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Dorset Harpoon Endblade Hafting and Early Metal Use in the North American Arctic

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ABSTRACT. Composite tool hafting research has touched upon almost every era and region of human history. One aspect that has seen little attention is how those traces of hafting strategies might reflect the raw material of the endblade that an organic handle would have held. This aspect is particularly important for clarifying the scope and scale of novel raw material use in contexts that have concurrent use of different lithic, bone, and metal materials. This article analyzes harpoon heads from the Canadian Arctic in Dorset cultural contexts and identifies three different hafting techniques employed across time. For roughly one millennium, Dorset groups used a single harpoon endblade hafting technique. After AD 500, new hafting techniques were developed, corresponding with the emergence of metal use. Some of these methods are not compatible with common chipped stone materials and signal an increase in metal endblade production. However, surviving metal objects are underrepresented in museum collections because of various taphonomic processes. By recognizing the materials of the harpoon endblade and the specific constraints of some hafting techniques, it is possible to identify what these endblade materials may have been and expand the known extent and intensity of early metal use by observing the hafts alone.

Key words: Arctic; archaeology; Dorset; Palaeo-Inuit; hafting; harpoon head; metal; material culture; Nunavut; Nunatsiavut

RÉSUMÉ. Les recherches sur l'emmanchement d'outils composites ont touché presque chaque ère et chaque région de l'histoire humaine. Un aspect qui a reçu peu d'attention a trait à la manière dont les traces des stratégies d'emmanchement pourraient refléter le matériau brut de la pointe qu'un emmanchement organique aurait permis de tenir. Cet aspect est particulièrement important quand vient le temps de préciser la portée et l'échelle de l'utilisation de nouveaux matériaux bruts dans des contextes où se trouve l'usage concurrent de différents matériaux de pierre, d'os et de métal. Cet article analyse les têtes de harpon de contextes culturels du Dorset dans l'Arctique canadien et fait état de trois techniques d'emmanchement différentes employées au fil du temps. Pendant environ un millénaire, les Dorsétiens se sont servis d'une seule technique d'emmanchement des pointes de harpon. Après 500 A.D., de nouvelles techniques d'emmanchement ont vu le jour, correspondant avec l'apparition de l'utilisation du métal. Certaines de ces méthodes ne sont pas compatibles avec les matériaux communs de pierre taillée commune et signalent l'intensification de la production de pointes en métal. Cependant, les objets en métal ayant survécu au passage du temps sont sous-représentés dans les collections de musées en raison de divers processus taphonomiques. En reconnaissant les matériaux de la pointe de harpon et les contraintes particulières découlant de certaines techniques d'emmanchement, il est possible de déterminer ce qu'auraient pu être les matériaux des pointes et d'enrichir l'étendue et l'intensité connues des débuts de l'utilisation du métal seulement en observant les emmanchements.

Mots clés : Arctique; archéologie; Dorset; paléo-inuit; emmanchement; tête de harpon; métal; culture matérielle; Nunavut; Nunatsiavut

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INTRODUCTION

Composite tool hafting has been used by archaeologists across the world to help explain various aspects of past human behaviour. By studying the ways people have used hafted tools, researchers have made advances in our understanding of cognition (Wadley et al., 2009), tool manufacture (Tankersley, 1994; Pawlik and Thissen, 2011), raw material use (Connan, 1999; Rots and Van Peer, 2006), and trade (Torrence, 1993). Unfortunately, the organic handle or support of a composite bladed tool and the endblade itself are infrequently found together and rarely fully articulated. Additionally, comparatively little research has explored how the handles or supports of bladed composite tools can indicate the raw material of the blade itself. For example, the ways a metal endblade is hafted is potentially different from how a chert or flint endblade can be hafted. By observing hafting strategies in this way, it is possible to more fully understand the scope and intensity of how past peoples used different endblade raw materials and chart any shifts in raw material use through time. These observations are particularly significant in contexts where different types of lithic, organic, and metal materials may have been used concurrently (e.g., Young and Humphrey,

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1999; Ruiz-Taboada and Montero, 2000; Ames et al., 2010; Appelt et al., 2016; Jørgensen, 2021).

Most research regarding hafted technology is conducted in Palaeolithic contexts where the materials that are generally used to construct hafts, such as wood, bone, ivory, or antler, are underrepresented compared to lithic materials. In contrast, the North American Arctic is a region where there is a particularly rich archaeological record of objects made from those organic materials, but little research regarding the hafting strategies of past peoples. Moreover, despite humans first arriving in the Arctic relatively late compared to other regions, hafted tool technology was important since this first peopling (Powers and Jordan, 1990; Mason, 2009; Friesen, 2016, 2017; Grønnow, 2017).

These hafted objects span a variety of uses but those relating to sea mammal hunting are among the most common (e.g., Maxwell, 1985; Grønnow, 2012). A core composite tool in Arctic sea mammal hunting across time is the harpoon (Maxwell, 1985:132). While the design of this tool is variable through time, space, and cultural context, some of the most common components in archaeological collections are the most distal parts of the tool—the harpoon head and its endblade.

Despite the variability in design and use, harpoons function in similar ways. The core functionality of the tool is to attach a line from the hunter to the prey to reduce the likelihood of the animal escaping and increase the likelihood of a successful kill. In Arctic contexts, harpoons were used in breathing-hole, ice-edge, and open-water hunting (e.g., Schledermann, 1980; Arnold, 1989). In most cases, the harpoon head and its endblade, located at the distal end of the harpoon, detach from the rest of the harpoon when it is thrown or thrust into a target (Maxwell, 1985:133). A line tied to the harpoon head through its line hole is held by the hunter or attached to a float to secure the prey (Fig. 1). Many, although not all, Arctic harpoon heads "toggle" by rotating roughly 90° once inside the target and tension is applied on the line (either by the hunter pulling or the target fleeing), which decreases the likelihood of the prey escaping (Park, 2010:414). The harpooned prey can then be more easily fatally struck with a lance or spear. Arctic harpoon heads effectively come in two varieties: bladed, where the harpoon head requires the addition of a hafted penetrating edge (i.e., the endblade); and self-bladed, where the harpoon head is sharpened to be its own penetrating edge (Maxwell, 1985:135). While much research has been dedicated to understanding the typological and functional variation of harpoon heads and their endblades (e.g., Stordeur-Yedid, 1980; Maxwell, 1985; Park and Mousseau, 2003; Desrosiers et al., 2006), little attention has been paid to the hafting strategies for attaching the endblades to the harpoon head itself.

An important question that harpoon head endblade hafting can help answer concerns the emergence and intensity of metal use. Metal has been demonstrated to be underrepresented in Arctic archaeological collections, making assessing the scope, scale, and timing of its use nearly impossible if relying on metal objects alone (McCartney, 1988, 1991; Cooper, 2016:183). Previous research has approached this problem by measuring the thickness of the harpoon head blade slot in order to assess if a harpoon head held either a stone or metal endblade (Gullason, 1999; Whitridge, 1999:59–270; Jolicoeur, 2021a). While it is effective, this type of analysis requires both blade beds (i.e., the surfaces of each side of the blade slot that physically contact the endblade) to survive. Therefore, damaged harpoon heads with only a single surviving blade bed or a partial blade slot are excluded from this sort of analysis. However, the choice between using metal or stone for a harpoon head endblade adds a specific list of constraints on how to haft that endblade to the harpoon head. Acknowledging these differences can help inform why certain hafting strategies were or were not used. These constraints add an additional method to assess what endblade material was being used even if the collected harpoon heads do not have both surviving blade beds.

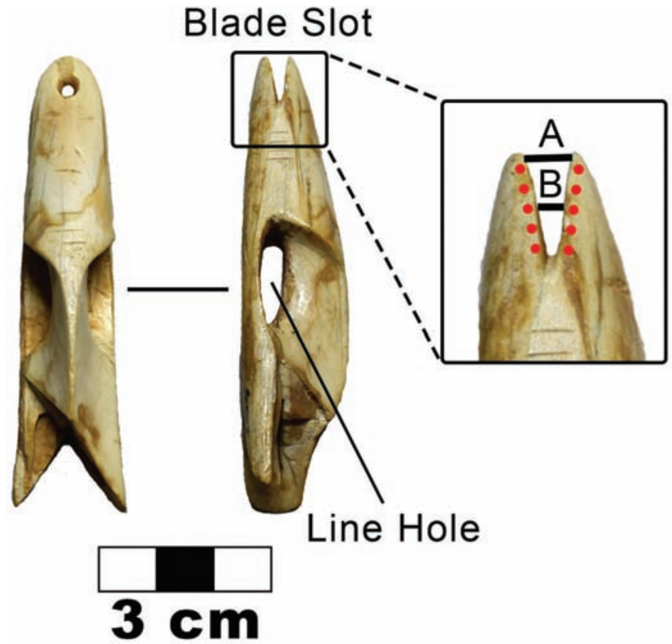

FIG. 1. The ventral (left) and lateral (right) view of a bladed Dorset harpoon head with technological terms mentioned in text. Note the location of the blade slot thickness measurements (A, B). Dotted red line: blade beds; A: Distal blade slot thickness measurement; B: Medial blade slot thickness measurement.

This paper details the ways harpoon endblades were hafted in Dorset cultural contexts through time and demonstrates how this choice directly relates to the raw material of the endblade. By identifying the type of hafting strategy used, it is possible to more accurately predict the raw material of the endblade, thereby adding an important proxy indicator of metal use. Given the few known sources of metal in the Arctic, broadening the ways the emergence, extent, and intensity of metal use can be charted is significant for understanding the development of large-scale interaction networks in the region.

THE DORSET HARPOON

The archaeologically defined Dorset designates a people who are the direct descendants of the earliest inhabitants of the North American Arctic (Jenness, 1925; Raghavan et al., 2014). Although the specific timing varies across the Arctic, the Dorset culture is separated into three periods: Early Dorset (ca. 800 BC to AD 1), Middle Dorset (ca. AD 1 to 500), and Late Dorset (ca. AD 500 to 1300) (see Friesen, 2017). While there is considerable debate between the archaeological differences of Early and Middle Dorset assemblages (see Odess, 2005; Desrosiers et al., 2006; Ryan, 2016), there are some clear distinctions between the Middle and Late Dorset. In particular, the Late Dorset period is marked by a reoccupation of the High Arctic potentially beginning around AD 800. The High Arctic lacks any evidence of settlement during the Middle Dorset period, a time when central and southern Labrador also appear to have been abandoned (Cox, 1978; Schledermann, 1990; Appelt et al., 2016; Friesen, 2017:172). Furthermore, Late Dorset groups were the first to widely exchange and use metal (Jolicoeur, 2021a). The cause of the total disappearance of Dorset groups around the 13th and 14th centuries is unknown, although it occurs around the same time that culturally and genetically distinct early Inuit groups (frequently called the Thule culture) first migrate from Alaska into the eastern North American Arctic (McGhee, 2009; Raghavan et al., 2014; Park, 2016; Friesen, 2020).

The ubiquity of harpoon heads in Arctic sites and their changing attributes through time and space initially led to them being one of the major object types for creating these chrono-typological frameworks (Collins, 1950; Taylor, 1968; Maxwell, 1976, 1980:165; Mason, 2009:81; Houmard, 2018). While the utility of harpoon heads and other objects for this purpose has been complicated given the rise of newer and more accurate absolute dating methods (Desrosiers et al., 2006; Mason, 2009; Howse et al., 2019), some stylistic differences do exist across time. These differences are particularly true for a type of harpoon head commonly referred to as “Type G,” which is exclusively found in Late Dorset contexts and has not been identified in Early or Middle Dorset sites. More recent harpoon head research has moved beyond these chrono-typological uses and has focused on how they were manufactured (LeMoine and Darwent, 1998) and their role in hunting (Murray, 1999; Park and Mousseau, 2003; Howse, 2019).

Lithic endblades are one of the most durable and common object types in Dorset collections. Chipped stone dominates most Dorset lithic assemblages with endblades being commonly made with various types of chert but other lithic materials as well (Maxwell,1973; Sutherland, 1996:275; Renouf, 1999; Nagy, 2000; LeBlanc, 2010; Milne et al., 2011). Ground slate becomes increasingly rare within Dorset contexts through time (Taylor, 1968:121; Fitzhugh, 1975:366; McGhee, 1980:43). Likewise, bone, antler, and ivory were also used as materials for endblades although they are even more rare than slate. Metal endblades are also rare in Dorset collections, but because of various taphonomic processes, they are likely substantially underrepresented compared to other raw materials (McCartney, 1988, 1991).

The importance of the strategies used by Dorset groups to haft these endblades to harpoon heads has been briefly discussed (e.g., Holtved, 1944:193; Schledermann, 1975) but no detailed analysis has been published about Dorset harpoon endblade hafting or its broader implications for Dorset lifeways. In particular, I will demonstrate that the interface between harpoon heads and their associated endblades is an important source of information for understanding the scope, scale, and timing of metal use in the Arctic.

DORSET METAL USE

Metal became widely used in the eastern North American Arctic around AD 500 and was sustained until the disappearance of the Dorset around the arrival of the Inuit in the 13th – 14th centuries AD (McCartney, 1991; Friesen, 2020; Jolicoeur, 2021a). This use corresponds with the Late Dorset period as well as the extensive exchange networks seen at this time across the Arctic (Appelt et al., 2016). Metal was mainly used for utilitarian tools, although there is some evidence that it was also used for personal adornment (Harp, 1974). Although the material is relatively rare in museum collections, recent work has shown that it was much more commonly used (Jolicoeur, 2021a). Importantly, the development and exchange of metal by Dorset groups in the eastern North American Arctic seems to be independent from and unrelated to roughly concurrent metal use around the Bering Strait (Dyakonov et al., 2019; Friesen and O’Rourke, 2019).

Despite metal being a widespread and potentially common material used by Late Dorset groups throughout the Arctic, there are only two known major sources of it during this time period, found at opposite ends of the region (Fig. 2). Meteoritic iron was sourced from the Cape York meteorite strewn field in northern Greenland (Buchwald and Mosdal, 1985; Buchwald, 2001). It is possible however that Late Dorset groups only began to use Cape York meteoritic iron after wide-scale reoccupation of the High Arctic around AD 800. Native copper was likely sourced from the Coppermine River area and adjacent portions of Victoria Island in the western Canadian Arctic (Franklin et al., 1981:5; Rapp et al., 1990; Farrell and Jordan, 2016). Some of the metal may have been acquired through trade with the Greenlandic Norse, although there is considerable debate regarding the scale of use of this source (e.g., Harp, 1974; Park, 2008; Sutherland, 2009). Copper from the Coppermine River area and iron from Cape York were exchanged widely throughout the Arctic by the Late Dorset and later by the Inuit, although the exact source of many existing metal objects is still poorly understood (e.g., McCartney, 1991; Buchwald, 2001; Pike et al., 2019; Jolicoeur, 2021a).

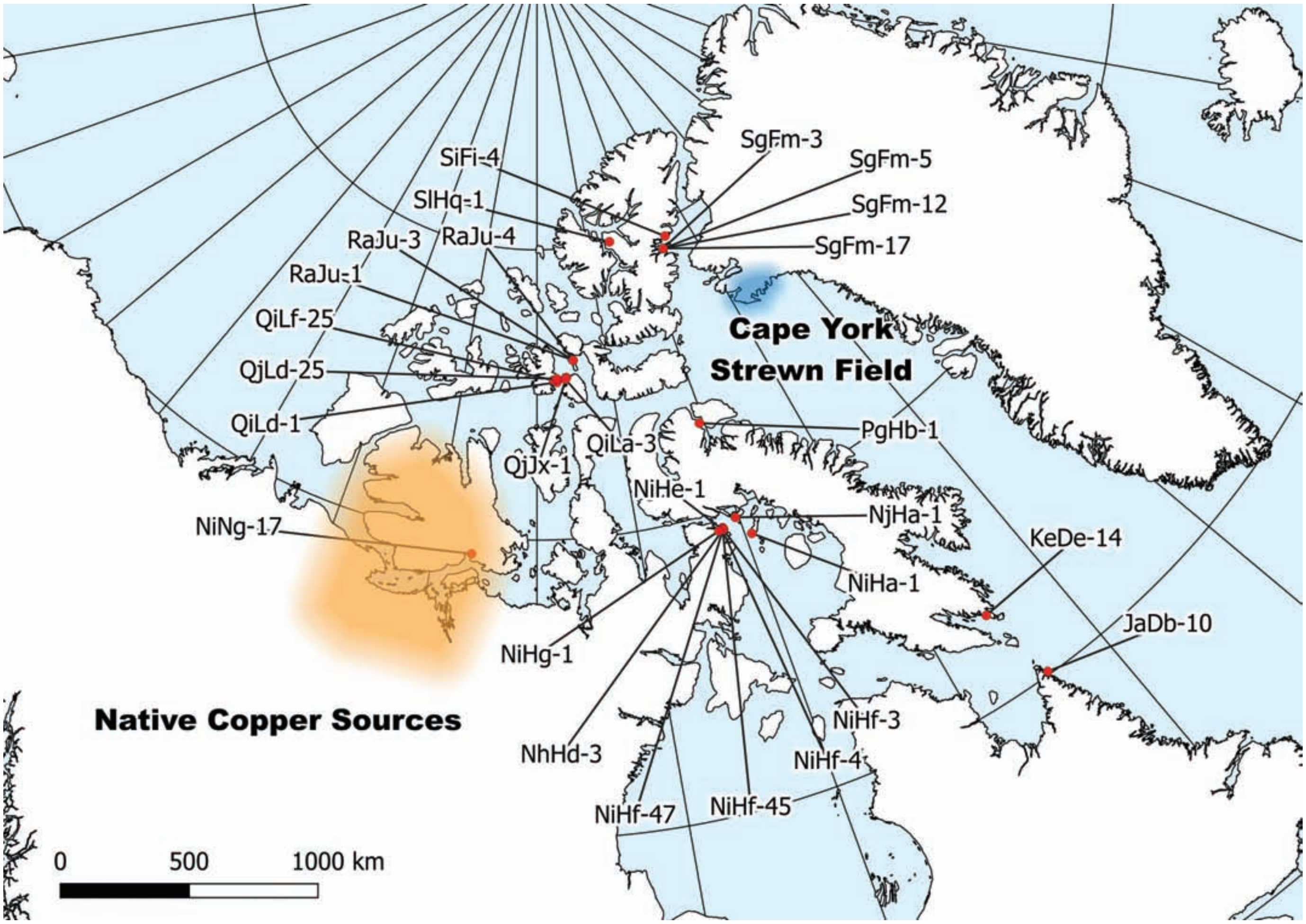

FIG. 2. The eastern North American Arctic with known Dorset metal sources and sites included in this study.

METHODOLOGY

This paper analyzes 182 bladed harpoon heads from 27 Dorset sites throughout the Canadian Arctic in order to chart the evidence for endblade hafting techniques (Fig. 2). All harpoon heads have been sorted into three categories that broadly relate to their period of use following Jolicoeur (2021a) (Fig. 3). First, 38 single line hole harpoon heads were classified as "pre-Late Dorset," representing examples from Early and Middle Dorset contexts (ca. 800 BC to AD 500) (Maxwell, 1976). This category was left as broad as possible because of the known challenges of separating Early and Middle Dorset harpoon heads based on their physical attributes (Desrosiers et al., 2006; Ryan, 2016). Second, 76 were classified as "Dorset Parallel" harpoon heads, representing a type used in all three Dorset periods (Taylor, 1968:52; Park and Stenton, 1999:35). This harpoon head type is typically more robust than other types and has a distinctive transverse line hole. These are typically interpreted as walrus hunting harpoon heads while others are thought to be used for seal hunting (Maxwell, 1976:63; Murray, 1999:474; Park and Mousseau, 2003:264). These can be further separated into Early/Middle and Late Dorset subcategories based on the dating evidence of the sites from which they were recovered. Third, 68 harpoon heads were classified as "Type G" (Park and Stenton, 1999:36). These all have double line holes and are exclusively found in sites dating to the Late Dorset period.

The harpoon heads analyzed here correspond to those in previous studies (Jolicoeur, 2021a, b), which demonstrated a correlation between blade slot thickness (i.e., the linear distance between the blade beds) and metal use. As such, all harpoon heads discussed here have a complete blade slot in order to assess if the thickness of a blade slot is related to the selected hafting technique and if hafting techniques are related to the raw material of the endblade.

RESULTS

Keeley (1982:799) identifies three main strategies for tool hafting, which can be used individually or in combination. First, there are wedged hafts where the endblade is held or "pinched" in place by the force and friction exerted by the blade beds. Second, there are "wrapped" hafts where endblades are lashed to their support. Third, there are "mastic" hafts that use some form of adhesive to secure the endblade. Within this dataset, wedged and wrapped hafts

FIG. 3. Pre-Late Dorset (top row, left to right: NiHf-47:180; NiHf-3:821; PgHb-1:4039), Dorset Parallel (middle row, left to right: SgFm-5:2; RaJu-1:427; NiHa-1:215), and Type G (bottom row, left to right: NiHf-4:4339; QiLf-25:168; NiHf-4:1192) harpoon heads that use wedge hafting. Note that the distal perforation and grooves on PgHb-1:4039 are below the blade slot.

were identified along with an additional type not listed by Keeley (1982). None of these techniques are mutually exclusive and in some cases they were used together.

First and most commonly, Dorset harpoon heads relied on wedge hafting (Fig. 3). This means that the endblade was pressed into the blade slot with the pressure and friction of both blade beds keeping the endblade in place. This technique was likely a factor for all bladed Dorset harpoon heads. The harpoon heads that were classified as using only wedge hafting were those that had no other visible means of securing the endblade in the blade slot. The use of adhesives by Dorset groups is poorly understood but testing whether red ochre, material that is found in Dorset contexts, could have been used as an adhesive for harpoon endblade hafting merits future work (e.g., Wadley, 2005). Wedge hafts are the only technique used by the 38 pre-Late Dorset harpoon heads in this dataset.

Dorset harpoon head blade slots are commonly wedge- or V-shaped, which parallels the respective shape of typical endblades from Dorset contexts. The common materials of Dorset endblades, such as chert or quartzite, are more commonly pressure-flaked, resulting in a proximal profile also being V-shaped. Blade slots are almost always created by making two converging angled cuts down the distal portion of the harpoon head (in the shape of a V) as opposed to a single cut that removes all the material (Holtved, 1944:193 cf. Stordeur-Yedid, 1980:90). This indicates that the V-shaped slot and its associated thickness is not a result of coincidentally being made with a V-shaped tool but rather an intentional angle to match the slot to its intended endblade (Jolicoeur, 2021a).

The second most common hafting technique identified is a "securing hole," a type of endblade hafting not identified by Keeley (1982). This type is found on 34 harpoon heads in this dataset (Fig. 4). Of these, 31 were Type G (45.6% of Type G) and three were Dorset Parallel (3.9% of Dorset Parallel). All of the Dorset Parallel are found in Late Dorset contexts. No Early or Middle Dorset harpoon heads included in this dataset had securing holes.

The presence of securing holes on Late Dorset harpoon heads was first noted by Holtved (1944:193) and later by Schledermann (1975, 1990), although the holes are not described in detail. A securing hole is a single central perforation gouged through both blade beds. If the endblade fitted into the blade slot also has a central perforation, then a rivet (i.e., a solid plug) or a sinew line may be passed through both objects, securely hafting them together. The term "securing hole" is preferred over "rivet hole" as the latter implies the use of rivets, which are not identified in the published literature of Dorset collections, while the former is broad enough to include both rivets and sinew line. In a small number of cases, harpoon heads in this dataset had a perforation that was only on a single blade bed or immediately below the blade slot which would have functioned differently than a true securing hole or was used for a non-hafting purpose. For the purposes of this study, these were not included in the securing hole count.

In this dataset, 15 harpoon heads with securing holes (44.1% of those with securing holes), all of which are Type G, have the distal portion of the perforation worn away

FIG. 4. Type G with securing holes (circled at the distal end of the harpoon head) (top row, left to right: NiHf-4:4889; SgFm-5:90; SgFm-3:349; SgFm-3:335) and Dorset Parallel with securing holes (bottom row, left to right: NiNg-17:25; SgFm-3:350). Note that SgFm-3:335 has a securing hole and lashing grooves.

FIG. 5. Type G with securing notches (arrow) and longitudinal channels (dotted line) (left to right: QiLd-1:2208; QjLd-25:191; QjJx-1:100; QiLd-5:558).

entirely, creating a notch along the distal edge of both blade beds (Fig. 5). It is equally possible that this notch was either the intended outcome or as the final stage of a reuse and repair cycle. In the latter scenario, the securing hole of a harpoon head would be reworked into a notch when the perforation is worn away or is sufficiently weakened either during manufacture or through use.

With a securing notch, it would have been physically impossible for the endblade to be secured to the harpoon head with a solid metal or organic rivet. However, a thin sinew lashing could have been passed through this notch and the perforation in the endblade and then tied around one of the two Type G line holes. This would exert downward pressure on the endblade while not requiring a complete perforation for the endblade to function. It is possible that Late Dorset harpoon endblades were exclusively hafted with sinew lashing as this works with both securing holes and notches while a rivet only works with a securing hole. The small diameter of some securing holes makes a thin sinew lashing also seem more probable than a thin rivet of metal or organic material.

Eighteen of the Type G harpoon heads with a securing hole (53.9%) have a longitudinal channel gouged from the distal securing hole or notch down the length of the harpoon head towards one of the line holes (Fig. 5). In all cases, this channel is on both faces and connects to the same line hole. These channels do not appear on Type G harpoon heads that do not have either a securing hole or notch, which indicates that the two features are related. All Type G with a securing notch have this longitudinal channel and only three with a securing hole have this feature. The lack of a second line hole on other harpoon heads, such as Dorset Parallel, might be the reason why this feature is only seen on Type G. The longitudinal channel would have almost certainly supported some sort of sinew lashing for securing the endblade and would have been a means to house this hafting line. The higher frequency of this channel on harpoon heads with securing notches might represent a way of extending the use life of a harpoon head as it was reworked and repaired from one that used to have a securing hole to one that has a fully developed notch.

In Inuit contexts, similar securing holes are found on some types of harpoon heads and lance heads (e.g., McCartney, 1977:232; Morrison, 1981, 1987; Gulløv, 1997:494; Schledermann and McCullough, 2003:71; Whitridge, 2016:831). However, securing holes are less common in very early Inuit contexts in the Canadian Arctic and Alaska in the 11th to 14th centuries (e.g., Collins, 1937; Rainey, 1941:476; Taylor, 1963; McCullough, 1989:87–93). In rare cases where the endblade is still hafted to the organic support, there are examples of both rivets and sinew lines being used (e.g., Gulløv, 1997:114). The sinew line cases almost always have a secondary perforation below the blade slot to secure the line (McCartney, 1977:232). None of the published examples of Inuit harpoon heads with a securing hole seem to have developed into a functional notch.

The final hafting technique that was identified involves lashing grooves (Fig. 6), which are found on 23 of the Type G harpoon heads (33.8% of Type G). Lashing grooves are circumferential grooves around the blade bed and would be classified as “wrapped hafting” in Keeley’s (1982) typology. The ephemeral grooves on some harpoon heads

FIG. 6. Type G harpoon heads (left to right: QiLd-1:973; QiLd-1:1493; QiLd-1:2245) with (bottom) and without (top) annotations showing visible lashing grooves.

suggest these are use-wear traces of having an endblade lashed to the harpoon head, while some grooves were purposely carved to house those lashings. While no Early or Middle Dorset harpoon heads analyzed for this study showed any evidence of lashing grooves, Mary-Rousselière (2002:82 – 84) reports that some single line hole Dorset harpoon head types from the complex multicomponent Nunguvik (PgHb-1) site have lashing grooves. However, the reported lashing grooves are infrequently located around the blade bed and would have served some other purpose, such as securing the harpoon head to the foreshaft. Given the complexity of that site and that single line hole harpoon head variants are known from some Late Dorset sites (e.g., Park and Mousseau, 2003; Damkjar, 2005), it is not impossible that some of the harpoon heads from Nunguvik relate to Late Dorset activity. Additionally, Knuth (1968:65) reports a single harpoon head from an Early Dorset context in northernmost Greenland that has what appears to be lashing grooves around the blade slot. Other than these, no other publication cites harpoon heads from pre-Late Dorset contexts that have lashing grooves relating to endblade hafting.

Many pre-Late Dorset harpoon, knife, and lance endblades have corner or side notches (e.g., Maxwell, 1973:134, 1985:205; Linnamae, 1975:111 – 114; Mary-Rousselière, 2002:21; Lavers and Renouf, 2012:315), which must have been used with some sort of lashing but for some reason are not as common on harpoon heads from those periods as reported here in Late Dorset contexts. The presence of lashing grooves on knife handles in all Pre-Dorset and Dorset time periods also makes it likely that some sort of wrapped hafting was used in Early and Middle Dorset periods (e.g., Owen, 1987; Grønnow, 2017:127). Future work identifying use wear on Dorset harpoon heads might broaden the prevalence of the wrapped hafting technique throughout all Dorset periods.

Two Type G harpoon heads in this dataset have both a lashing groove and a securing hole, suggesting that multiple forces were used to haft harpoon endblades. Unfortunately, it is unclear if both techniques were used concurrently. Since it is impossible to exclude wedge hafting, it is likely that all three techniques were used in these harpoon heads in some fashion.

DISCUSSION

An important outcome of this study is that securing holes and lashing grooves are found only on Late Dorset harpoon heads. Furthermore, they are found in high proportions of Type G harpoon heads with only 16 (23.5% of Type G) relying exclusively on wedge hafting. This finding is supported by the Type G descriptions by Holtved (1944:193) from his work in northern Greenland where a single example out of nine relied only on wedge hafting. The lack of observable harpoon endblade hafting techniques in Early and Middle Dorset contexts, other than wedge hafting, indicates that an additional means beyond wedge hafting was needed in the Late Dorset period. The emergence of these novel harpoon endblade hafting strategies correlates with the decrease in blade slot thickness observed in harpoon heads (Jolicoeur, 2021a). The most parsimonious explanation is that Late Dorset groups were using a new raw material for harpoon endblades that required additional hafting techniques.

The presence of a securing hole clearly signals what these other raw materials might have been. For a securing hole to function as intended, a corresponding perforation on the endblade is required. Therefore, while it is not impossible for a chipped stone endblade to be used with a harpoon head that happens to have a securing hole (Holtved, 1944:193), common chipped stone materials used for Dorset endblades could not have been hafted with a securing hole given the physical limitations of producing a perforation through those materials.

Conversely, organic materials, slate, and metal can all be perforated in this way. However, bone, antler, and ivory endblades are extremely rare in Late Dorset collections despite other organic objects being common. One of the few known examples is from QjJx-1 (Arvik) on Little Cornwallis (LeMoine et al., 2003:260). This antler endblade has a central perforation correlating to a securing hole on a harpoon head, suggesting that the securing hole in some cases might also relate to bone, antler, and ivory endblade use. However, this specific object has a thickness similar to lithic endblades (Jolicoeur, 2021a:12). By comparison, bone, antler, and ivory endblades are much more common in Inuit contexts (e.g., McCartney, 1977:357; McGhee, 1984:49; Gulløv, 1997:129; Schledermann and McCullough, 2003:71). Therefore, it is unlikely the dearth of organic material endblades in Dorset contexts is related to poor preservation. Similarly, slate endblades are exceedingly rare in Late Dorset contexts but are much more common in Early and Middle Dorset collections where they may have also been used as knife blades (e.g., Maxwell, 1973:151). The slate endblades that do exist across all Dorset contexts more frequently have paired lateral perforations than a single central perforation and are generally much larger than typical harpoon endblades. The best-known examples of this come from Dorset contexts in Newfoundland (e.g., Linnamae, 1975:119; Tuck, 1976:95).

This raw material use contrasts with Inuit contexts where chipped stone material is uncommon, but ground slate, bone, antler, and ivory endblades are more common. Numerous slate and organic material endblades are found with a single central perforation (e.g., McGhee, 1980:44, 1984:49). Likewise, early Inuit harpoon heads frequently have visible securing holes (e.g. Morrison, 1981; Gulløv, 1997:494; Schledermann and McCullough, 2003:71). Ultimately, it is unlikely that slate, bone, antler, and ivory harpoon endblades are as common in Late Dorset contexts where there is significantly less evidence despite similar levels of preservation.

Metal endblades are also rare but this rarity is likely due to various taphonomic factors that don't affect slate and organic endblades (e.g., McCartney, 1988). One known copper endblade from northern Greenland, for example, has a central perforation that would have been used in conjunction with a securing hole (Appelt et al., 1998:151). With this in mind, harpoon head securing holes on Late Dorset period harpoon heads most likely relate to metal endblades. This supposition correlates well when comparing the presence of hafting techniques, especially securing holes, with blade slot thickness.

Following the methods in Jolicoeur (2021a), when the linear distances between the distal tip and the midpoint of Type G blade slots are plotted, harpoon heads with securing holes have the thinnest blade slots while those that use wedge hafting or lashing grooves have thicker blade slots (Fig. 7). Clearly, there is a considerable amount of variability in these data but some quantitative differences do exist among the different hafting strategies. On average, Type G harpoon heads that rely only on wedge hafting tend to have thicker blade slots than those with other hafting techniques (Table 1). Harpoon heads with these visible securing techniques are also less variable than those using only wedge hafting. Type G harpoon heads have consistently thinner blade slots than other harpoon head types; those with securing holes are among the thinnest of all known Dorset harpoon head blade slots (Jolicoeur, 2021a). While a thin metal endblade could theoretically be used in any harpoon head, the presence of a securing hole effectively eliminates the possibility of using chipped stone materials, and a thin slot eliminates bone, antler, ivory, and slate endblades, which tend to be thicker (Jolicoeur, 2021a). Therefore, the only remaining possibility is that metal endblades were used in these harpoon heads.

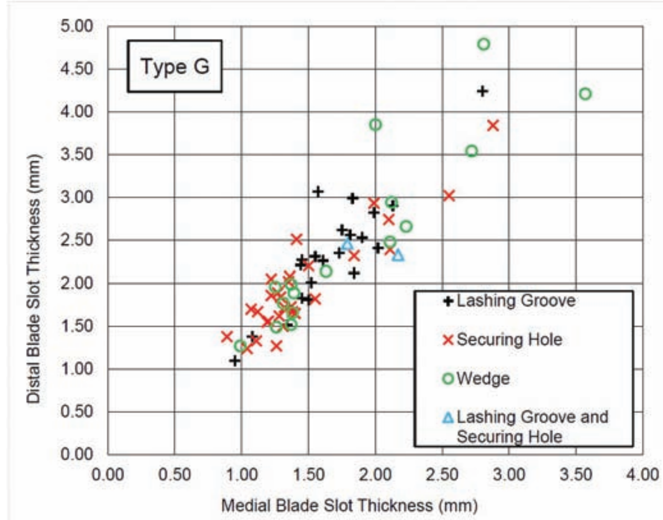

FIG. 7. Medial and distal blade slot thicknesses of Type G harpoon heads separated by hafting strategy.

Schledermann (1975) briefly hypothesized that different hafting strategies are more prominent in different regions. However, when separating this dataset into four different regions, the relative proportion of each technique is evenly distributed despite the different absolute sample sizes (Fig. 8). Additionally, given the link between securing holes and metal use, the widespread use of securing holes on the harpoon heads in this dataset suggests that metal use itself might also be relatively evenly distributed across the Arctic and is not necessarily clustered around known sources. This finding contrasts significantly with the expected "distance decay" drop-off seen in Dorset lithic exchange contexts in which sites farther away from a raw material source tend to have less evidence of that raw material than those closest to the source (e.g., Nagle, 1984). This result might indicate the high value of metal during the Late Dorset period (e.g., Jolicoeur, 2021a). Another possibility is that harpoon heads simply represent the proportion of metal use and are less accurate at demonstrating the absolute amount of metal

TABLE 1. Descriptive statistics of harpoon head medial and distal blade slot thicknesses separated by hafting strategy.[1]

	Wedge (Type G)		Securing hole (Type G)		Lashing (Type G)		Wedge (Dorset Parallel)		Securing hole (Dorset Parallel)		Wedge (pre-Late Dorset)	
	Medial	Distal	Medial	Distal	Medial	Distal	Medial	Distal	Medial	Distal	Medial	Distal
Mean	1.84	2.51	1.47	1.97	1.68	2.35	2.57	3.37	1.83	2.62	2.19	2.75
Median	1.51	2.07	1.32	1.82	1.61	2.31	2.58	3.37	1.81	2.53	2.13	2.69
σ	0.71	1.07	0.46	0.59	0.39	0.68	0.57	0.60	0.79	0.94	0.31	0.48
Range	2.58	3.52	1.99	2.60	1.85	3.14	2.51	2.94	1.57	1.87	1.65	2.15
Min	0.99	1.27	0.89	1.24	0.95	1.10	1.45	1.59	1.05	1.73	1.42	1.65
Max	3.57	4.79	2.88	3.84	2.80	4.24	3.96	4.53	2.62	3.60	3.07	3.80
n	16	16	29	29	21	21	73	73	3	3	38	38

[1] Two harpoon heads with both lashing grooves and a securing hole were not included in the table.

used compared to direct evidence of the raw material (e.g., LeMoine, 2005:141). Therefore, it is possible that metal was used frequently throughout the Arctic despite potentially varying in overall quantity depending on a site's distance from the source. Given that direct evidence of metal use is underrepresented in Arctic collections, the use of proxy indicators such as the one presented here likely provides a more reliable dataset for understanding the overall extent and intensity of Late Dorset metal use and exchange (McCartney, 1988; Jolicoeur, 2021a). Although the sample size differences among the subsregion make it difficult to assess any real differences, it does appear that lashing grooves are less well represented in material from the Foxe Basin compared to the central or High Arctic. Furthermore, the dataset only includes sites from what is now Canada; more data from Greenland might somewhat alter these conclusions, especially regarding proportional use of metal at sites closer to known metal sources.

CONCLUSIONS AND FUTURE DIRECTIONS

Other work has clearly demonstrated the value of studying tool hafting techniques for understanding other aspects about human behaviour. In this paper, I have shown the ways hafting can directly indicate the type of material being held in a blade slot. I have identified that wedge hafting techniques were used by Dorset people in Arctic North America for more than a millennium, and that two new harpoon endblade hafting techniques (i.e., securing holes or notches and lashing grooves) emerged around AD 500 at the start of the Late Dorset period.

There seems to be a causal link between these new forms of harpoon head endblade hafting and the emergence of metal use. This link is particularly clear with the presence of securing holes and notches, which are not physically compatible with common chipped stone tool materials. Given the rarity of both slate and organic material endblades in Late Dorset contexts, these securing holes and notches must have been used to haft metal endblades. Furthermore, harpoon heads with securing holes and notches generally have thinner blade slots which, as demonstrated previously (Jolicoeur, 2021a), are also linked to metal use. Holtved (1944:193) and Schledermann (1975) briefly noted the possible link between hafting techniques, blade slot thickness, and metal use but did not explore the topic systematically. With these newly analyzed data from across the Arctic in mind, these three variables seem inextricably linked in the North American Arctic.

Although using sinew lashing rather than rivets to haft endblades is seen in Inuit contexts, the securing notch and longitudinal channels found on Late Dorset harpoon heads appear to be unique in Arctic contexts. Having these notches would preclude the use of a solid rivet made of metal or organic material. It is more likely that a thin sinew line threaded through this notch and endblade and was tied to one of the Type G harpoon head line holes. The longitudinal channel associated with all the harpoon heads with notches would have been used to help protect the sinew line from breakage or wear during regular use.

The association of metal use and harpoon heads identified here is particularly significant as previous work has shown that harpoon heads tend to be more common at Late Dorset longhouse sites than at other site types (Damkjar, 2005). While the function of these longhouses is not completely understood, researchers agree that they were likely important locations for seasonal aggregation and exchange (Plumet, 1985; Schledermann, 1990; Appelt and Gulløv, 1999; Damkjar, 2000, 2005). Undoubtedly, the dramatic increase in metal use that occurs at this time was either facilitated by or an important cause for these widespread exchange networks. More research is needed at these longhouse sites to understand if other materials, such as ivory, wood, soapstone, nephrite, or amber, travelled as extensively as metal (e.g., Jolicoeur, 2021a). Importantly, this paper did not discuss the changes in metal use throughout the Late Dorset period. The lack of solid chronological data from many Late Dorset sites makes this sort of analysis challenging. More detailed radiocarbon dating data might make it possible to tease apart any changes in Late Dorset interaction over time and provide a better understanding of the exact timing of Cape York meteoritic iron use and how this might relate to the Late Dorset reoccupation of the High Arctic around AD 800.

The shift from one material to another or the incorporation of a new material is a crucially important

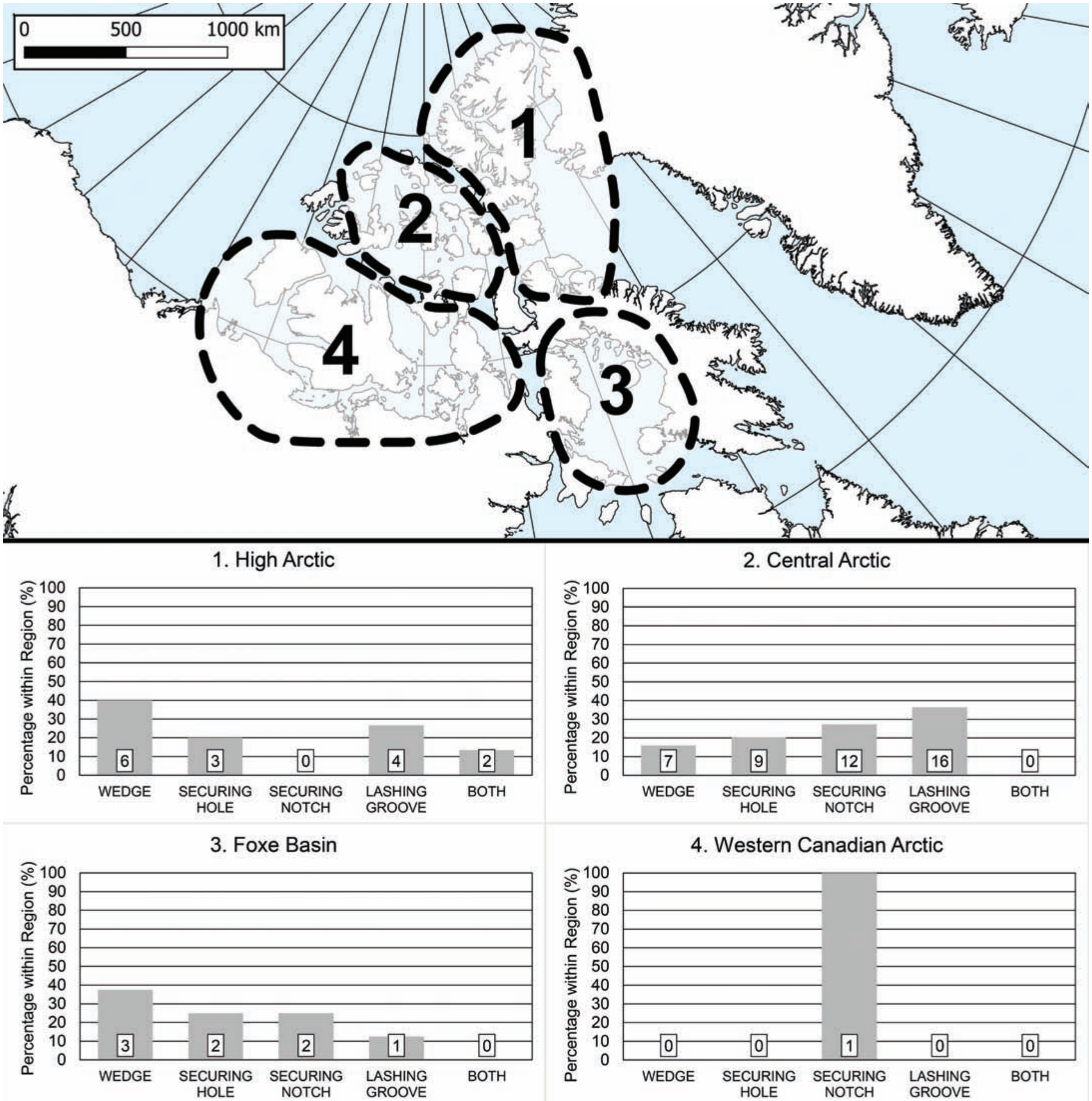

FIG. 8. Relative proportions of Type G hafting techniques separated into four different regions. Note the sample size for each hafting strategy is reported in each box on the bar chart.

question asked by archaeologists across the globe for understanding both long-term change and rapid short-term shifts in human behaviour (e.g., Fitzhugh, 1974, 1975; Ames et al., 2010; Jørgensen, 2021). In some contexts with sufficient organic preservation, it is possible to approach how and when these new materials were being incorporated simply by understanding the different hafting strategies that were selected. This approach is particularly relevant in regions such as the Pacific Northwest, Alaska, the eastern Siberian Arctic, and even the European Arctic where the presence of new materials such as slate and metal become more commonly used throughout time (e.g., Fitzhugh, 1975; Møllenhus, 1975; Engelstad, 1985; Damm et al., 2020:57). Tracking potentially novel hafting strategies used by past humans significantly contributes to understanding the scope, scale, and timing of these new materials in those regions.

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