Anne Lisbeth Schmidt, Roberto Fortuna, Anette Hjelm Petersen,
Klaus Støttrup Jensen and Karsten Jensen

Assessment of material resource usage in Inuit skin clothing

Abstract
This study focuses on reliable methods for measuring the use of resources determining the extent or amount of skin used in Inuit garments. A collection of parkas of known provenance dating from approximately 1830 to 1940 CE currently housed at the National Museum of Denmark was measured using three quantitative metric methods: 3D-measurement with a FaroArm (Method 1), tape measurement (Method 2), and 2D-measurement of digital images (Method 3). Methods 1 and 3 produced statistically reliable results, while Method 2 failed. This research is a sub-study within a project that aims to reconnect Inuit garments that are currently only provisionally numbered with their original provenance information by applying measuring methods. The hypothesis supporting this study posits that three parameters: 1) design, 2) animal species, and 3) material resource usage, provide sufficient data to categorise unidentified items geographically and identify the gender for whom the garments were earmarked.

Keywords: Material resource usage, area measurement, Inuit skin parkas, provenance, FaroArm

Introduction

In cultural-history museums, the absence of an original accession tag or inventory number may cause problems as unidentified objects cannot provide information about their origin, use, date, etc. Without contextual data, the museum often considers these items less valuable, insignificant, or even candidates for cassation. At the National Museum of Denmark (NMD), several unique historical Inuit skin garments have lost their original inventory numbers. Thus, these parkas, trousers, footwear, mittens, etc. have no link to the information on provenance contained in museum inventories and archives, such as geographical origin, cultural affiliation, animal species, design, date, gender, donor, acquisition, etc. In 2024, this is the case for 22% of the garments from Greenland (135 out of a total of 602) and 4% of those from the Bering Strait region, Alaska, and Arctic Canada (25 out of 569) inventoried in the NMD registration database GENREG on 1 July 2023 and available at the NMD website Skin Clothing Online. The *Inuit Skin Clothing* project at the NMD attempts to re-establish links between unidentified skin garments and information on their provenance. The hypothesis supporting the study submits that by combining three parameters: 1) design assessment, 2) species identification, and 3) material resource usage, it is possible to identify Inuit clothing. In this study, "material resource usage" denotes the total area of skin material used for the garment, including the garment's fur trimmings and edgings.

Background

The term Inuit refers "… both to the present occupants of the area from the coast of Chukotka in Siberia to Kalaallit Nunaat (Greenland) and to their immediate forebears, who descended from the Thule culture peoples" (Issenman 1997, 7). The major Inuit groups can be divided geographically, from west to east, but with floating boundaries. The western Inuit consist of the Alutiiq on the Alaskan Peninsula and southern coast, Yupiit in western Alaska, Yupiget on St Lawrence Island and in Siberia, and the Inupiat and Iñupiat in northern Alaska. The Central Inuit in Arctic Canada comprise the Inuvialuit, Inuinnait, Netsilingmiut, Aivilimmiut, Kivallirmiut, Iglulingmiut, and Nunatsiarmiut. On the Labrador Peninsula are the Nunavimmiut and Nunatsiavummiut. The eastern Inuit in Greenland consist of the Inughuit in northern Greenland, the Kalaallit in western Greenland, and the Iivit in eastern Greenland (Balickci 1970; Issenman 1997; Krupnik 2016). The Inuit names mentioned are those currently in use.

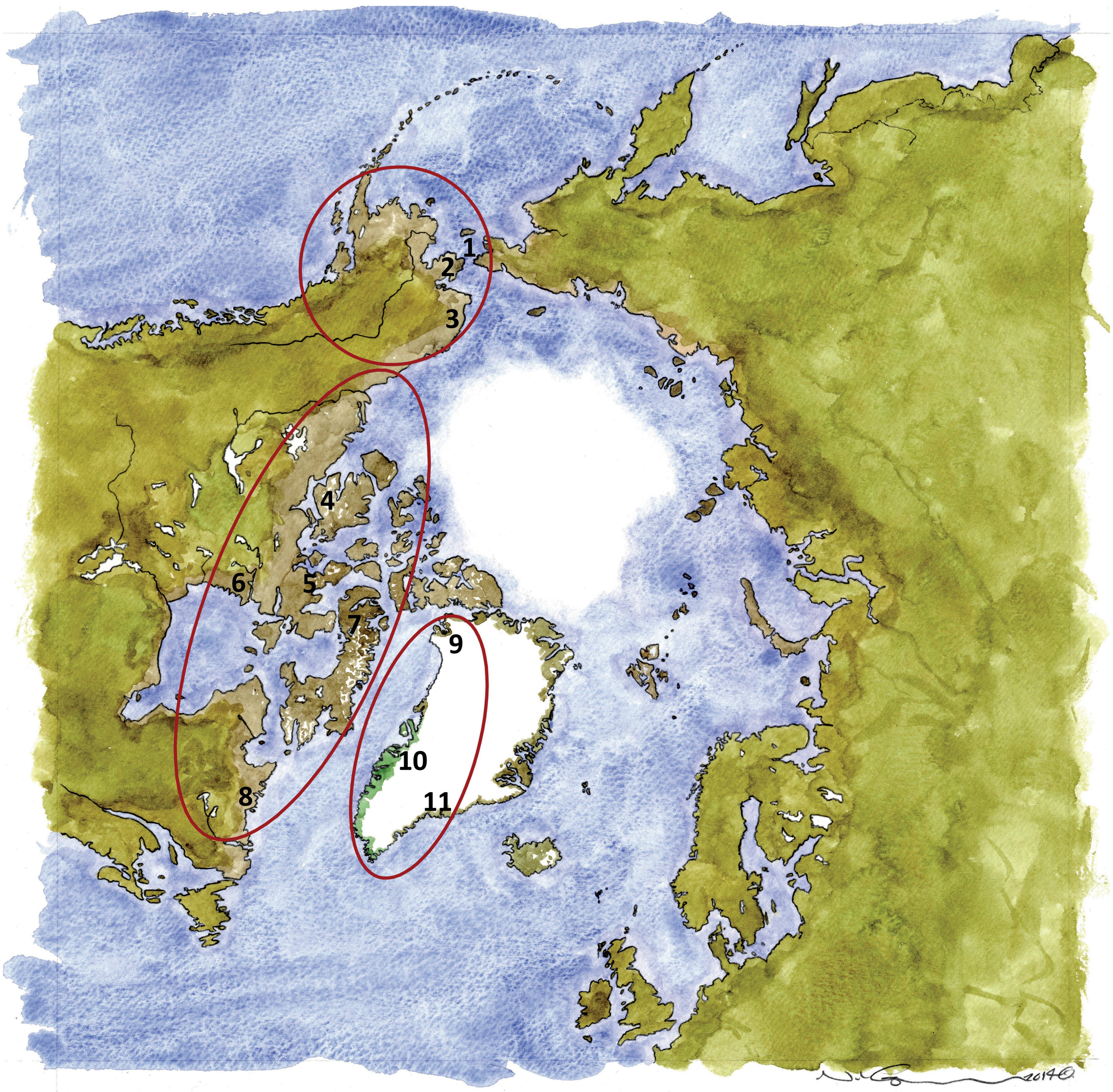

Fig. 1: Map showing the provenances of the Inuit parkas included in this study. From the western Inuit: the Yupiit (1) along Bering Strait, the Yupiget (2) on St Lawrence Island and in Siberia, and the Iñupiat in northern Alaska (3). From the Central Inuit in central Arctic Canada: Inuinnait (4), Netsilingmiut (5), Kivallirmiut (6), Iglulingmiut (7), and from the Labrador Peninsula, the Nunatsiavummiut (8). From the eastern Inuit in Greenland: the Inughuit (9), Kalaallit (10), and Iivit (11). The encircled areas should be considered with floating boundaries (Image: Nuka Konrad Godtfredsen)

Geographical region: Inuit groups	Number of garments	Men	Women	Gender not defined / children
Western Inuit in the Bering Strait region and Alaska: The Alutiiq, Yupiit, Yupiget, Inupiat, and Iñupiat	Total 146	All items: 69 Parkas: 24 Analysed: 3	All items: 18 Parkas: 7 Analysed: 1	All items: 59
Central Inuit in Arctic Canada: The Inuinnait, Netsilingmiut, Kivallirmiut, Iglulingmiut, and Nunatsiavummiut	Total 423	All items: 223 Parkas: 68 Analysed: 4	All items: 88 Parkas: 27 Analysed: 5	All items: 112
Eastern Inuit in Greenland: The Inughuit, Kalaallit, and Iivit	Total 602	All items: 220 Parkas: 75 Analysed: 9	All items: 215 Parkas 48 Analysed: 10	All items: 167
Number of NMD Inuit garments	Total 1,171	All items: 512 Parkas: 167 Analysed: 16	All items: 321 Parkas: 82 Analysed: 16	All items: 338

Table 1: Areas inhabited by Inuit groups

Inuit clothing of skin and fur maintained local design features within different groups until the early 20th century despite overlapping geographical divisions. The appearance of fur clothing was influenced by colonisation, the commercial fur trade, Christian missions, and the interactions between migrating Inuit groups. However, the traditional clothing construction, initially established by the Inuit centuries ago, persisted as they selectively incorporated a few elements from outsiders that suited their needs (Issenman 1997, 174–175). Specific traits in Inuit clothing design and the clothing of some eastern Siberian groups demonstrate the migration of groups from Siberia to Arctic North America and Greenland (Hatt 1969, 98–109; Issenman 1997, 98, 232–238; Schmidt in press).

The oldest Greenlandic Inuit garments in the current NMD collection were collected in 1834 on the initiative of the museum's first director, Christian Jürgensen Thomsen (1788–1865) (Jensen 1992, 309). The Arctic collection gradually grew, mainly due to the collecting activities of government officials, traders, and missionaries. Between 1916 and 1928, the number of items of Inuit clothing more than doubled at the NMD. This increase was a result of a research-based collection procedure, for example, as practiced by Danish ethnographer Kaj Birket-Smith (1893–1977) (1924; 1929; 1945) and archaeologist Terkel Mathiassen (1892–1967) (1928). From 1938 until the present day, the NMD has collected only a few items of Inuit clothing, as modern clothing made of fabric, leather, rubber, etc. replaced traditional clothing in the Arctic. The NMD collection covers a span of approximately 110 years, documenting the transition from the original production and daily use of traditional skin clothing among the Inuit to the use of imported materials and current western fashion. It is important to note that traditional patterns are still maintained among contemporary Canadian Inuit, where a woman's amauti is now made from fabric (Issenman 1997; Pharand 2012). In Greenland, women's festive trousers and footwear are still made from seal skin, and the material resource for men's hunting trousers in northern Greenland is polar bear skin.

The Inuit Skin Clothing project

The project aims to create an identification key applicable to unlabelled garments, allowing them to be matched with their original accession data in museum inventories or archives. By reconnecting these items with their initial data and inventory number, the aspiration is to restore their cultural value in alignment with the ICOM (International Council of Museums) Code of Ethics for Museums. This research is particularly relevant in collection care. Section 2.18 of the code entitled "Care of Collections" states, "Museum collections should be documented according to accepted professional standards. Such documentation should include a full identification and description of each item, its association, provenance, condition, treatment, and present location. Such data should be kept in a secure environment and be supported by retrieval systems providing access to the information by the museum personnel and other legitimate users." (Anonymous 2017, 14). Some NMD parkas have remained unidentified for a century or more (for example, Hatt 1969, 49, 52; Birket-Smith 1924, 187), and remain so to this day according to the museum registration carried out in 1986, when the collection was registered digitally.

It is important to apply standardised measurement methods to document and compare historical or archaeological clothing items. However, museums often have their own embedded practices that are not well-documented. Researchers have called for the need to introduce standard methods of measuring clothing (Issenman 1997, 140). Despite this, museum staff continue to use century-old conventional methods utilising grid paper, pencils, measuring tapes, and pins to document clothing patterns (Flecker 2007). These methods are unsuitable for fragile materials, such as bird skin and gut skin, which could easily be torn by inserting needles or through pressure from handling. Numerous records of patterns of Inuit skin clothing have been published without attaching a

Fig. 2: 16 parkas for Inuit men. Western Inuit: AsM1, AlM1, AlM2. Central Inuit: CoM1, NeM1, CaM1, IgM1. Eastern Inuit: NGM1, NGM SQ, WGM1, WGM SQ, WGM SQX, WGM3X, EGM1, EGM SQ, EGM3X (Images: Roberto Fortuna)

reference scale (for example, Murdoch 1892; Hatt 1969; Birket-Smith 1924; Birket-Smith 1929; Mathiassen 1928; Jenness 1946; Holtved 1967; Chaussonnet 1988; Issenman 1997; Buijs 2004; Oakes and Riewe 2007; Pharand 2012). Some works present patterns, which include a scale bar (for example, Holtved 1954; 1967; Møller 1989; Oakes 1991; Issenman 1997; Buijs 2004).

No accurate area measurement has been applied to the research material resource usage in skin clothing apart from one study (Jensen et al. 2012). Some publications mention the quantity of animal skins required for making garments. For example, one polar bear skin was used to make three pairs of trousers for Inughuit men (Issenman 1997, 74). Inuit caribou or sealskin parkas were typically made using two skins (Hatt 1969, 36; Birket-Smith 1924, 172).

Fig. 3: 16 parkas for Inuit women. Western Inuit: AlF1. Central Inuit: CoF1, NeF1, CaF1, IgF1, LaF1. Eastern Inuit: NGF1, NGF2, NGF3X, WGF1, WGF2, WGF3, WGF4, EGF1, EGF2, EGF3X (Images: Roberto Fortuna)

Geographical group, Inuit name	Gender	Acronym	Inventory number	Accession year	References to specific garment	METHOD 1 3D-measured area, incl. tape-measured edgings (sqm)	METHOD 2 Tape-measured area, *not* compensated (sqm)	METHOD 3 2D-measured area, *not* compensated (sqm)	Method 3 / Method 1 (%)	Cause of photo-measuring failure
Western Inuit, Yupiget	Man	AsM1	Kc.99	1860	Schmidt et al. 2013, 66, 69. Schmidt 2024, 118.	1.824	1.746	~~1.363~~	-	Many folds
Western Inuit, Yupiit	Man	AlM1	P.152	1913		2.290	2.526	~~2.146~~	-	No hood
Western Inuit, Iñupiat	Man	AlM2	P32.5	1926	Schmidt 2024, 116.	1.666	1.727	1.485	89,1	
Central Inuit, Inuinnait	Man	CoM1	P30.2	1927	Birket-Smith 1945, 144.	1.167	0.965	0.962	82,4	
Central Inuit, Netsilingmiut	Man	NeM1	P29.8	1924	Birket-Smith 1945, 28, 30.	1.529	1.600	1.386	90,6	
Central Inuit, Kivallirmiut	Man	CaM1	P28.6	1924	Birket-Smith 1929, 200-202.	1.464	1.615	1.221	83,4	
Central Inuit, Iglulingmiut	Man	IgM1	P27.410	1924	Mathiassen 1928, 161, 163.	1.496	1.656	1.347	90,0	
Eastern Inuit, Inughuit	Man	NGM1	L.9549	1928		1.421	1.072	1.237	87,1	
Eastern Inuit, Inughuit	Man	NGM2	L.2097	1905	Birket-Smith 1924, 173-174.	1.503	1.694	1.334	88,8	
Eastern Inuit, Kalaallit	Man	WGM1	Ld.31a	1883	Hatt [1914] 1969, 45.	1.059	0.974	0.869	82,1	
Eastern Inuit, Kalaallit	Man	WGM2	L.8500	1924		1.096	0.983	0.930	84,9	
Eastern Inuit, Kalaallit	Man	WGM2X	L.7822	1918	Birket-Smith 1924, 172-173.	1.327	1.233	1.140	85,9	
Eastern Inuit, Kalaallit	Man	WGM3X	L.7830	1918	Birket-Smith 1924, 170-172.	1.123	0.954	~~0.835~~	-	Cylindrical shape
Eastern Inuit, Iivit	Man	EGM1	Ld.17	1881		1.316	1.169	1.131	85,9	
Eastern Inuit, Iivit	Man	EGM2	L.4990	1911		1.241	1.310	1.094	88,2	
Eastern Inuit, Iivit	Man	EGM3X	Ld.16	1881		1.138	1.087	0.980	86,1	
Western Inuit, Alaska	Woman	AlF1	P32.1	1926		1.758	1.906	1.511	85,9	
Central Inuit, Inuinnait	Woman	CoF1	P30.15	1927	Birket-Smith 1945, 154-155.	1.323	1.544	1.057	79,9	
Central Inuit, Netsilingmiut	Woman	NeF1	P29.10	1924	Birket-Smith 1945, 37-38; Issenman 1997, 121.	1.856	1.590	~~1.436~~	-	Many folds
Central Inuit, Kivallirmiut	Woman	CaF1	P28.10	1924	Birket-Smith 1929, 217-218.	1.585	1.698	1.392	87,8	
Central Inuit, Iglulingmiut	Woman	IgF1	P27.453	1924	Mathiassen 1928, 175-177.	1.971	1.844	~~1.456~~	-	Many folds
Central Inuit, Nunatsiavummiut	Woman	LaF1	P.230a	1922	Issenman, 1997, 168.	1.273	1.458	1.038	81,5	
Eastern Inuit, Inughuit	Woman	NGF1	X.233	1921		0.976	1.173	~~0.745~~	-	Long-haired fur
Eastern Inuit, Inughuit	Woman	NGF2	L.9554	1928		1.159	1.321	0.900	77,7	
Eastern Inuit, Inughuit	Woman	NGF3X	L.4357	1909	Hatt [1914] 1969, 43.	0.763	0.842	0.631	82,7	
Eastern Inuit, Kalaallit	Woman	WGF1	L.7819	1918	Birket-Smith 1924, 200-201.	1.076	1.073	0.880	81,8	
Eastern Inuit, Kalaallit	Woman	WGF2	Ld.32a	1883	Birket-Smith 1924, 193-195; Hatt [1914] 1969, 44.	0.694	0.716	0.572	82,4	
Eastern Inuit, Kalaallit	Woman	WGF3	Lc.187a	1844	Hatt [1914] 1969, 44; Birket-Smith 1924, 195-197; Bahnson 2005, 86-87.	0.818	0.762	0.646	79,0	
Eastern Inuit, Kalaallit	Woman	WGF4	L18.140a	1938		0.858	0.813	~~0.686~~	-	No hood
Eastern Inuit, Iivit	Woman	EGF1	L.5064	1911		1.061	1.072	0.959	90,4	
Eastern Inuit, Iivit	Woman	EGF2	L.5066	1911		0.773	0.944	0.690	89,3	
Eastern Inuit, Iivit	Woman	EGF3X	Lc.378	1854		0.875	0.945	0,770	88,0	
					Statistical validity, i.e., normal distribution of data	**METHOD 1 Valid**	**METHOD 2** ***Not valid***	**METHOD 3 Valid**		
								Mean value 25 parkas	85,2,2%	
								Standard deviation	3,7%	
								Compensation factor	1,174	

Table 2: Data sets on the 32 parkas

The primary focus of this paper is to reliably measure material resource usage. It attempts to answer the following questions: is it possible to identify Inuit parkas' geographical and cultural origin based on their material resource usage? Is it possible to differentiate men's and women's clothing by area measurement? Can material resource usage stand alone as a metrically identifying parameter?

To address these questions, the paper is divided into two parts. First, the testing of accuracy, validity, non-damaging effect, and costs of three methods for quantifying the material resource usage for skin garments are described: 3D-measurement with a FaroArm (Jensen et al. 2012) (Method 1), tape measurement (Method 2), and 2D-measurement performed on digital images of garments (Method 3). Apart from Method 1 (Jensen et al. 2012), no similar studies on material resource usage regarding clothes or garments was found. The aim is to determine which of the compared methods is the most reliable, least harmful, accessible, and cost-effective. The reproducibility, equipment and time costs, and ease of performance are evaluated.

Secondly, the study aims to assess the validity of material resource data as a critical parameter in identifying Inuit clothing from the Bering Strait region, Alaska, Arctic Canada, and Greenland. Fur and skin parkas from the NMD provide the main material for examination.

The Inuit parka

Parkas are a part of the traditional Inuit skin clothing outfit for outdoor use, which also comprises trousers, footwear, and mittens. These items are often double layered, with the fur side either turned inward (toward the body) or outward (exposed to the elements). Apart from the Inuit in the Bering Strait region and southern Alaska, where some parkas are hood-less, the parka is usually a hooded garment, closed at the front and pulled over the head. Men's parkas have relatively tight-fitting hoods; cut straight across on the lower hemline. Women's parkas either have a hood and a spacious back, shaped to carry small children (Inuktitut: amauti, Greenlandic: amaat) or a pointed hood without the roomy back. Women's parkas have substantial front and back flaps (that is, tails, pointed or u-shaped) (Birket-Smith 1924, 197).

So-called double hood roots (that is, two-pointed skin gores, sewn from the hood to the front, occasionally also to the back, like illusory walrus tusks) (Fitzhugh and Kaplan 1982, 146), sleeve gussets and a triangular top piece in the hood are western designs. Eastern designs are characteristic by their so-called single hood root (that is, a square gusset connecting the hood under the chin) and a median top seam in the hood (Hatt 1969, 106).

Pattern components for skin clothing are cut symmetrically out of the skin, and the corresponding parts in the finished garments match as on the animal (Issenman 1997, 87).

Empirical material

According to the NMD GENREG-database, the museum's collection currently numbers 1,171 pieces of Inuit clothing (covering all types of garments, with sets of outfits, such as a pair of boots, stockings, mittens, etc., counting as one item) (for example, described in Holm 2010; Hatt 1969; Thalbitzer 2010; Birket-Smith 1924; 1929; 1945; Mathiassen 1928; Issenman 1997; Bahnson 2005; Schmidt et al. 2013; Schmidt 2014; 2019). The extent of the NMD collection identified by region and Inuit groups is presented in table 1. This study specifically focuses on measurements taken on parkas, so these items are specified.

Methodology

Criteria for selection of items for the study

The following criteria are employed in the selection of garments from the NMD's collection:

An inventory number must be attached to the item to ensure a correct link to provenance, gender, and date. The item must be of known provenance, affiliated with an Inuit group, specific gender, etc. Items without inventory numbers are omitted.

Garments from the late 19th to early 20th century are prioritised for identification of the design characteristics, and clothing with the oldest design is preferred within this period.

The selected items are evenly distributed between men and women. Children's clothing is considered too variable in size to be included. On average, Inuit men are approximately 12 cm taller than women. At the end of the 19th century, the average height of Inuit women in Greenland was approximately 148 cm, while men were approximately 160 cm tall (Roser et al. 2021). In 1960, anthropometric studies from Kodiak Island, Alaska, indicated that Inuit women had an average height of approximately 149 cm, while men were approximately 160 cm tall (Jørgensen 2002).

Where possible, the study includes various designs from the same Inuit group. Both inner (skin's hair side turned inwards) and outer (hair side turned outwards) parkas were selected.

As per the NMD's digital documentation, the collection items are categorised based on American anthropologist George Peter Murdock's (1897–1985)

Outline of World Cultures (Murdock 1963). The items are sorted from west to east, grouping the western Inuit in the Bering Strait region and Alaska as NA1, NA3, NA6, NA9, NA10, NA13, and RY5 (Murdock 1963, 91–92, 150). The Central Inuit in Arctic Canada are classified as follows: Inuinnait: ND8, Netsilingmiut: ND13, Kivallirmiut: ND6, Iglulingmiut: ND5, and Nunatsiavummiut: N15 (Murdock 1963, 93–94, 97). The eastern Inuit in Greenland are categorised as Inughuit: NB5, Kalaallit: NB6, and Iivit: NB4 (Murdock 1963, 91–92).

A total of 32 Inuit parkas – 16 for adult men, 16 for adult women – constitute the empirical and statistical base for testing and comparing the three methods of area measurement. For the geographical distribution of the 32 parkas, that is, the areas inhabited by the Inuit groups are listed in table 1 (figs 1-3). Table 2 provides a data set on the 32 parkas with inventory numbers and code names.

Methods of quantifying material resource usage

Three non-destructive methods for measuring skin garments are presented and assessed in the following sections. In addition to the somewhat costly, complicated, and time-consuming 3D-measurement with a FaroArm (Method 1), two less expensive and more easily executed procedures are evaluated for their suitability and statistical validity: Method 2 involves the physical measurement of clothing with a tape measure, and Method 3 entails 2D-measurement carried out on digital images of garments.

Method 1: 3D-measurement of clothing with a FaroArm

3D-measurements of the 32 parkas were carried out using a FaroArm (Sterling, model 10-02 and FARO EDGE) according to a procedure established in an earlier research project aimed at developing a non-destructive method to document the design patterns of Artic skin or fur clothing (Jensen et al. 2012).

To establish a 3D-model of the skin clothing, the probe of the flexible measuring arm is passed along all seams and edges of each component (fig. 4). For a parka, this comprises the front, back, hood and sleeves. Secondly, an imaginary line of points is measured on the surface of each component, approximately 2 cm from the seams and edges. Each measured point is represented by a set of 3D-coordinates. Using these 3D-coordinates, the software programmes Matlab, Rhino, and AutoCAD are employed to calculate and construct a 2D-pattern for each component. The material resource usage for the parka is measured by summing up the calculated areas of each component. For practical reasons, the

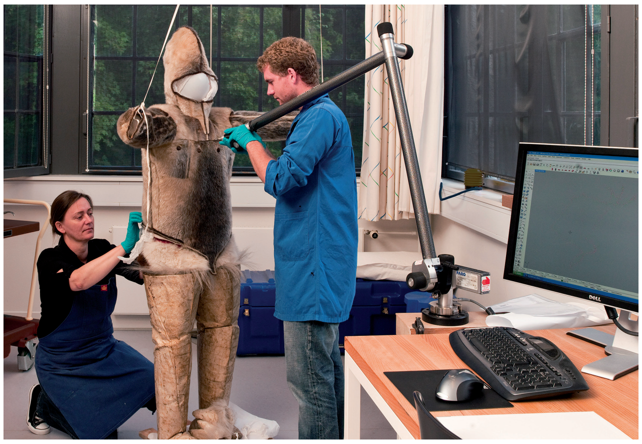

Fig. 4: Method 1: 3D-measurement of Inughuit women's parka NGF2 (inventory number L.9554) with a FaroArm in 2011 at the National Museum (Image: Roberto Fortuna)

garment's narrow edges and trimmings are measured with a tape measure, and the area is calculated and added (Jensen et al. 2012).

Method 1 requires a skilled operator with access to a costly FaroArm and special software (Rhino). The average processing time, including pattern description, is up to 10 hours per garment. The garment must be carefully mounted on a mannequin specially adapted to the item. As the 3D-measurement is performed without touching the item, possible contact with biocide-treated garments is not a necessary consideration. The time consumption, demand for skilled staff, and costly equipment (FaroArm, Rhino programme) are considerable.

Method 2: Tape measurement of clothing

Garments were previously meticulously documented, with measurements taken with a tape measure. The tape measurements were undertaken following a detailed protocol, with the tape held tightly between the measuring points.

The procedure is to measure the outer edges of the skin garment, that is, not the end of the hair on a hood brim or the ends of fringes. The parkas are recorded using 12 different tape measurements (fig. 5). It seems reasonable to follow the same breakdown of garments into components, that is, hood, front and back (torso), and sleeves that is used in Method 1.

The hood can be described as an equilateral cylinder where 'Crown length' (measurement 3) is the diameter and 'Hood height' (measurement 5) is the height of the cylinder. 'Crown length' also provides a measurement for the head circumference, which is significant when determining gender, size, age, and use (for example, a women's parka could be used for carrying a small

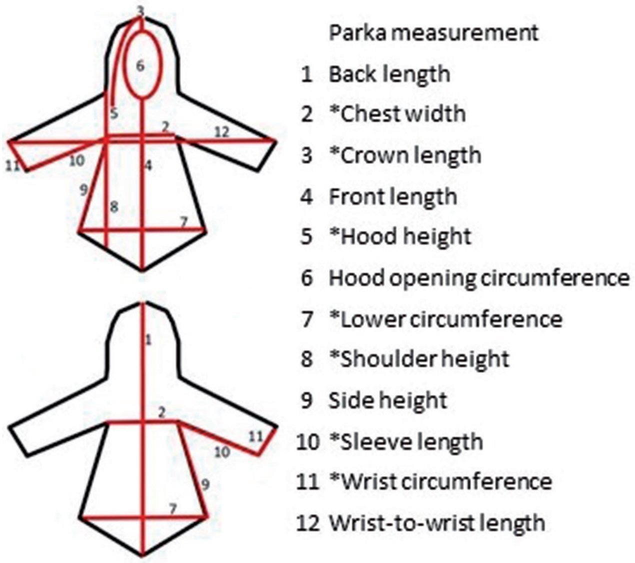

Fig. 5: Method 2: Tape measurement of Inuit parka. * indicates measurements used for parka area calculation (Drawing: Anne Lisbeth Schmidt)

child). By comparing the measurements of the parka hood opening to the crown area, the performed measurements in the present study show that the area of the hood opening is equal to the crown area. The formula for the hood area is thus:

A= d x h

That is, *Hood area = Crown length x Hood height*

The front and back of the parka can be regarded as one component, as they have the same dimensions. The upper body forms what can be considered a trapezoid. "Chest width" (measurement 2) and "Lower circumference" (measurement 7) are the parallel sides of the trapezoid and 'Shoulder height' (measurement 8) is its height. Even though the chest width is measured under the arms, it is the same when extended to over the shoulders. It should be noted that this calculation does *not* include front and back flaps, which may be of minor or substantial size. The formula for the torso area is:

A x h

That is, *Torso area = (Chest width + Lower circumference): 2 x Shoulder height*

The sleeves are two rectangles, where "Sleeve length" is the length and "Wrist circumference" is the width:

A l x w x 2

That is, *Sleeve areas = (Sleeve length x Wrist circumference) x 2*

The sum of the area of the hood, torso, and sleeves constitutes the total material resource usage for the parka. The areas of two hood-less parkas are calculated using the area of the torso and sleeves. For a representative quantity of measurements, the standard deviation between the material resource usage obtained in Method 1 and Method 2 must be low and normally distributed about a mean value. Method 2 takes approximately 30 minutes per garment. The method requires careful handling, knowing that the skin material can be fragile and contaminated with biocides. Time consumption and cost of equipment (tape measure) are minimal.

Method 3: 2D-measurement of digital photos

In previous digital photo documentation, care was taken to place each garment flat on a low-iron (Weiss) glass table to prevent any greenish-blue tint in the photos. To avoid shadows, the items were illuminated from below and images were taken of the front and back with a scale bar, colour patches, and printed inventory number in the lower right corner. A Hasselblad camera, equipped with a Schneider Kreuznach 80 mm lens, was positioned centrally above the item. The camera was levelled horizontally using a spirit level. A few larger items, notably large parkas, necessitated using a wide-angle lens. Long scales were placed perpendicularly in the photograph to control camera aberration, and subsequent measurements showed negligible deviation.

Measurement of the high-definition photos of the skin clothing are used in Method 3. In contrast to the 3D-measurement used in Method 1, Method 3 measures the areas within the outer edges of the garment on the front and the back, without taking the individual components into consideration (fig. 6). Because the garments are not entirely flat when laid out on the glass table, the assumption is that Method 3 records a certain percentage of the total area, that is, a smaller part of the factual material resource usage obtained with Method 1. Consequently, the item's total area can be measured using Method 3 and calibrated by multiplying the number by a factor representing the estimated difference between Methods 1 and 3. For this hypothesis to be valid, certain criteria must be fulfilled.

For a representative quantity of measurements, the standard deviation between the material resource usage obtained in Method 1 and Method 3 must be low and normally distributed about a mean value.

The process of obtaining a value for the material resource usage of items of skin clothing using 2D-measurements of digital images is as follows:

The highly accurate digital image of the front and back of the garment is imported into a computer-aided design and drafting software application (CAD).

Fig.6: Method 3: 2D-measurement of digital photos of a Kalaallit women's parka, WGF2 (inventory number Ld.32a). The parka's outer edges, front and back, were 2D-measured on the photo (marked with red line), using digital software (CAD) and the inner area was calculated (Image: Roberto Fortuna, Klaus Støttrup Jensen)

Using the scale bar included on the digital images, these are scaled to 1:1.
The garment's boundaries are digitised, creating two multipoint polygons (from the front and back). Each time the boundary geometry changes a digitisation point is added. The number of digitised points varies from about 100 for smaller items to 300 for larger ones. The areas of the front and back are calculated using the CAD application's area calculator and subsequently summed, thereby giving a value for the material resource usage of a given item.
Several digital images of skin garments are digitised several times to evaluate the accuracy of the actual digitisation procedure. The deviation between the areas of polygons for the same item is less than 0.5%, that is, negligible.
Method 3 takes about 30 minutes for each piece of clothing, with minimal handling of the garment apart from arranging for front and back photography. Nevertheless, possible contamination through contact with biocides should be considered. Levelled digital photos could be taken with a less advanced camera than the one used here, for example, a high-definition camera phone. The CAD software used for drawing the garment's outlines is standard. Regarding Method 3, the time and equipment costs are affordable.

Findings
See table 2 regarding the results following Methods 1, 2, and 3.

Method 1: Statistical assessment of 3D-measurement of clothing
An estimate of the accuracy and precision of areas determined by Method 1 was calculated in accordance with standard procedures for testing surveying equipment.
The parka es_68927, WGF2 (inventory number Ld.32a) was measured using Method 1, and a pattern containing 12 components was produced. Based on this pattern, a copy was cut in felt, consisting of all components. Before the felt components were sewn together, each individual component was photographed. The 'true' area of the felt components was determined by measuring the photographic image using Method 3. This area is as close as one can get

to the true area. The felt components were then sewn together to create a parka, which was measured using Method 1 (fig. 7), whereby the area of the garment was calculated. The two determinations of the 12 areas were thus completely independent.

Accuracy

For each component, the difference in area between the true area and the area found using Method 1 was calculated (table 3). Thus, the accuracy of an area of one component was estimated. The standard deviation was 0.002 m^2. Employing the law of error propagation, the accuracy of the total area was 0.007 m^2, corresponding to 1.1% of the total area of the parka.

Precision

Six of the 12 components of the felt copy were then measured twice using Method 1. By calculating the difference in area for each of the components (table 4), the precision of the area of one component could be estimated. The standard deviation was 0.001 m^2. Employing the law of error propagation, the precision of the total area of the parka was 0.004 m^2. This corresponds to 0.6% of the total area of the parka.

Method 2: Statistical assessment of physical (tape) measurements of clothing

The areas of 32 parkas measured by Method 2 ranged between 75.4% and 122.1% of the areas calculated by Method 1. These deviations were *not* normally distributed, and the calculation of parka areas from tape measurements was consequently *not* a valid method for quantifying their material resource usage.

Method 3: Statistical assessment of 2D-measurement of digital images

The material resource usage of 32 parkas was quantified using Method 3. Seven parkas were subsequently excluded from the statistical dataset as they deviated significantly due to their large volume or hoodless design, see the Appendix 'Survey of Inuit parkas'. The areas of the remaining 25 parkas obtained by Method 3 corresponded to an average of 85.2% of the material resource usage obtained by Method 1, with a standard deviation of 3.7%. The deviations were evaluated as normally distributed.

Consequently, 2D-measurement of digital images is a valid method to use to obtain approximate values for the material resource usage of parkas. Multiplying the

Fig. 7: The replica of Kalaallit women's parka, WGF2 (inventory number Ld.32a) sewn in felt, from the back and front (Image: Roberto Fortuna)

Component no	'True' area Method 3 square meter	Area Method 1 square meter	Difference square meter
es_68927 a1	0.061	0.064	0.003
es_68927 a2	0.020	0.021	0.001
es_68927 a3	0.045	0.047	0.002
es_68927 b1	0.042	0.044	0.002
es_68927 b2	0.035	0.033	- 0.002
es_68927 c1	0.101	0.104	0.003
es_68927 d1	0.047	0.048	0.001
es_68927 a1	0.061	0.063	0.002
es_68927 a3	0.045	0.042	- 0.003
es_68927 b2	0.035	0.033	- 0.002
es_68927 c1	0.101	0.103	0.002
es_68927 d1	0.047	0.046	- 0.001

Table 3: Calculations of the areas using Method 1

Component no	Area1 Method 1 square meter	Area2 Method 1 square meter	Difference square meter
es_68927 a1	0.064	0.063	0.001
es_68927 a2	0.021	0.021	0.000
es_68927 b1	0.044	0.042	0.002
es_68927 b2	0.033	0.033	0.000
es_68927 c1	0.104	0.103	0.001
es_68927 d1	0.048	0.046	0.002

Table 4: Estimation of the precison of the area of one component

area obtained by method 3 by a factor of 100/85.2 = 1.174 gives the expected real value for material resource usage of a parka with an accuracy of 1.174*3.7% = 4.3% of the expected real value.

The applicability of Method 1: 3D-measurement of clothing

The optimal method of measuring the actual material resource usage for skin garments is the 3D-measurement procedure (Jensen et al. 2012) because of its high accuracy and high reproducibility. However, the previous project (Jensen et al. 2012), which measured 103 skin garments, including parkas, coats, trousers, and footwear showed that items deformed by wear, made of uneven material (for example, gut skin), or skin with long fur and hidden seams (for example, polar bear skin) were not measurable using Method 1. The traditional but destructive measuring method, using pins, paper, and tape measure, may be the only possible way to measure the material resources of such items. However, the accuracy of this method is unknown, it is damaging, and the garment's possible biocide contamination must be considered.

Method 1 is challenging because of the need for costly special apparatus with skilled operators. Regarding the usefulness of Method 1, it is noted that the pattern measurements provide accurate patterns of all components, which, accompanied by a description and high-resolution photos, make it possible to produce an exact copy of the original garment. Making exact clothing replicas, after careful measurement with Method 1, gives researchers new opportunities to examine and spare delicate, perhaps contaminated original materials. Replicas allow museum audiences to wear the garments and experience how warm, water- and wind-proof, and comfortable the clothing is without fear of damaging the original material. The experience gives an immediate sense and respect for the craftsmanship and skill in the making of the garment.

The precision of Method 2: Tape measurement of clothing and Method 3: 2D-measurement of digital images

Methods 2 and 3 are assumed to be less precise and less accurate than Method 1. This is due to the following considerations:

Method 1: The area is calculated based on 2D-coordinates for numerous points representing the seams and edges of each component of the garment.

Method 2: Only a few selected dimensions are measured for each component. The dimensions form parts of simple geometrical shapes, such as cylinders, trapezoids, and rectangles. The resulting area therefore becomes larger or smaller than the 'true area'. The precision and accuracy are only at the same level as in Method 1 in cases where the component or item is flat and can be divided into a few simple shapes. Data about hood width and the size of flaps, which may have been useful, were not measured.

Method 3: The area is calculated based on 2D-coordinates for numerous points representing the outline of the entire item. The calculated area will be systematically smaller than the 'true area', but if the item is totally flat the precision and accuracy are only slightly lower than those achieved with Method 1.

Method 1 provided results with 1.1% standard deviation. In some cases, it was not possible to measure items with undulating surfaces or hidden seams. Method 2 was not statistically valid for parkas. Method 3 proved statistically valid for most parkas, with a standard deviation of 3.7%. Folded items, and items with long fur were omitted. The object's flatness and, thus, suitability for photographic measurement with Method 3 is essential. It is recommended that a method involving 3D-laser scanning be further investigated in the future.

Material resource usage in relation to design in Inuit parkas

In Fig. 8 the material resource usage for the 32 Inuit parkas is seen. The area in square metres from the 3D-measurement is inserted as the X-value, while the tape-measured back length in meters serves as the Y-value. With a few exceptions, the men's parkas are located below the median line, while the women's

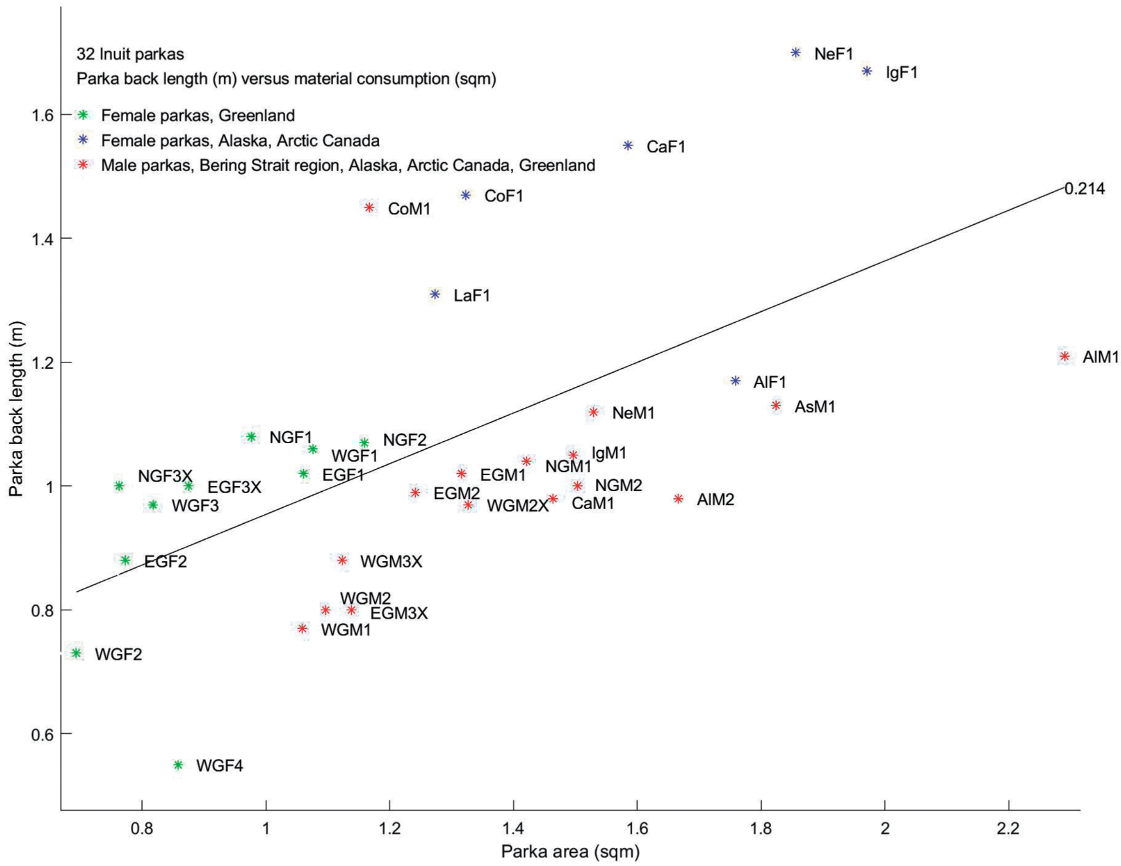

Fig. 8: Area of material versus back length for 32 parkas. Areas obtained by Method 1: 3D-measurement (Image: Karsten Jensen)

parkas are located above. Over the median line, eight small women's parkas from eastern Inuit in Greenland form one cluster (green), while five large women's parkas from Central Inuit in Arctic Canada form another (blue). One Central Inuit man's parka (CoM1) (orange) lies alone over the median line. Under the median line are two small Kalaallit women's parkas from Greenland (WGF2, WGF4) and one large women's parka (AlF1) from western Inuit in Alaska. From eastern Inuit, four men's minor parkas from Greenland form a cluster (orange); adjacent, five men's medium-sized parkas from Greenland form another cluster (orange) with three Central Inuit men's parkas. One large men's parka from the Bering Strait region (AsM1) and two large men's Alaskan parkas (AlM1, AlM2) lie solitary; all are from the western Inuit.

Six men's parkas (WGM1, WGM2X, WGM3X, EGM1, EGM2X, EGM3X) from eastern Inuit in Greenland (Kalaallit and Iivit) are generally small, with back lengths ranging from 0.77–1.02 m and areas ranging from 1.059–1.327 m^2, due to their tight-fitting design, with or without miniscule flaps. Three men's parkas (CaM1, IgM1, NeM1) from Central Inuit and two from eastern Inuit (Inughuit) (NGM1, NGMM2) have larger areas, due to their design with a longer front and back; back lengths range from 0.98–1.12 m and areas from 1.167–1.503 m^2. One Central Inuit man's parka from the Inuinnait (CoM1), stands out because of its long back-flap and tight-fitting design. The sample size is too small to enable further distinction between the Central Inuit. From the western Inuit in Bering Strait region and Alaska, one man's parka (AsM1) from the Yupiget, and two men's parkas from the Yupiit (AlM1), and Iñupiat (AlM2) have the largest material resource usages, due to their voluminous design. Moreover, AlM1 is hoodless.

The ten women's parkas from eastern Inuit in Greenland (NGF1, NGF2, NGF3X, WGF1, WGF2, WGF3, WGF4, EGF1, EGF2, EGF3X) differ significantly from the six women's parkas from western and Central Inuit (AlF1, CoF1, CaF1, NeF1, IgF1, LaF1). In the smaller women's parkas from Greenland, the back lengths range from 0.55–1.07 m and the areas from 0.694–1.159 m^2. The smaller areas are linked to the close-fitting garment, small or miniscule flaps and a generally tight-fitting design. The sample size is considered too small to differentiate further, but two women's parkas stand out: WGF4, a hoodless festive Kalaallit parka, with a short back length, and NGF2, an Inughuit parka, with a large area, apparently sewn for a European woman. In the voluminous six women's parkas from western and Central Inuit, the back lengths vary from 1.17–1.70 m. Compared to the ten eastern Inuit women's parkas (0.694–1.159 m^2), the material resource usage for Central Inuit (1.273–1.971 m^2), is for some, approximately two and a half times as high. The large areas are due to the elongated hood, large flaps, and a generally roomier fit. The sample size is too small for a distinction to be made between the western and Central Inuit.

This study confirmed the results of the initial studies of material resource usage undertaken using 3D-measurements by a FaroArm, which indicated that such measurements provided information enabling identification of origin and gender for items of traditional Greenlandic Inuit skin clothing (Jensen et al. 2012, 985–990). Furthermore, this study also confirms the previously demonstrated conclusion that material resource usage enabled the distinction of origin between skin parkas from Greenland, Arctic North America, Siberia, and North Scandinavia (Schmidt 2014).

Discussion

Tailored design?

The Canadian Arctic researcher, Bernadette Driscoll Engelstad (1952–), points out that "… the outward appearance, pattern construction, design features, and choice of animal resources indicate two major divisions in the clothing design of the North American Arctic" (Engelstad 2020, 235–236). One is the horizontally tiered design (used in parkas), made from bird skin, marine mammal gut skin, and small mammals used by the Inuit in the Bering Strait region and southern Alaska (Unangax, Aluttiiq/Sugpiaq, Yup'ik, and Yupik). The other is the tailored design, made from caribou and seal skin by the Inuit in northern Alaska, Arctic Canada, and Greenland (Engelstad 2020, 236). In this study, only one parka, (AlM1), has a design with horizontally stitched panels of gut skin. This long, roomy Yupiit men's parka without hood, has the largest material resources of all 32 parkas, 2.290 m^2.
If Engelstad's 'tailored design' is understood as made-to-measure and tight-fitting, the smaller areas used for men's parkas from Arctic Canada and Greenland indicate that these parkas were tailored, and with no superfluous material added to the garment. Also, Birket-Smith observed slim-fit garments, stating that the Kalaallit man from *Godthaab* (Nuuk) dressed like a "dandy", in a short, close-fitting tight parka in contrast to the Central Inuit's voluminous parkas for men (Birket-Smith 1929, 199–200). The Greenlandic women's parkas all have low material resource

use, indicating tight-fitting designs. In contrast, the six women's Alaskan and Canadian parkas have voluminous outfits, initially measured, cut, and sewn to the wearer, however, not tight-fitting.

Animal species in relation to material resource usage

The reasons for the men's and women's differences regarding parka volume are due to the difference in gender body size, the purpose for clothing, climatic demands, and the animal species of the skin garment. In this context, the study limits the options and solely reflects on the animal species. western and Central Inuit parkas are mostly made from large land mammals, that is, caribou (Schmidt et al. 2023). This study shows that western and Central Inuit parkas are generally the most voluminous. For parkas, the eastern Inuit predominantly used skin from smaller sea mammals. However, they also used skin from caribou, Arctic fox, domestic dog, polar bear, birds, and gut skin from sea mammals (Schmidt et al. 2023). This demonstrates that measurement of material resource usage alone does not provide a complete answer regarding the origin of the garment.

Methods 1 and 3 for quantification of material resource usage provide reliable information useful in the upcoming task of identifying garments of unknown origin, and material resource usage will certainly be included alongside studies of design and identification of animal species in the attempts at identifying such items in forthcoming studies of the NMD's collection. A more detailed analysis of the 2D-patterns provided by Method 1 is also required to reinforce the design assessment.

Conclusions

Regarding Method 1: 3D-measurement, this time-consuming method has the lowest standard deviation and is the most accurate method. Regarding Method 2: calculation based on tape measurement, is not statistically valid for quantification of parka area. The study revealed that Method 3: 2D-measurement of digital images is a viable, fast option when it comes to estimating material resource usage in parkas. Method 3 is less accurate compared to Method 1, and furthermore, it is less time consuming. However, it is important that the garment does not have long fur or folds. Some parka surfaces are too distorted and uneven to measure, and thus neither Methods 1 nor 3 are suitable. Regarding measuring parkas, if possible, it is recommended to use both methods to confirm the results and prevent errors.

Distinguishing geographic origin between Inuit parkas of known provenance, especially regarding women's clothing proves possible when applying measurements of material resource usage. Men's parkas from Central and eastern Inuit appear, on the face of it, to be more homogeneous, but among these there are also outliers. Men's parkas, from western Inuit distinguish themselves by their larger areas.

This study states, that measurement of material resource usage is important for the identification of Inuit parkas regarding men and women's clothing, as well as their Inuit connection. However, without classifying the parka design and identifying the used species of fur and skin, the conclusion is that quantification of material resource use cannot stand alone. The design and animal species are vital parameters which must also be taken into consideration.

With regards to assessing material resource usage in traditional, historical skin clothing from other population groups, or garments made of fabrics, or archaeological garments, the options are open – but accurate assessment requires the inclusion of a comparative reference collection of items of known provenance. To document material resource usage of fragile, perishable skin parkas, two measurement methods, Method 1: 3D-measurement, and Method 3: 2D-measurement of digital images are recommended. Consistent museum practice provides many opportunities. Hence, the findings of this study could motivate cultural history museums to adopt documented practices, which include capturing images of garments of various types and materials in a flat position (both front and back), photographing them with a scale bar, and using measuring tapes following a specific procedure for measurements.

This project's scope does not allow for an analysis of reasons for minor material usage among some Inuit, whether due to the longevity of traditional designs, animal resource limitations, climate, or other factors. However, further research, including archaeological finds, will provide valuable perspectives and insight into clothing material usage.

Acknowledgements

This study was undertaken as part of the research project *Skin clothing from Inuit* at the National Museum of Denmark, as a collaborative venture supported financially by the Danish Ministry of Culture, Knud Rasmussen Fondet, and Greenland Research Council.

Over countless generations, Inuit women produced beautiful, vital skin clothing for life in the Arctic. Mothers taught daughters to prepare the skin, cut, sew, and maintain the garment, using the most appropriate material for the particular purpose of

the garment. The unique, skilful, clever, and uniform designs fortunately preserved in museum collections are a treasure.

Thanks to Jane Richter and Beate Knuth Federspiel (Royal Danish Academy, School of Conservation), Bjarne Grønnow, Peter Rasmussen, and Isa Brayer (National Museum of Denmark), Kristoffer Schmidt (The Royal Danish Collection, Rosenborg) for much appreciated comments, and Tom Nicolajsen (Viking Ship Museum) for additional FaroArm assistance. Aviâja Rosing Jakobsen and Christian Koch Madsen (Greenland National Museum and Archives) are thanked for their support. Lise Stengaard Hansen is thanked for revising the article's language.
The content has been improved thanks to the valuable comments from anonymous peer reviewers.

Bibliography

Anonymous (2017) ICOM Code of Ethics for Museums. *ICOM International Council of Museums*. https://icom.museum/wp-content/uploads/2018/07/ICOM-code-En-web.pdf (accessed 1 June 2024)

Bahnson, A. (2005) Women's Skin Coats from West Greenland. In J. H. C. King, B. Pauksztat and R. Storrie (eds), *Arctic Clothing*. Montreal: McGill-Queen's University Press, 84–90.

Balickci, A. (1970) *The Netsilik Eskimo*. New York: The American Museum of Natural History.

Birket-Smith, K. (1924) *Ethnography of the Egedesminde District: With Aspects of the General Culture of West Greenland*. Meddelelser om Grønland 66. Copenhagen: C.A. Reitzel, Boghandel.

Birket-Smith, K. (1929) The Caribou Eskimos. *Report of the Fifth Thule Expedition 1921–24*, Vol. 5: Parts 1-2. Copenhagen: Gyldendal.

Birket-Smith, K. (1945) Ethnographical Collections from the Northwest Passage. *Report of the Fifth Thule Expedition 1921–24*, Vol. 6: Part 2. Copenhagen: Gyldendal.

Buijs, C. (2004) *Furs and Fabrics: Transformations, Clothing and Identity in East Greenland*. Leiden: Mededelingen van het Rijksmuseum voor Volkenkunde.

Chaussonnet, V. (1988) Needles and Animals: Women's Magic. In W.W. Fitzhugh and A. A. Crowell (eds), *Crossroads of Continents*: *Cultures of Siberia and Alaska.* Washington: Smithsonian Institution Press, 209–226.

Engelstad, B. D. (2020) Averting Animal crashes: Function and Symbolism in Arctic Clothing Design. In I. Krupnik and A.L. Crowell (eds), *Arctic Crashes. People and Animals in the Changing North*. Washington, D.C.: Smithsonian Scholarly Press, 235–253.

Fitzhugh, W. and Caplan, S. (1982) *Inua. Spirit of the Bering Sea Eskimo.* Washington: The Smithsonian Institute.

Flecker, L. (2007) *A practical guide to costume mounting.* Published in association with the Victoria and Albert Museum. Amsterdam: Elsevier.

Hatt, G. (1969) Arctic skin clothing in Eurasia and America: An ethnographic study [1914] (translated by K. Taylor). *Arctic Anthropology* 5(2), 3–132.

Holm, G. (2010) Ethnological Sketch of the Angmagsalik Eskimo [1911]. In W. Thalbitzer (ed), *The Ammassalik Eskimo. Contributions to the Ethnology of the East Greenland Natives*. Meddelelser om Grønland 39, First Part. University of Copenhagen: Museum Tusculanum Press, 1–147.

Holtved, E. (1954) *Archaeological Investigations in the Thule District. III Nûgdlît and Comer's Midden*. Meddelelser om Grønland 146(3). Copenhagen: C.A. Reitzels Forlag.

Holtved, E. (1967) *Contributions to Polar Eskimo Ethnography*. Meddelelser om Grønland 182(2). Copenhagen: C.A. Reitzels Forlag.

Issenman, B. K. (1997) *Sinews of Survival: The Living Legacy of Inuit Clothing*. Vancouver: University of British Columbia Press.

Jenness, D. (1946) *Report of the Canadian Arctic Expedition 1913–1918. Volume XVI. Material Culture of the Copper Eskimo.* Ottawa: King's Printer and Controller of Stationary.

Jensen, J. (1992) *Thomsens Museum. Historien om Nationalmuseet*. Copenhagen: Gyldendal

Jensen, K., Schmidt, A. L. and Petersen, A. H. (2012) Analysis of Traditional Historical Clothing: Automated Production of Two-dimensional Patterns. *Archaeometry* 55(5), 1–19. https://doi.org/10.1111/j.1475-4754.2012.00722.x

Jørgensen, J. B. (2002) Anthropological Measurements from Kodiak Island (1960–1983). In B. Frolich, A. B. Harper and R. Gilberg (eds), *To the Aleutians and Beyond. The Anthropology of William S. Laughlin.* Copenhagen: Department of Ethnography, the National Museum of Denmark, 169–175.

Krupnik, I. (2016) *Early Inuit Studies. Themes and Transitions 1850s–1980s*. Washington D.C.: Smithsonian Institution.

Mathiassen, T. (1928) Material Culture of the Iglulik Eskimos. *Report of the Fifth Thule Expedition 1921–24*, Vol. 6: Part 1. Copenhagen: Gyldendal.

Murdoch, J. (1892) Ethnological results of the Point Barrow expedition. *Ninth Annual Report of the Bureau of Ethnology to the Secretary of the Smithsonian Institution*, 1887–1888. Government Printing Office, Washington, 3–442. Available at https://www.gutenberg.org/ebooks/43568 (accessed 5 July 2024)

Murdock, G. P. (1963) *Outline of World Cultures*. New Haven, CT: Human Relations Area Files.

Møller, G. (1989) Eskimo Clothing from Qilakitsoq. In J. P. H. Hansen and H. C. Gulløv (eds), *The Mummies from Qilakitsoq – Eskimos in the 15th century.* Meddelelser om

Grønland, Man & Society 12. Copenhagen: Nyt Nordisk Forlag – Arnold Busk.
Oakes, J. E. (1991) *Copper and Caribou Skin Clothing Production*. Canadian Ethnology Service Mercury Series Paper. Hull: Canadian Museum of Civilization.
Oakes, J. E. and Riewe, R. (2007) *Alaska Eskimo Footwear*. Fairbanks: The University of Alaska Press.
Pharand, S. (2012) *Caribou Skin Clothing of the Igloolik Inuit.* Iqaluit and Toronto: Inhabit Media.
Roser, M., Appel, C. and Ritchie, H. (2021) *Human Height*. Published online at OurWorldInData.org. Available at https://ourworldindata.org/human-height (accessed 5 July 2024)
Schmidt, A. L., Gottlieb, B., Gulløv, H. C., Jensen, K. and Petersen, A. H. (2013) Pelse fra Nord. In P. K. Madsen (ed), *Nationalmuseets Arbejdsmark*. Copenhagen: The National Museum of Denmark, 64–79.
Schmidt, A. L. (2014) Skin Clothing from the North: New Insights into the Collections of the National Museum. In H. C. Gulløv (ed), *Northern Worlds: Landscapes, Interactions and Dynamic. Research at the National Museum of Denmark. Proceedings of the Northern Worlds Conference 28–30 November 2012*. Copenhagen: The National Museum of Denmark, 273–292.
Schmidt, A. L. (2019) The Holmberg Collection of Skin Clothing from Kodiak Island at the National Museum of Denmark. *Etudes Inuit Studies*, Vol. 42, No. 1, 117-136. https://www.jstor.org/stable/26775763
Schmidt, A. L. (2022) An Analysis of 600-year-old Gut Skin Parkas of the Early Thule Period from the Nuulliit Site, Avanersuaq, Greenland. *Arctic Anthropology,* Vol. 59, No. 2, 107–130. doi:10.3368/aa.59.2.107
Schmidt A. L., Brandt, L. Ø., Sinding, M-H. S., Stenderup, J. and Viera, F. G. (2023) Species Identification of Inuit Skin and Fur Clothing: Analyses of DNA, Hair Microscopy, and Macroscopical Identification. *ARCTIC* 76(4), 382–399. https://doi.org/10.14430/arctic78938
Thalbitzer, W. (2010) The Ammassalik Eskimo. Contributions to the Ethnology of the East Greenland Natives [1914]. *Meddelelser om Grønland* 39, First Part. University of Copenhagen: Museum Tusculanum Press.

Websites

Skin Clothing Online. Available at http://skinddragter.natmus.dk/ (accessed 5 July 2024)

Authors:
anne.lisbeth.schmidt@natmus.dk;
roberto.fortuna@natmus.dk;
nette.hjelm.petersen@natmus.dk;
kjvav@outlook.dk; bogehoj@privat.dk