	18	11	22	91
2	1	0	0	0	3
5	0	0	0	0	6
22	37	30	23	18	271

landowner, and therefore, there may have been a temptation to under-report its value to avoid higher taxation. Climate and weather conditions may also have had an impact. Documentary sources indicate a mild interval in an otherwise cold period in Iceland from ca. 1640–1670 CE, with correspondingly little sea ice during the period ca. 1640–1680 CE (Ogilvie & Jónsdóttir 2000). We have already explored the influence of sea ice on driftwood delivery, and it seems probable that reports of diminished driftwood in JÁM in the early 18th century CE are related to changes in sea ice (and, correspondingly, driftwood) levels in living memory.

As is shown in Table 1, some of the entries in JÁM also indicate the various purposes for which driftwood was used. The most commonly mentioned use of driftwood is for house repair or household needs. This collates several

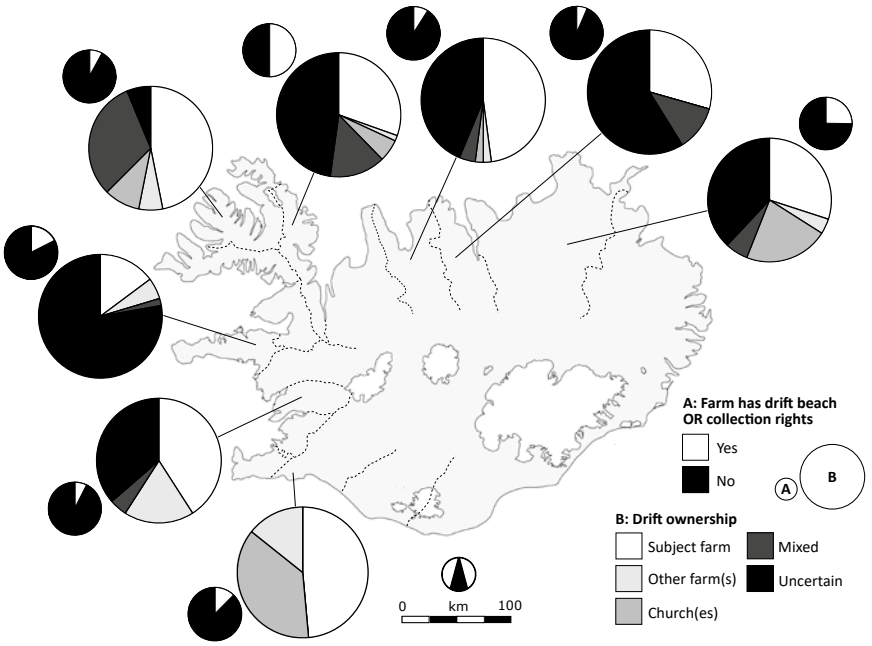

FIGURE 2 Proportion of farms in eight Icelandic counties with driftwood beaches and/or rights to driftwood collection, and the ownership of these resources, according to JÁM Vols. I, IV, V, VII, IX, X, and XI.

different references to driftwood use, such as *viður til húsa* (wood for houses), *til húsabyggingar* (for the building of houses), and *til húsnauðsynja* (for household needs). The latter could be interpreted as including the use of wood for fuel, but entries in JÁM generally include a specific mention of the source of fuel used by the farm (Vésteinsson & Simpson 2004). At various tenant farms, larger driftwood was collected by the landowner, while smaller pieces could be used by the occupants for fuel or for repairs and/or household items. At some farms, these items had to be left behind at the end of tenancy (*cf.* Gr. Ch. 220), while at others, it was stipulated that the occupants could sell items that they made from the smaller driftwood. A parallel for this is found in *Sturlunga saga*, in which the vagrant Otkell and his wife sell tubs or casks (IS: *keröld*) from Strandir, presumably made from driftwood (Thorsson 1988: 352).

Wood was also required to produce charcoal. Charcoal, along with peat, was the only fuel available in Iceland that burns at a sufficiently high temperature for ironworking, which was essential for the maintenance of agricultural tools

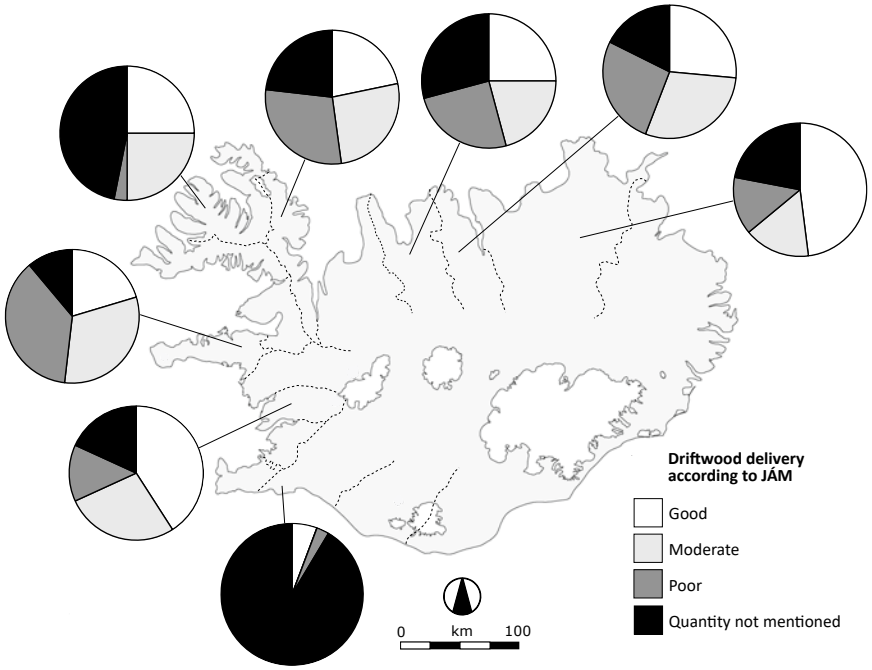

FIGURE 3 Delivery of driftwood at farms with driftwood beaches and/or rights to driftwood collection, according to JÁM Vols. I, IV, V, VII, IX, X, and XI.

as well as weapons. Making charcoal from driftwood was rare but not unknown, with references in JÁM from both Ísafjarðarsýsla and Strandasýsla (Table 1). This practice would have been dictated by the relative local scarcity of native birch wood, which was usually used for charcoal production (Dugmore *et al.* 2006, 2007a,b; Church *et al.* 2007; Guðmundsdóttir 2010, 2012, 2016), and the local abundance of driftwood. One of the best driftwood beaches in Árneshreppur in Strandasýsla is at Kolgrafarvík, which literally translates as 'charcoal pit bay' (Jóhannesson 2000). Charcoal pits have been found in archaeological surveys at several locations along the coast of Árneshreppur (Lárusdóttir *et al.* 2003, 2005), and excavations at Kolgrafarvík have confirmed the presence of conifer charcoal in these pits (Mooney 2016d, see below).

In Norway, a similar detailed survey of farms and their resources was conducted in 1863 CE, again for taxation purposes. This document (the 1863 *matrikkelrevisjon* or *herredsbeskrivelse*) is a potential, albeit unexplored, archival source of information on the use of driftwood in Norway. It also includes

accounts of access to woodland, fuel, and various alternative fodders, such as seaweed, twigs, and fern rhizomes (Alm 1986, 2016). Such land registers and surveys from Norse Greenland do not survive.

5 Driftwood in Folklore, Medieval Literature, and Historical Customs

While documentary sources can tell us about the ownership and legal status of driftwood, literary and ethnohistorical sources can give us a glimpse into how people perceived and interacted with it in the past. Driftwood has a uniquely prominent place in Norse mythology, wherein the first humans were, in fact, created from driftwood. These logs were found on a beach and named Askr and Embla: the god Óðinn gave them life, and his brothers Hænir and Loður gave them senses and understanding (Sturluson & Byock 2005). Aside from this, however, driftwood plays only a minor role in Icelandic and Norwegian folklore and early literature, most often as a backdrop to the action rather than taking centre stage itself. Understanding of the origin of Arctic driftwood may have tempered any fantastical notions; ethnohistorical evidence from Norway shows that the term *russetømmer*, 'Russian timber', was widely used for driftwood on coasts between Lofoten and Varanger (Alm 2019: 250) before any significant scientific research into driftwood sources was conducted. However, Icelandic superstitions regarding the use of driftwood in boatbuilding are known; if a small piece cut from a driftwood log failed to float, it was considered *manndrápsviður* (killing wood), and the log would not be used. Similarly, if a wood shaving from a log, when allowed to fall, landed with the inside of the wood facing down, it was considered a bad omen (Kristjánsson 1980).

5.1 *Driftwood in the Sagas*

In the Icelandic sagas, among the world's richest bodies of medieval literature, landscape often plays a narrative role, and driftwood is a part of that, including as a villain. Towards the end of *Grettis saga*, Grettir, his brother Illugi, and his slave Glaumur are in exile on the island of Drangey in Skagafjörður. Firewood on the island is scarce, and driftwood was the main source of fuel for the outlaws (ÍF VII: 238, Ch. 74). Grettir's enemy, Þorbjörn öngull, has his foster-mother Þuríður curse a driftwood log and send it floating over to Drangey. Grettir recognises the log as a bad omen and twice casts it back out to sea. However, on the third day, the weather is bad and the brothers send Glaumur to fetch firewood alone. Glaumur finds the log immediately next to the ladder used to reach the beach from the cliffs and brings it home, considering himself lucky to have found firewood so quickly. Grettir then tries to chop the log without

first inspecting it. The axe glances off the log and gives Grettir a deep wound, which eventually festers and causes his death (ÍF VII: 245–264, Ch. 78–82). The necessity of driftwood is evident in this excerpt: Þuríður's curse is so effective because she knows that the outlaws will eventually take it home. In such a harsh climate, firewood can be the difference between life and death, whether cursed or not.

However, despite this necessity, driftwood is rarely mentioned explicitly in the sagas. In *Hávarðar saga Ísfirðings*, Ólafr Hávarðarson uses a piece of wood found on a pile of driftwood on the beach at Lónseyri to drive some lost sheep (ÍF VI: 305, Ch. 4). Lónseyri lies too deep in the relatively sheltered fjord of Ísafjarðardjúp for substantial driftwood delivery; it has not been a known driftwood beach in modern times (Kristjánsson 1980), nor is driftwood mentioned in relation to Lónseyri in either JÁM or DI. It is therefore assumed that this wood was collected from productive driftwood beaches to the north and east for use at Lónseyri or for transport across Ísafjarðardjúp.

The transport of driftwood is also mentioned in *Þorsteins saga Hvíta*, wherein wood is dragged overland by horses from beaches at Melrakkanes or Bjargalönd in Norður-Þingeyjarsýsla to the farm of Sveinungsvík, a few kilometres to the west. The wood is specifically mentioned as being '*til skálagørðar*', for building a *skáli* (ÍF XI: 15, Ch. 7). The transport of timber in this manner is also mentioned in the later *Íslendinga saga*, wherein Valgarður Styrmisson and his companions steal some horses in order to collect wood from Skagafjörður (Thorsson 1988: 349). It is not stated whether this is driftwood or imported wood, but the former is more likely, given the abundance of productive driftwood beaches on the coasts of Skagafjörður (see Fig. 3). Driftwood was commonly transported both with horses and sleds, and by sea in Iceland in the past, depending on the local landscape and the distance to be covered (Kristjánsson 1980). The collection of wood from Strandir and its transport by sea is also implied in *Reykdœla saga og Víga-Skútu* (ÍF X: 230, Ch. 25).

The reference to driftwood beaches in *Egils saga Skallagrímssonar* is less equivocal. It is written that '*Skalla-Grímr var skipasmiðr mikill, en rekavið skorti eigi vestr fyrir Mýrar* (Skallagrím was a great shipwright, and there was no shortage of driftwood to the west of Mýrar)' (ÍF II: 75, Ch. 29). Productive driftwood beaches are known to exist in this area. The link between the presence of driftwood and Skallagrím's prowess as a shipwright is a good indicator of the importance of driftwood in boatbuilding in Iceland. Even the largest birch trees in the Icelandic woodlands rarely grew tall and straight enough to be used for large elements of boats, such as the keel, although at least one ocean-going ship of native Icelandic wood is known from ethnohistorical sources (Ólafsson 1943: 47). Archaeological evidence from Icelandic boat graves also indicates

the use of driftwood timber in Icelandic boats (Mooney 2016c; Gestsdóttir *et al.* 2017, see below). Even without this supporting evidence, the way in which this passage is written makes it clear how obvious the link between driftwood and boatbuilding was; there is a tacit understanding that driftwood was used in boatbuilding, and the reader needs no further information to recognise this.

The casual attitude of the saga storytellers towards driftwood as a construction resource is also exemplified in a passage in *Laxdœla saga*. Ólafr Höskuldsson builds a farmhouse in a clearing in woodland on his land, '*af þeim viðum, er þarváru hǫggnir í skóginum, en sumt hafði hann af rekastrǫndum* (of wood which was cut from that forest, although he also got some from the driftwood beaches)' (ÍF V: 67, Ch. 24). In this passage, driftwood is almost an afterthought; of course *some* timber had to be obtained from driftwood beaches, but what is of most interest is that the timber from the forest was of high enough quality to use in construction. This reflects a recurring trope in the sagas, in which the ownership of native woodland is portrayed as a status signifier (Mooney 2013). Although we have already discussed how driftwood was perhaps not easily available to everyone, the lack of description of driftwood in the sagas can be attributed to how familiar and mundane this wood was to saga tellers and writers.

In Greenland, driftwood is mentioned in both *Króka-Refs saga* (ÍF XIV) and *Flóamanna saga* (ÍF XIII: 283). These sources locate driftwood collection in the *óbyggðir*, the uninhabited resource regions to the north of the Norse settlements (Grove 2009). Upon travelling to Greenland, Refur Steinsson sails into a deep fjord north of Vestribyggð and finds that '*rekaviður lá þar um allar fjörur* (there was driftwood lying on every shore)' (ÍF IV: 132, Ch. 6). This statement sits alongside descriptions of other resources — woodland, pasture, game, and fish — and it is intended to impress the reader (Grove 2009). Refur is a master carpenter and boatbuilder, and his saga is replete with examples of his work. Although not explicitly stated, it is implied that these are made from driftwood in both Iceland and Greenland. Nevertheless, it should be noted that *Króka-Refs saga* is a fantastical work that incorporates historical inaccuracies and tropes from continental European literature (Thorsson 2000: 595; Grove 2009). The description of driftwood lying on the inner shores of a deep fjord may reflect the storyteller's lack of familiarity with driftwood beaches or the landscape of Greenland, as in reality, driftwood rarely reaches such sheltered coastlines (Grove 2009; Guðmundsdóttir 2022).

5.2 *Driftwood in Place Names*

The beaches where driftwood and other drift goods were often washed up can be recognised in place names across the region. In Norway, *Rekvik* (drift

bay) and *Tømmervik* (timber bay) are the most common of these (Alm 2019: 258–259), although the multiplicity of Norwegian dialects necessitates the consideration of local variations. Toponyms alone can, in fact, provide a guide to the relative prevalence of driftwood along Norway's long coast; far more place names related to driftwood (e.g., *Rekved-* (driftwood-, 6), *Rekvik* (21) and *Tømmervik* (22)) are found in the area north of 64°30′ N (Anonymous 1991b) than below this latitude (Anonymous 1990, 1991a). The Norse term *við-* (wood, woodland) has lost its meaning to present-day Norwegians, but is preserved in place names. Rygh (1905: 288) interpreted the farm name *Vidrek* in Narvik as a place where *viðr* would *reke* (drift) ashore. This was disputed by Røger (1943), who found it unlikely for a site deep inside a fjord. However, one of the present authors (TA) spent his childhood summers in this area. The collection of driftwood for fuel from the nearby islands was commonly practiced and repeated every summer. The wood was likely derived mostly from local sources.

Iceland has a much wider range of driftwood place-names, perhaps connected to the greater significance of driftwood to its occupants. Place name elements relating to driftwood include *bolung-* (trunk), *borð-* (plank), *drumb-* (stump), *furu-* (pine), *greni-* (spruce), *kefl-* (log(s) of driftwood), *reka-*/*-reki* (drift), *stokk-* (log), *tré-*/*trjá-* (tree), and of course *við-*. The latter can also be seen in the northernmost of the Faroe Islands; this island is named *Viðøy* (wood island), and is home to *Viðvík* (wood bay) and *Viðareiði* (wood isthmus), named for the driftwood that arrives there.

From Greenland, only one Norse place name connected to wood has survived: *Stokksnes*, which is located in Eystribyggð (Halldórsson 1978: 46). It is unknown if this name is linked to driftwood, but as mentioned above, this association is known in Icelandic place names. Any other Norse Greenlandic toponyms associated with driftwood have been lost. However, native Greenlandic place names tend to be very descriptive of the landscape, and references to driftwood can also be found here. A few examples are *Perserajuk* (place where drifts often occur) and *Qilivit* (the driftwood) (Danish Geodata Agency 2020a). Both these places lie in locations posited as remote resource regions for the Norse in Greenland (see Fig. 1, *cf.* Madsen 2019; Mooney, Pinta & Guðmundsdóttir 2022).

5.3 *Collecting and Claiming Driftwood*

Even without place names to direct them, people living near coasts where driftwood washed ashore would have been well acquainted with the locations of the best driftwood beaches, how driftwood came ashore, and the best weather conditions in which to find driftwood. However, differences in the legal ownership of driftwood, as detailed above, engendered different attitudes towards

driftwood collection in Iceland and Norway. Additionally, despite the legal regulation of driftwood ownership, these regulations may not have always functioned in practice. In practice, driftwood in Norway was often considered the property of the first person to reach it, although in some areas, local customs dividing the value of drift goods between finders and landowners were established (Bratrein 2009; Alm 2019).

In subarctic Norway, it was common for people to carefully follow the weather and wind conditions and be ready to head out to claim or collect driftwood and other material washed up on the shores as soon as a storm abated (Alm 2019: 254–256). The same practice was followed in Iceland, although in cases where a driftwood beach was owned by an absent landowner, a watchman might have been employed to ensure that driftwood was not unlawfully taken by the local population (Kristjánsson 1980: 251–255). People would also often go out in boats to collect driftwood, especially after storms; they did not always wait for the wood to reach the shore (Matthíasson 1967). The sources quoted may suggest that collecting driftwood was primarily a male domain, but this was not necessarily the case. Berit Østberg, who studied female tasks on the islands of Frøya and Hitra on the outer coast of Trøndelag, central Norway, noted that they also 'collected driftwood at the seashore' (Østberg 1977: 36).

The more dispersed nature of the Norse Greenlandic settlements is likely to have necessitated different driftwood collection strategies; most farms were situated relatively far inland along sheltered fjords, while driftwood washed up on the outer coasts, often far from settlements, in the *óbyggðir* (Møhl 1982; Madsen 2019). Driftwood may have been gathered on deliberate driftwood voyages, as is also known from Iceland (Kristjánsson 1980), as well as being collected opportunistically during travel or hunting/fishing trips. Such voyages would have been a communal effort centrally organised by high-status farms (Dugmore *et al.* 2007b; Guðmundsdóttir 2022). Both medieval and 16th–19th century CE sources suggest that driftwood was collected in south Greenland and that the acquisition of driftwood mostly took place at sea (Magnússon 1945; Halldórsson 1978; Guðmundsdóttir 2022). Similar customs regarding timber claims are likely to have existed in Greenland as elsewhere in the Norse diaspora, but they are not recorded.

As it was not always possible to remove driftwood from the beach at the time it was first found, it was necessary to mark the wood in some way, in order to demonstrate that it had been claimed. We know that the practice of marking driftwood to indicate ownership dates back to at least the Commonwealth Period (930–1262 CE) in Iceland. *Grágás* mentions that those who claimed driftwood were required to mark it with their own unique ownership mark (Gr. Ch. 209). Lúðvík Kristjánsson (1980: 256), however, notes that despite

FIGURE 4 Examples of driftwood ownership marks from Iceland
REDRAWN AND MAPPED BY DAWN ELISE MOONEY, AFTER KRISTJÁNSSON (1980: 258)

this legal stipulation, very few driftwood marks were known from the north of Iceland and the Westfjords by the 19th century CE. Examples of ownership marks used in early modern Iceland are shown in Fig. 4. Although this map does not include all known Icelandic driftwood ownership marks, it does show a general pattern of their geographical origin; they are clustered near to the estuaries of large rivers, which have a significant impact on coastal currents and can easily move driftwood between beaches (Kristjánsson 1980: 257).

The form of these marks is varied. Some, such as Maríufjara (younger futhark 'M', ᛘ) and Eyvindarhólar (younger futhark 'Yr', ᛦ), are runic. Others are based on the Latin alphabet, representing either the name of the farm (e.g., Vik, VK, and Mýrnafjara, MF) or the initials of the owner. Yet others appear more abstract, with straight lines that are easily and quickly carved. Some, such as a bird claw representing a local pair of nesting eagles or a key or cross representing church authority, are representative (Kristjánsson 1980: 259). The location of the mark could also be important; Kristjánsson (1980: 256) presents an example of Sandsreki in Suður-Þingeyjarsýsla, northern Iceland, where ownership was indicated with an 'X' carved in both ends of the log. A single find of

a log with a possible ownership mark from Greenland suggests that this custom may also have been practiced by the Norse Greenlanders (Guðmundsdóttir 2022).

Ethnohistorical sources from subarctic Norway suggest a more varied set of practices for marking ownership of driftwood (Alm 2019). The most commonly described practice is the claiming of driftwood by carving an ownership mark or initials (Brox 1976: 26; Olsen 1994: 66; Berg 2001: 520; Tjelle 2003: 42; Dava 2012: 20; Borgos 2018: 263), but other traditions are also known. In some places, ownership was claimed by tying rope around a log (Tjelle 2003: 42), possibly with a specific kind of knot that served as an ownership mark (Grønbech 2018: 52). Driftwood logs were also marked as 'claimed' by positioning them on the beach in a way that was unlikely to be the result of tides and waves. This could be simply moving the log above the high-water mark (Olsen 1994: 66; Tjelle 2003: 42; Robertsen 2010: 164; Larsen 2015: 58), or placing it so that it lay perpendicular to the shoreline (Berg 2001: 520; Hanssen 2017: 53; Alm 2019: 253). Piling logs or smaller pieces of wood would also serve as an indicator that they had already been found and collected, and removing anything from the pile would be regarded as theft. Lúðvík Kristjánsson (1980: 252–254) details the various means by which early modern Icelanders dragged driftwood above the shoreline, but this wood was still only claimed by marking it, not by simply moving it to safety.

6 Archaeological Evidence for Driftwood Exploitation

Given the wide-ranging historical evidence for driftwood use detailed above, it is unsurprising that driftwood exploitation can also be identified in the archaeological record. The dominance of driftwood taxa in wood assemblages in the Faroe Islands, Iceland, and Greenland has been described as a 'North Atlantic island signature' of wood exploitation (Mooney 2016b: 287). This dominance is demonstrated in Fig. 5. The current state of archaeological studies of wood exploitation across the North Atlantic has recently been presented in detail (Mooney, Pinta & Guðmundsdóttir 2022) and we do not wish to repeat this information here. Instead, this section summarises the evidence for driftwood exploitation unearthed in these studies.

Wood is most commonly preserved on archaeological sites as charcoal. This charcoal is usually the remains of wood used as fuel, but could also result from accidental fires burning structures or objects. Despite this, few detailed charcoal studies have been undertaken in the North Atlantic, and thus there is relatively little evidence of driftwood in such assemblages. Small quantities

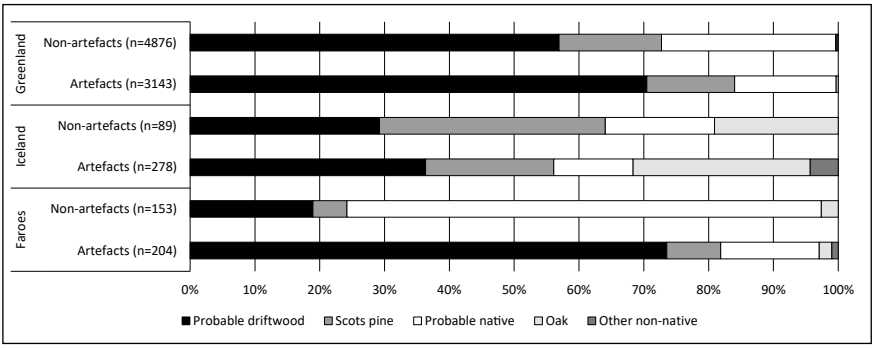

FIGURE 5 Approximate proportions of likely driftwood taxa (white pine, spruce, and larch) compared with taxa native to the North Atlantic islands, Scots pine, oak and other wood taxa in wooden artefact assemblages from the Faroe Islands, Iceland and Greenland.
BY DAWN ELISE MOONEY, AFTER MOONEY (2013, 2016B), GUÐMUNDSDÓTTIR (2021), PINTA (2018), PINTA *ET AL.* (2021) AND UNPUBLISHED DATA

of conifer charcoal, including both pine and larch, have been identified in Icelandic domestic assemblages (Lawson *et al.* 2009; Mooney 2013), implying the minor use of driftwood as fuel. Driftwood also seems to have played a role in fuel acquisition strategies at trading sites (Guðmundsdóttir 2011; Bishop 2016). Conifer charcoal from 17th–19th century CE Reykholt has been interpreted as the remains of objects or timbers used as fuel once they had reached the end of their use-life, and uncharred remains from the same site indicate the use of driftwood for both objects and construction (Zutter 2000). The presence of conifer charcoal may also imply the use of conifer wood in construction at the stave church of Þórarinsstaðir in Seyðisfjörður; however, the wood identifications from this site are somewhat uncertain (Kristjánsdóttir *et al.* 2001; Kristjánsdóttir 2004; Mooney 2013). Lastly, the use of driftwood for charcoal-making is evidenced by the presence of conifer charcoal in (as yet undated) coastal charcoal pits (Mooney 2016d).

Occasional finds of conifer charcoal in domestic fuel residues at V51 and V54 in the Norse Greenlandic Vestribyggð may represent driftwood (McGovern *et al.* 1983; Fredskild & Humle 1991; Buckland *et al.* 1994). This has also been postulated at Ø69 in Eystribyggð, although such wood could also have been imported from North America (Bishop *et al.* 2013). A similar pattern has been noted at Ø29a (Edvardsson *et al.* 2007). In the few existing charcoal studies from the Faroe Islands, finds of larch, spruce, and pine were also treated as driftwood (Church *et al.* 2005; Lawson *et al.* 2005; Vickers *et al.* 2005).

Detailed charcoal studies from archaeological sites in northern Norway are generally lacking. Most studies have been undertaken for the purpose of

radiocarbon dating, where it is best to avoid driftwood taxa due to their potential inbuilt age. In such studies conducted on behalf of the Tromsø University Museum (which is responsible for development-led archaeological excavations in the counties of Nordland and Troms og Finnmark), conifer wood is often found, but is now routinely discarded; this is because as well as possible driftwood of spruce and larch, native pine can also have a long lifespan and therefore a high inbuilt age (e.g., Kirchhefer 2014, 2020). However, some such samples from sites from Karlsøy and Helgøy excavated in the mid- to late-20th century CE include instances of larch, which suggests the use of driftwood as fuel here (Bratrein 1989: 251–252). Additionally, a study of charcoal from Stone Age sites in Varanger, Finnmark found pine in coastal sites well outside its present distribution (Žumer 1968), which may represent either driftwood use or a more extensive distribution of this taxon in the past.

Assemblages of wooden artefacts preserved by waterlogging are much less common, but they have been the subject of more comprehensive analysis in the North Atlantic. In the Faroe Islands, the analysis of wooden artefacts from Viking Age sites indicates the use of driftwood for construction and household objects (Malmros 1990, 1994; Christensen 2013). The assemblage from Toftanes showed evidence of shipworm (Teredinidae) activity in objects of spruce or larch, confirming the presence of driftwood (Christensen 2013: 145). Studies of Icelandic artefacts (Mooney 2013, 2016a) have also demonstrated the dominance of driftwood as a raw material, and driftwood has been identified among the remains of structural timbers from Viking Age and medieval Icelandic houses (Guðmundsdóttir 2013b, 2018) and churches (Guðmundsdóttir 2013a, 2019).

In Greenland, the published assemblages are dominated by driftwood to an even greater extent; although many also have a minor but significant input of native wood, imported wood is generally rare except at high-status sites. Medium-sized farms have generally produced assemblages composed of 60–70% likely driftwood taxa, while larger proportions (e.g., 80% at Gården under Sandet, and over 90% at Igaliku) probably include imported Scots pine (Guðmundsdóttir 2021, 2022). A larger quantity of Scots pine is also present in Iceland than in Greenland (Fig. 5). The Greenland assemblages studied so far are Ø34-Qorlortup Itinnera (Pinta 2018), Ø47-Igaliku (Guðmundsdóttir 2021), Ø172-Tatsip Ataa (Pinta 2018; Guðmundsdóttir 2021), Ø171-Tasilikulooq (Pinta 2018; Guðmundsdóttir 2021), and Ø17a-Narsaq (Guðmundsdóttir 2021) in Eystribyggð, and Gården under Sandet (Pinta 2018; Guðmundsdóttir 2021), V51-Sandnes (Pinta 2018), V52a-Umiviarssuk (Pinta 2018), and V53d-Austmannadal (Pinta 2018) in Vestribyggð. These trends can be seen in Fig. 5, although it should be noted that many assemblages are not directly

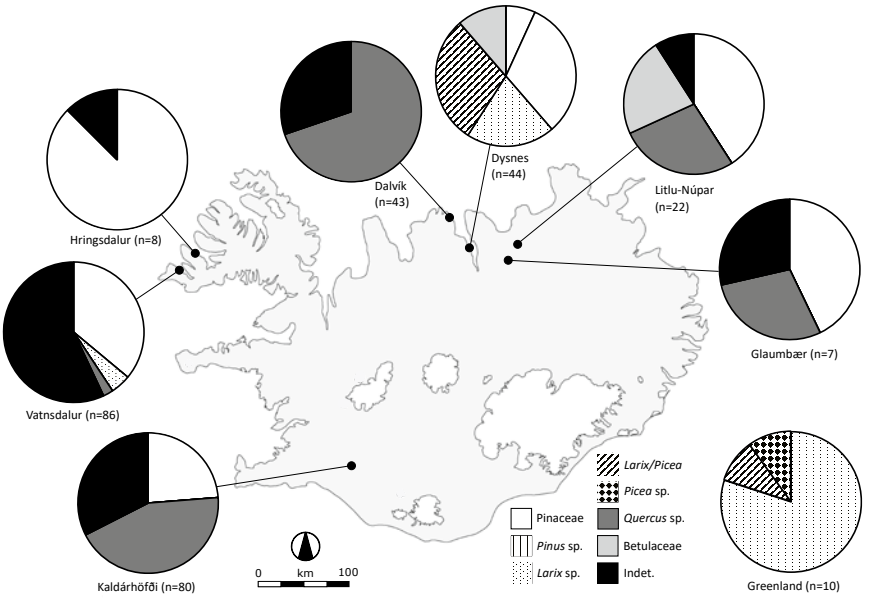

FIGURE 6 Results of analysis of wood remains from Norse boats in Iceland and Greenland by Dawn Elise Mooney. Data is taken from Mooney (2016c), except for Greenland (Andersen & Malmros 1993) and Dysnes (Lísabet Guðmundsdóttir, unpublished data)

comparable, and the data should be explored in greater detail (*cf.* Mooney, Pinta & Guðmundsdóttir 2022).

Conifer wood is also dominant in many assemblages of the remains of boats from Iceland and Greenland. The data presented in Fig. 6 are derived from mineralised wood from boat graves in Iceland (Mooney 2016c; Gestsdóttir *et al.* 2017) and waterlogged boat remains from various sites in Greenland (Andersen & Malmros 1993). These assemblages are, to some extent, not directly comparable, due to various factors. Not only are they preserved in different manners, but they have also undergone different methods of conservation before analysis. Five of the Icelandic boat burials (Kaldárhöfði, Vatnsdalur, Glaumbær, and two at Dalvík) were excavated in the early to mid-20th century, between 1909 and 1964 (Eldjárn 2016). The mineralised wood remains from these excavations were conserved using a type of wax, which obscured many of their diagnostic anatomical features. By the time they underwent taxonomic analysis (Mooney 2013), no identification was possible for many fragments. As shown in Fig. 6, more than a quarter of all the remains from these graves were completely unidentifiable. This proportion decreases dramatically at Hringsdalur and Litlu-Núpar, where remains were analysed before conservation (Mooney

2013, 2016c), and results from Dysnes, where an experienced wood specialist was present at the excavation (Gestsdóttir *et al.* 2017), are even better. This trend highlights the importance of involving specialists in the analysis of organic materials as early as possible in the recovery of such remains.

However, despite these discrepancies, the assemblage of boat remains from Iceland and Greenland still provides a glimpse into the use of driftwood in early Icelandic boatbuilding. The graves in Iceland generally date to the 10th century CE (Mooney 2016c; Gestsdóttir *et al.* 2017) while the material from Greenland spans the 11th–14th centuries CE. Some of the Icelandic grave assemblages include a proportion of oak wood, which must have been imported. It is assumed that this represents boats or parts thereof built in Scandinavia (Mooney 2016c). Pine, which was identified at Dysnes, may also represent an imported element; pine is common in smaller components of Scandinavian boats, and is often dominant in Viking Age boat remains from western and northern Norway (Gjessing 1941; Christensen 1985, 1998; Schanche 1991; Godal 1995; Pedersen 2002; Bill & Roesdahl 2007; Mooney 2016c).

Due to issues of preservation and/or conservation, it was not always possible to differentiate between pine, spruce, and larch in the material. However, despite this and despite anatomical similarities between the latter two genera (Bartholin 1979; Anagnost *et al.* 1994; Talon 1997), fragments were identified as larch or larch/spruce at Vatnsdalur and Dysnes. These boats almost certainly included elements made from driftwood. Driftwood was most likely used for boatbuilding and/or repair in northern Norway as well. One of the strakes of the Bårset boat from Nord-Kvaløy, Troms, was made from spruce (Gjessing 1941), which may represent driftwood, although the past distribution of spruce in Norway remains uncertain (Øyen & Nygaard 2020; Nota *et al.* 2022). The Norse Greenlandic material comprises very few objects, mostly of larch, but also of spruce. It is possible that some of the boat parts were made from wood felled in North America, but it is more likely that they also represent part of an early driftwood boatbuilding tradition (Andersen & Malmros 1993; Guðmundsdóttir 2022).

7 Future Directions

While the importance of driftwood is clear from both the archaeological and historical evidence presented here, the certain identification of driftwood in archaeological assemblages remains problematic. Historical sources indicate that timber was imported to the North Atlantic islands from both Europe and North America, and it is often not possible to distinguish between taxa native

to these areas and those arriving as driftwood on the basis of microscopic anatomy alone (Mooney *et al.* 2022b). Taxonomic analysis has recently identified the North American woods *Pinus banksiana* and *Tsuga* sp. amongst archaeological wood assemblages from Norse Greenland (Guðmundsdóttir 2021), but this is a rare find. Additionally, although Arctic driftwood can be provenanced through tree ring analysis, most archaeological remains from the study area are too small to provide sufficiently long tree ring sequences for this method to be widely used.

Numerous methods have been employed to identify the chemical signatures indicative of drifted or seawater-inundated wood. These include combined spectrophotometric and energy dispersive X-ray spectroscopy analysis of wood ash samples from timber inundated during the 2011 Tohoku tsunami in Japan (Yamada *et al.* 2014), energy dispersive X-ray spectroscopy analysis of experimental and archaeological charcoal from Patagonia, Argentina (Caruso Fermé *et al.* 2015), inductively coupled plasma mass spectrometry (ICP-MS) analysis of experimental and modern seawater-inundated wood from northern Canada (Steelandt *et al.* 2016), and electrical conductivity measurements of modern fresh and drifted wood along with archaeological wood samples (Mooney 2017). These studies have had some success. Analysis of modern samples shows increased levels of various elements, including Na, Mg, and Cl (Yamada *et al.* 2014; Caruso Fermé *et al.* 2015; Steelandt *et al.* 2016). However, while this may facilitate the identification of driftwood in standing structures, in archaeological remains the chemical signature of the burial environment appears to overwhelm any 'marine' signature that the timber may have had (Caruso Fermé *et al.* 2015; Steelandt *et al.* 2016; Mooney 2017). The storage of driftwood timber outside, especially in the wet climate of the North Atlantic, is also likely to contribute to the leaching of compounds of marine origin from driftwood.

Recently, strontium ($^{87}Sr/^{86}Sr$) isotope analysis has been increasingly used to determine the provenance of organic archaeological remains. The $^{87}Sr/^{86}Sr$ signature reflects the underlying geology of a region, including its age and chemical composition. The relative abundance of Sr isotopes remains essentially stable, as they are incorporated into plant and animal tissue from hydrological, dietary, and atmospheric sources (Bentley 2006). Thus, the $^{87}Sr/^{86}Sr$ ratio of animal and plant tissue reflects the local geological environment during tissue formation, prior to post-depositional diagenetic changes (Moffat 2014). Sr provenancing has been successful in the analysis of construction timber (English *et al.* 2001; Reynolds *et al.* 2005) and charred grain (Styring *et al.* 2019; Larsson *et al.* 2020). Initial Sr analysis of archaeological wood from Greenland has indicated a possible distinction between local and non-local

wood, with three samples showing a Sr value significantly different from that of the site from which they were retrieved (Pinta *et al.* 2021). However, the original Sr values of these timbers are unknown, and experimental work suggests that it may not be possible to recover the original $^{87}Sr/^{86}Sr$ signature of seawater-inundated wood (Van Ham-Meert *et al.* 2020). This, combined with geological similarities in many regions of the North Atlantic, presents significant challenges for the use of Sr analysis to identify driftwood in archaeological assemblages (*cf.* Price 2018). Combined analysis of oxygen ($\delta^{18}O$) and hydrogen ($\delta^{2}H$) appears to be able to distinguish between possible wood sources in Greenland, Newfoundland, and Labrador, despite overlapping Sr values in these regions (Pinta *et al.* 2021); this should be an avenue for future research.

The increasing availability of non-destructive methods for tree ring analysis (e.g., Grabner *et al.* 2009; Bill *et al.* 2012; Stelzner & Million 2015; Bossema *et al.* 2021) and accessibility of tree-ring chronologies from Siberia (e.g., Siborova *et al.* 2017) should enable artefacts made from Arctic driftwood to be provenanced more easily. Additionally, on-going advances in DNA analysis may also aid in the identification of driftwood species. Even DNA preserved in sediments, with no visible wood fragments remaining, can now be identified not only to species, but sometimes to genetic groups within a species (e.g., Parducci *et al.* 2012; Nota *et al.* 2022). Recent studies on oak timbers suggest that this method has strong potential for provenancing even seawater-inundated wood (e.g., Spiers *et al.* 2009; Akhmetzyanov *et al.* 2020), but it has not yet been applied to other wood taxa. However, both methods should be explored in greater detail.

8 Conclusion

This paper has presented historical, documentary, ethnological, literary and archaeological evidence for the use of driftwood in subarctic Norway and the North Atlantic islands from the Viking Age onwards. Conifer driftwood, primarily originating from Siberia and transported with Arctic sea ice, provided timber for construction, boatbuilding, and artefact production in locations where needs could not be met by the limited native woodlands. While taxonomic provenancing can, to a certain extent, identify driftwood in archaeological contexts in the North Atlantic, further work is needed to develop ways to accurately differentiate between drifted and imported conifer wood. Nonetheless, the importance of this resource is clear, and driftwood use should be considered as a possibility in all analyses of Norse wood use in the North Atlantic. The potential inbuilt age of driftwood has consequences for its employment in radiocarbon dating, but the practice of driftwood use is also indicative of

a general diversity and flexibility in Norse wood exploitation strategies. We should carefully incorporate these cultural and individual preferences and experiences into our interpretations of Norse wooden assemblages. Lastly, it is vital that we further explore this field with some urgency, as anthropogenic climate change threatens our ability to study past driftwood use in the North Atlantic, both through deteriorating preservation conditions and through the loss of sea ice, leading to declining driftwood delivery.

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