The *modus operandi* of walrus exploitation during the Palaeoeskimo period at the Tayara site, Arctic Canada

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ABSTRACT
Thanks to its high nutritional potential and huge ivory canines, walrus *(Odobenus rosmarus)* appears to have been a key resource in the subsistence economy of Dorset groups. However present archaeological data are sparse and a more global analysis of its exploitation by the Palaeoeskimos is required. The Tayara site (KbFk-7) in Nunavik (Quebec, Canada) yielded a significant assemblage of walrus bones and many manufactured ivory objects. In addition, Tayara serves as a reference site in Eastern Arctic cultural chronology. A thorough zooarchaeological study has been conducted which includes skeletal profile, the sexing and ageing of walrus bones, and a technological study of the manufactured

objects, including a use-wear analysis on lithic tools. This allows the discussion of several aspects of the *modus operandi* for the exploitation of walrus, from the death of the animal to the processing of the raw material into artefacts. Even if the walrus seems to have been treated with the same processes as other species, some specificities have been noted, particularly in the selection of the different skeletal elements for tool productions and the emblematic value that this animal may have played in consumption and production activities.

KEY WORDS
zooarchaeology,
hunting,
butchering,
use-wear traces,
bone technology,
Tayara,
Québec,
Nunavik.

RÉSUMÉ
Le modus operandi *de l'exploitation du morse sur le site Paléoesquimau de Tayara (Rive sud du détroit d'Hudson, Canada).*
Le morse (*Odobenus rosmarus*) est très apprécié des peuples arctiques, en particulier pour son grand potentiel nutritionnel et pour ses canines proéminentes. Au Dorsétien, l'exploitation de cet animal a été particulièrement valorisée, notamment à Tayara (KbFk-7), l'un des plus prestigieux sites paléoesquimaux. Localisé au nord du Nunavik (Québec, Canada), le niveau II de Tayara a livré une preuve évidente de chasse au morse ainsi qu'un très grand nombre de restes fauniques et d'objets fabriqués sur dents ou os de morse. Une exploitation diversifiée et généralisée des carcasses a été mise en évidence. Les études consacrées au morse étant encore limitées, nous avons entrepris une approche originale, globale et multidisciplinaire, permettant de reconstituer le *modus operandi* de la chaîne d'exploitation d'une carcasse. Les résultats de l'archéozoologie, de la technologie osseuse et de la tracéologie lithique ont ainsi été combinés. L'archéozoologie a permis de retrouver le profil squelettique, le sexe et l'âge des individus apportés entiers sur le site (*i.e.,* six individus des deux sexes, souvent adultes). L'examen technologique a montré que les défenses et os de morse étaient travaillés selon les mêmes procédés techniques que pour les autres espèces. Cependant, les intentions de production étaient plus ciblées, privilégiant la fabrication des armes de chasse et des objets à valeur de signe. L'étude tracéologique a confirmé que toutes les activités touchant à l'exploitation du morse ont bien été menées sur le site de Tayara.

MOTS CLÉS
archéozoologie,
chasse,
activités de boucherie,
traces d'utilisation,
technologie osseuse,
Tayara,
Québec,
Nunavik.

INTRODUCTION

For millennia prevailing climate conditions in the Arctic made animals almost the only source of subsistence. Among the animals, walrus *(Odobenus rosamarus)* played a major role for many arctic economies. It contributed to many daily activities (tools, clothes, shelter, boat, fuel, food), as well as in raw material to manufacture tools and hunting gear (spears, harpoons) and symbolic objects (pendants, shaman's mouth pieces, animal and human figurines, etc.). Walrus meat, grease, skin/hide, bone, and ivory were all used. In the Arctic, only narwhal or large toothed whales could substitute for walrus as a significant source of ivory (references *in* Houmard 2011a).

Not only archaeological (*e.g.,* Murray 1996, 1999; Dyke *et al.* 1999; Darwent 2004; Houmard 2011a, 2011b) but ethnographical and historical documents (*e.g.,* Boas 1888; Murdoch 1892; Birket-Smith 1924; Mathiassen 1928; Saladin d'Anglure 1967; Roy 1971) testify to the importance of walrus in the diet and culture for most Inuit populations. Many sites from Palaeoeskimo and Inuit/Thule periods across Canada and Greenland yielded walrus remains (see list and map of sites in Dyke *et al.* 1999). Walrus remains are found occasionally in the early part of the Palaeoeskimo sequence (ca. 4500 to 2200 B.P.) and are considered as scavenged resources rather than subsistence material (Dyke *et al.* 1999). The later Palaeoeskimo Dorset period, ca. 2200 to 1000 B.P., contrasts strongly with the earlier period. Walrus remains in sites of this period are relatively common and occur in definite "diet-related" contexts (Dyke et al. 1999). With few exceptions (Avayalik-1 (Cox & Spiess 1980), Nungivik (Mary-Rousselière 1976), Tasiarulik (Darwent 1995), and NiHf-4 at Igloolik (Murray 1996)), walrus never exceeds more than 100 remains, *i.e.* ~5% of the identifiable faunal material. For these sites, and in general, ringed seal or caribou usually dominate the bone assemblages (*e.g.,* Murray 1996; Darwent 2004). Finally, while the hunting of mammals like seals, beluga and/or caribou are well documented (see numerous references in the literature cited above), there is scant information on the hunting, and, more generally, on the exploitation of walrus by early Arctic peoples.

Because it is a central reference site for Arctic chronology and because Level II of the Tayara site yielded a significant collection of walrus bones and artefacts made from ivory or bone, we conducted a thorough analysis of walrus exploitation by Dorset peoples. Our goal was to decipher the several aspects of the *modus operandi*, from the acquisition of a walrus individual to the manufacturing and utilization processes of certain walrus anatomical elements (especially tusks, maxillaries and bacula). The originality of our analysis resides in the combination of zooarchaeological and technological studies, as well as use wear analysis, to document the significance of walrus for Palaeoeskimo people at the beginning of the Dorset period in Nunavik.

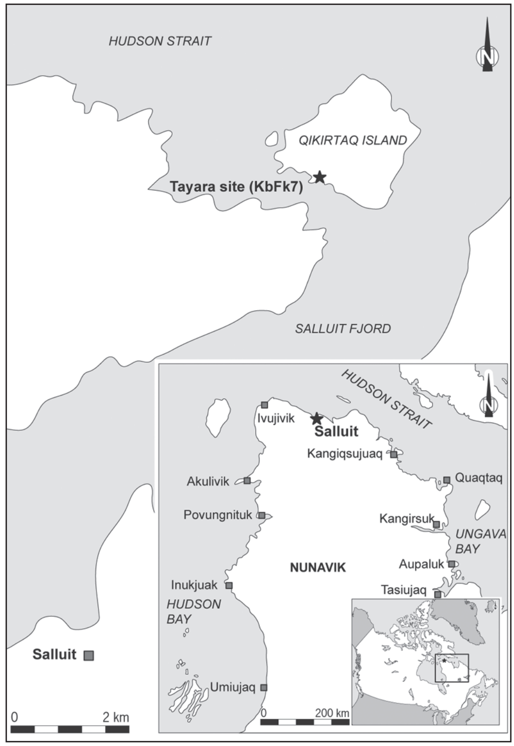

Fig. 1. — Tayara location on Qikirtaq Island (Nunavik, Canada).

THE TAYARA SITE: BACKGROUND

The Tayara site (KbFk-7) is located on Qikirtaq, a small island, 10 km north of Salluit (Nunavik, Quebec) at the entrance of Sugluk (Salluit) Fjord along the southern shore of Hudson Strait (Fig.1). Tayara occupies a raised sandy beach facing the mainland 175 m from the current shore at 18 m a.s.l. It appears to be a good camping ground as well as an advantageous area for hunting sea mammals when they pass through the Fjord Channel (see Fig. 1). This is perhaps why the people of Salluit have continued to occupy this island where many of the elders were born (Avataq cultural Institute 2007: 4-5). There is a general westward movement of walruses through Ungava Bay from the southeast coast of Akpatok Island as soon as ice conditions permitted (in June or early July) to Nottingham and Salisbury Islands in Hudson Strait, with a return movement following the same general route in the fall (numerous references *in* Cosewic 2006).

Discovered by Taylor in 1957, the Tayara site (KbFk-7) has proven to be indispensable in our understanding of the initial expansion of Dorset culture in the Eastern Arctic (Taylor 1968; Desrosiers *et al.* 2008). Recent excavations conducted

Table 1. — Faunal list count in NISP (number of identified specimens) and MNI (minimal number of individuals) by stratigraphic levels of the Tayara site. (*: The study is not completed; results for seals are not definitive. The MNI presented here reflects only the frequency and does not take into account age or specific species type).

	Level II		Level III	
Mammals	**NISP**	**MNI**	**NISP**	**MNI**
Phoca seals (mainly ringed seal) *	1957	8	858	4
Bearded seal (*Erignathus barbatus*)	575	5	128	2
Walrus (*Odobenus rosmarus*)	**799**	**6**	**138**	**2**
Beluga (*Delphinapterus leucas*)	45	2	2	1
Polar bear (*Ursus maritimus*)	23	1	6	1
Foxes (*Alopex lagopus/Vulpes vulpes*)	1108	16	355	8
Caribou (*Rangifer tarandus*)	287	4	27	1
Dog/Wolf (*Canis domesticus/lupus*)	13	1		
Birds				
Common eider (*Somateria mollissima*)	178	22	16	2
Canada goose (*Branta canadensis*)	3	1		
Snow goose (*Chen caerulescens*)	4	3	7	2
Ptarmigan (*Lagopus* sp.)	12	2	13	1
Thick-billed murre (*Uria lomvia*)	3	1	3	1
Common loon (*Gavia immer*)	8	2	1	1
Total	5015	74	1554	26

by the Avataq Cultural Institute over a period of four field seasons, have led to the identification of two primary archaeological levels: Level II and Level III. Level II was excavated over an area of 88 m^2 and overlies an earlier occupation, Level III, which was excavated over an area of 35 m^2. AMS dates place Level II between 1900 and 2100 B.P. placing it within the Dorset Period and Level III dates between 2500 and 2200 BP associated to a Predorset occupation (Desrosiers 2009: 229 & 256). The archaeological assemblage of Level II results from successive short seasonal episodes of activity, as indicated by charcoal dating (*circa* 200 years). It is composed of multiple Palaeoeskimo living floors, which were intermingled with water-laid sand, constituting a cultural layer 5 to 30 cm thick. In this regard, Level II may be viewed as a composite palimpsest, both cumulative and spatial, in which the successive episodes of deposition or layers of Dorset activities (knapping, use and waste disposals, and butchering) are superimposed (Todisco *et al.* 2009).

Level II also bears distinct structural evidence, specifically the presence of three hearths oriented along a North-South axis (Desrosiers *et al.* 2008). The alignment of hearths may indicate the central place of a longhouse as described by Plumet (1982) and may suggest a winter occupation. Alternatively, if they are positioned outside the living structure, it may indicate that this site was occupied during a warmer season (Appelt & Gulløv 1999; Friesen 2007). Other structural evidence includes the presence of large stones and a beluga skull on the southeast part of the excavated area. The link between them and the three hearths is not clear yet. The study of the spatial distribution of faunal remains and lithic artefacts, along with new excavations, should help to decide between these two hypotheses (see Monchot & Gendron 2011 for a spatial analysis of fox remains).

The lithic technology of Level II is characterized by a typical Palaeoeskimo microlithic industry and includes a large variety of raw materials such as chert, quartz crystal, and nephrite. Most are of local origins, although some originate from farther away, such as Ramah metachert and Diana blue quartzite. Stone tools include bifacial end blade points, end and side scrapers, various retouched microblades, knives, adzes, burin-like tools, and soapstone vessels. The lithic assemblage is mainly composed of small sized debris (*i.e.*, waste materials) (Desrosiers 2009).

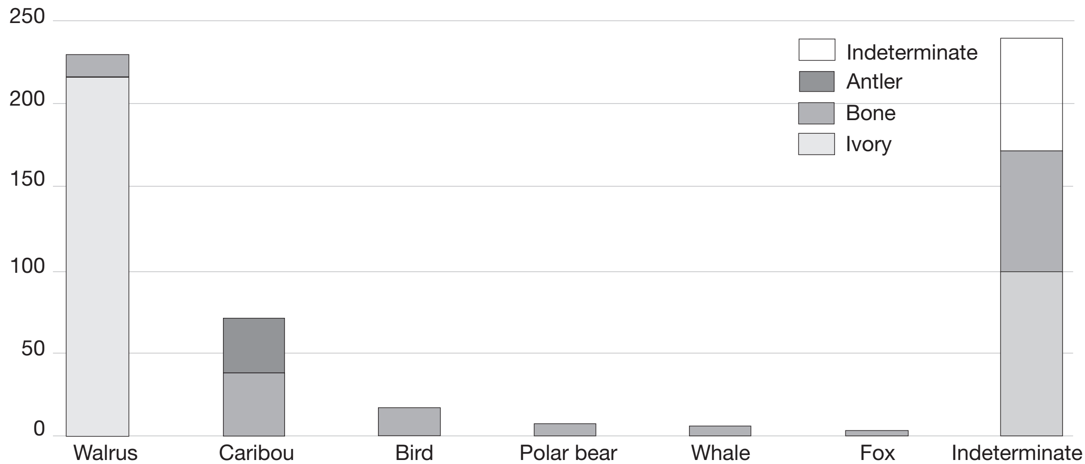

FIG. 2. — Distribution of worked artefacts by raw material and species, quantified by number of specimens

THE FAUNAL ASSEMBLAGE

All materials at Tayara were found *in situ* and include faunal remains (n>18000, including the unidentified fragments) most of which (approx. 60%) were from Level II. The assemblages from Levels II and III are dominated by marine and terrestrial mammals (Desrosiers *et al.* 2008; Todisco & Monchot 2008). Table 1 illustrates the level for the provenience of each specimen.

Although subsistence at the Tayara site seems centred on sea mammals, as is true for many Palaeoskimo sites in Nunavik (*e.g.*, Julien 1980; Nagy 2000), the proportions of land mammals, represented by caribou and foxes (Monchot & Gendron 2010, 2011), and birds is significant (Monchot in prep.). Both levels are statistically similar (Jaccard similarity index = 0.86) and our study focuses only on Level II. For Level III, the small area excavated, associated with a low walrus osteological representation and few worked artefacts, would not allow us to conduct a reliable study of the exploitation of walruses. For Level II, walrus represent 15.9% of the NISP and only 8.1% of the MNI. The seasonality of the occupations for Level II is difficult to estimate in the absence of cementochronological studies, but some clues, such as the presence of young seals aged less than 6 months, suggest human occupations of the site at the end of summer and beginning of fall during the return of migratory species.

RAW MATERIAL SELECTION FOR TOOL MANUFACTURE

Only part of the Tayara site faunal remains have been used for tool production purposes. It is interesting to note that the two most abundant hunted species, seals and foxes, are almost totally absent as raw materials in the tool assemblage. According to the whole tool assemblage from Level II, walrus elements (n=230) are the most numerous, especially the tusks (Houmard 2011a). Caribou antler and bones (n=71), as well as long bird bones (n=18), polar bear teeth (n=6), whalebone (n=4) and fox long bones (n=1) are selected less often (Fig. 2).

THE MATERIAL: THE WALRUS ASSEMBLAGE

THE SKELETAL PROFILE

Almost all walrus skeletal elements were found in Level II (Table 2).

Several remarks can be formulated:

– As is observed in many Palaeoskimo sites (LeMoine & Darwent 1998; Dyke *et al.* 1999) or in walrus caches (Jordan 1980; Grønnow *et al.* 2011), skulls and mandibles are most frequent; this is essentially due to their good preservation because of their size and robustness (Kastelein & Gerrits 1990). At Tayara, head elements are followed by

TABLE 2. — Census of walrus remains on Tayara. The fragments are expressed by NISP: number of identified specimens; MNE: minimum number of elements and MNI: minimum number of individual. Brackets designate the number of elements in a general walrus skeleton. % surv.: % of survival or observed/expected ratio, based on the number of each element expected for six individuals.

	NISP								
Skeletal elements	**Left**	**Right**	**Indet.**	**Total**	**Unfused**	**Worked**	**MNE**	**% Surv**	**MNI**
Neurocranium (1)	28	16	49	93		2	5	83.3	5
Viscerocranium (1)	2	4	1	7			3	50.0	3
Calvarium (1)			33	33			–	–	–
Mandible (2)	1	1	5	7			6	100	6
Hyoid (1)			5	5			3	50.0	3
Isolated postcanine			24	24		4	–	–	–
Ivory (tusk) fragment			324	324		324	–	–	–
Atlas (1)			3	3			3	50.0	3
Axis (1)			3	3			1	16.7	1
Vertebra cervicalis 3-7 (5)			10	10	6		6	20.0	2
Vertebra thoracica (14)			19	19	7		10	11.9	2
Vertebra lumbalis (6)			19	19	7		13	43.3	2
Vertebra unspec.			23	23	7		4	–	–
Sacrum (1)			5	5			2	16.7	2
Costa (30)			86	86	4		30	17.8	3
Scapula (2)		2	1	3		1	2	16.7	2
Humerus (2)	9	2	2	13	3		5	41.7	3
Radius (2)		1		1			1	8.4	1
Ulna (2)	1	2		3			3	25.0	2
Carpalia (14)	1			1			1	1.2	1
Metacarpus I (2)		1		1	1		1	8.4	1
Metacarpus II (2)	1			1			1	8.4	1
Metacarpus IV (2)	1	1		2			2	16.7	1
Metacarpus V (2)	2			2	2		1	8.4	1
Baculum (1)			6	6		6	3	50.0	3
Pelvis (2)	2	1	2	5	1		3	25.0	3
Femur (2)	2	4	1	7	7		2	16.7	1
Patella (2)	1		5	6			6	50.0	3
Tibia (2)	3	5	2	10	4	1	5	41.7	4
Fibula (2)	3	4	1	8	5	1	5	41.7	4
Talus (2)	1		1	2			2	16.7	1
Calcaneus (2)	1	1		2			2	16.7	1
Tarsalia (10)	1	1	1	3			3	5.0	1
Metatarsus			1	1	1		1	–	–
Metatarsus I (2)	1	1		2	1		2	16.7	2
Metatarsus II (2)	1	1		2	1		2	16.7	2
Metatarsus III (2)	1			1			1	8.4	1
Metatarsus IV (2)		1		1			1	8.4	1
Metatarsus V (2)	1	2	1	4	2		3	25.0	2
Metapodium			5	5	3		4	–	–
Phalanx 1 (20)			25	25	7		16	13.3	2
Phalanx 2 (16)			8	8	5		7	7.3	2
Phalanx 3 (20)			3	3			3	2.5	1
Sesamoids			2	2			2	–	1
Long bone shaft			4	4		3	1	–	–
Long bone epiphysis			4	4	1		2	–	–
Total	**62**	**51**	**684**	**799**	**75**	**342**	**177**	–	**6**

trunk elements (vertebrae and ribs) and long bones (*e.g.*, humerus and tibia) (Fig. 3). For other marine mammals (*e.g.*, seals) the most frequent skeletal parts are the ones with the greatest nutritive potential as measured by the Modified Meat Utility Index (MMUI) (Friesen *et al.* 2001).

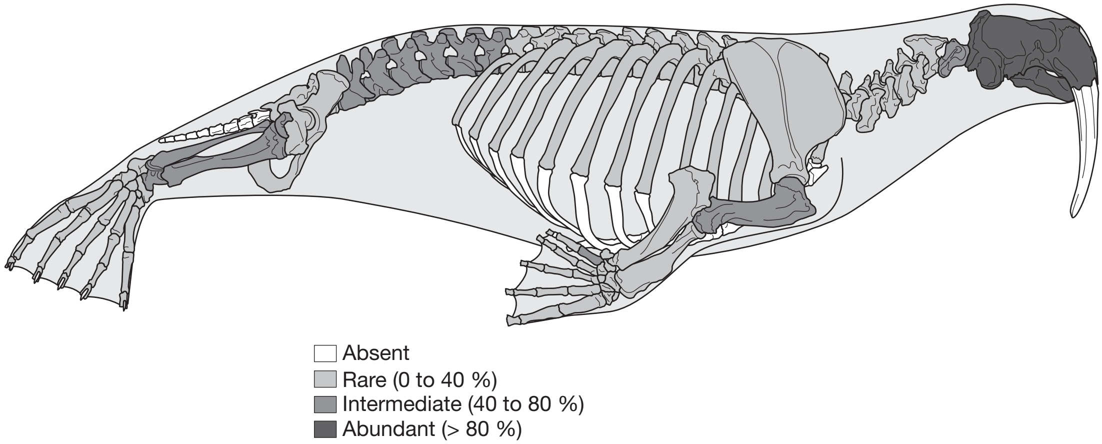

FIG. 3. — Skeletal profile of the walrus in Level II based on percentage of survival (MNI = 6, data from Table 2). (Drawing Michel Couteureau, available in http:www.archeozoo.org).

– For the paired element no differences were observed in the distribution between the right and the left parts in NISP (Level II, U Mann-Whitney=309, z=0,06, p=0.4761). This confirms the homogeneity of the bone assemblage (*e.g.*, no bone selection) and that all walrus limbs were brought on the site.

– The lack of small bones like carpals, phalanx or sesamoids, can be explained by their small size facilitating a dispersal by water runoff after the butchery (Behrensmeyer 1975). It is important to note that they are also rarely found in cache contexts. However, another plausible explanation for the missing parts (*e.g.* fore and hind flippers) is that they were cut off at the primary butchering site and the side slabs were cut from the ribcages, which were left behind to facilitate transport.

– At Tayara post-depositional taphonomic processes such as sediment compaction, trampling or caribou wallowing explain the fragmentation of the walrus long bones. The replacement of the cortical bone by cancellous bone, which also fills the medullary cavities that characterizes the sea mammals' long bone (Maas 2007) is a phenomenon present in Tayara assemblage.

– The walrus remains as well as the rest of the faunal assemblage and the bone tools are well preserved. This preservation has been favoured by the burial of bones and their encapsulation into the permafrost layer, suggesting limited mechanical deterioration (*i.e.*, freeze-thaw or wet-dry cycles, or both) (Todisco & Monchot 2008). Burial depth partly explains the degree of weathering (represented by different weathering stage, WS, Todisco & Monchot 2008). Indeed, the well-preserved bones are found mainly where burial is associated with thicker overlying sediments. This implies rapid bone burial with a low degree of exposure to temperature changes and atmospheric processes.

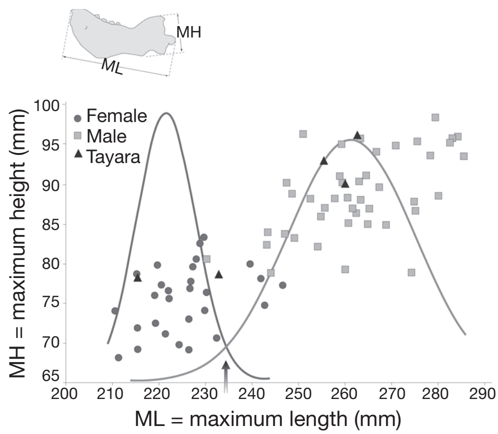

FIG. 4. — Diagram of the maximum length (mm) and the maximum height (mm) and mixture analysis curve of the maximum length of the Tayara and Foxe Basin walrus mandibles (reference collection: Stewart, personal data *in* Wiig *et al.*, 2007). (Mixture analysis, Cut-off point = 235.277 after Monchot & Léchelle 2002).

Sexing and ageing the walrus

The only identifiable remain of sexual gender is the baculum (penis bone). Six fragments of penis bones testify to the presence of a minimum of three walrus males in the bone assemblage. Secondary sexual characters are indirectly related with reproduction and deal with sexual behaviour of mate acquisition and courtship behaviour. Canines are also good sex indicators for walrus: the tusks of males are stouter and more elliptical in cross-section than those of females, which are also straighter and more divergent distally (Fay 1985). The intense fragmentation of the tusks linked to tool manufacture does not allow us to clearly identify male individuals from female individuals.

Body size differences can help separate male and female individuals in a population. Osteometrics have been standardized so that bone sizes can be compared within and between faunal assemblages. The most reliable and successful measurements for separating size groups in walrus focus on the mandible (Wiig *et al.* 2007; Monchot *et al.* submitted). Thus, using the walrus individuals from Foxe Basin as a reference population (Wiig *et al.* 2007), we can plot in a bivariate diagram 5 of the 7 mandibles from Tayara (Fig. 4). The results show clearly the presence of 3 males and 2 females.

The mandible of the sixth individual was not measurable and represented a juvenile whose sex cannot be determined. The young age is indicated by small size and also by the morphology of the mandible (*e.g.*, unfused mandibular symphysis, porous bone, Kastelein & Gerrits 1990: figs. 5 & 6). No age estimation by cementochonology analyses (Garlich-Miller *et al.* 1993) was made on the Tayara material, and aside from the morphology of this juvenile mandible only bone epiphyseal fusion allowed us to separate juveniles from adults. As no age data for the development of the postcranial skeleton in walrus are available in the literature, we have used the data for seals assuming that the order of epiphyseal fusion could be similar. Thus, according to Storå (2000: Tab: 11), of the 75 walrus unfused bones identified (columm unfused *in* Table 2), only one humerus really attests to the presence of a yearling. Other epiphyses/metaphyses belong to the juvenile group (*e.g.*, proximal tibia-fibula), to young adults (distal femur), and mostly to adults (vertebral disc, metapodial, rib). Indeed the process of fusion for these last two age groups begins when the individuals are sexually mature and have reached adult body size (Storå 2000). Full-sized but unfused elements originate from sub-adults or young adults walrus.

Gregariousness pervades the social system of walrus. Although animals sometimes occur singly, most are found in groups of two or more (Fay 1985). The number of animals per group tends to be largest when they are on shore, smaller when on ice, and smallest when in the water. The size of in-water groups varies with their age and sex composition and the type of activity. Sexual segregation for part of the year is common in walrus: while females are equally gregarious throughout all seasons, adult males usually occur singly during the breeding season but congregate at other times (Fay 1985; Born *et al.* 1995). However, in several areas of the Atlantic, males, females and young individuals use the same terrestrial haul-outs in summer (*e.g.*, Salter 1979; Miller 1982; Born *et al.* 1995).

HUNTING STRATEGIES AND MANUFACTURING PROCESSES

Hunting strategies and transport of the walrus

Hunting strategies

Hunting methods are not well studied and come mostly from an ethnological extrapolation. If the technology of the Dorset people yielded abundant evidence of the use of composite projectile gear, especially harpoons, it is more difficult to determine the human gestures which have been used to kill the animal. Bone injuries caused by human gear were identified from the beginning of prehistoric research (Lartet & Christy 1864; Ducateau & Vigne 1993). Many observations have been made, most notably in Scandinavia (*e.g.*, Bratlund 1996; Noe-Nyggard 1974), but they remain rare in the Arctic. In the case of walrus and marine mammals in general, the thick layer of fat certainly limits the penetration of the harpoon down to the bones. At Tayara, an exceptional discovery of a chert end blade embedded in a rib confirms that the wal-

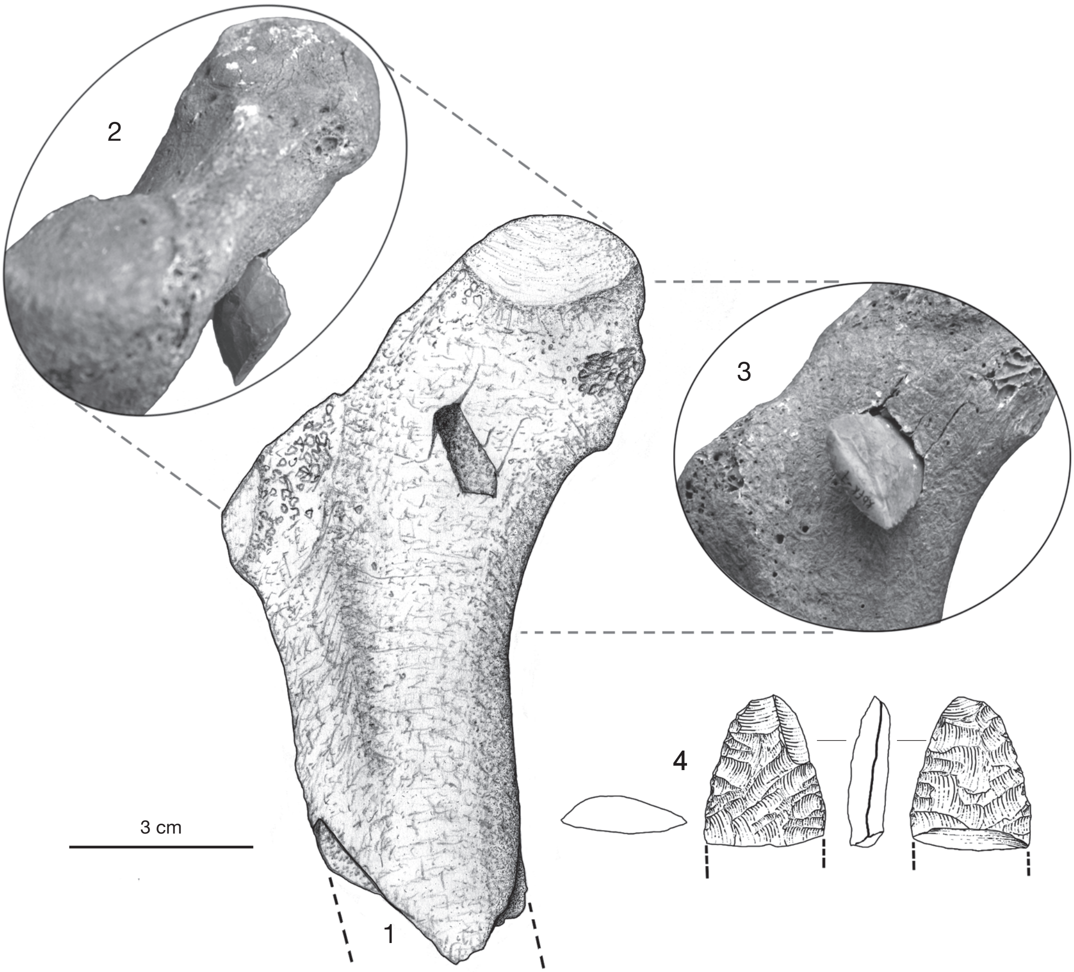

Fig. 5. — Distal fragment of a biface end blade embedded in the rib of a walrus (Drawing P. M. Desrosiers).

rus was killed and transported to the campsite, and is therefore clearly not an act of scavenging (Fig. 5).

The end blade is a distal fragment exhibiting tip fluting (Fig. 5). The object is thick and not very pointed for an end blade. In another context, it might have been interpreted as an unfinished preform. It is not finely chipped, light and sharp, as would be expected for a harpoon tip. The robust appearance of this point was probably more suitable to be used as a lance head or probably even more as a spearhead (the lance is longer, stouter and heavier than a spear, and unsuited for throwing, or for rapid thrusting) that was possibly used to kill the walrus instead of a harpoon (Taylor 1968). Based on the position of the point in the rib, the point entered the body from the left side of the flank, and with enough force to embed part of the tip deeply in the rib, and possibly causing the animal's death.

The hunter should thus have been close enough to the prey to kill it, which in turn suggests its presence on solid ground. Even with modern implements, it is easier for an Inuk to hunt a walrus during the Fall migration by attacking individuals or small groups. Hunters avoid attacking large herds for two reasons: the increased danger of being attacked by a walrus

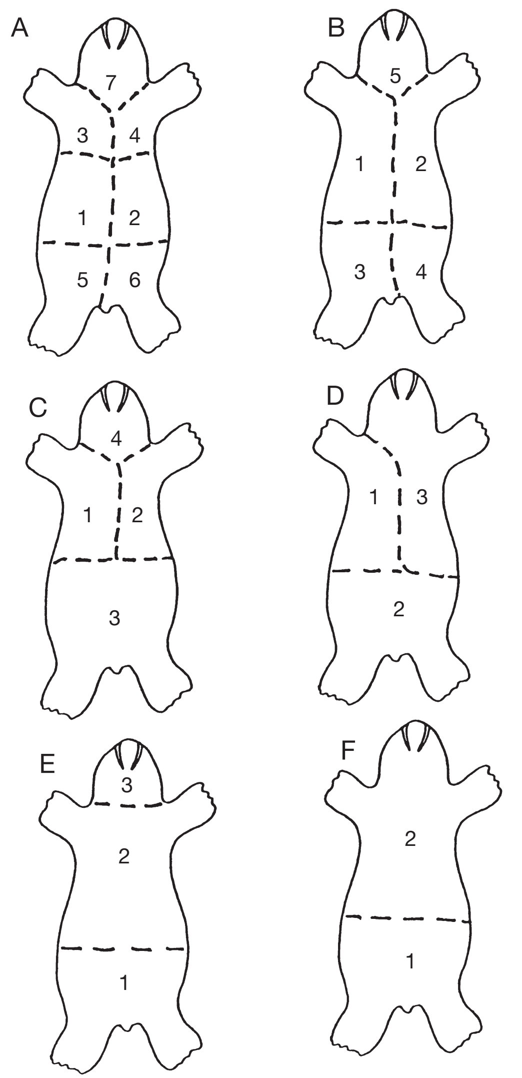

FIG. 6. Diagrammatic representation of walrus butchering, Southampton Island in 1970 (After Freeman 1974/75: 151; **A**, very large adult; **B**, adult; **C**, immature or adult; **D**, **E**, immature; **F**, immature and calf).

and the desire not to frighten large herds out of the hunting grounds (Riewe & Amsden 1979: 340).

The primary stage of butchering and the question of the transport of the walrus carcass to the camp site

Dismemberment or disarticulation occurs during the primary stage of butchering. The goal of this stage is to butcher the animal into portions that can be more easily transported from the kill site back to the camp site. This is especially true for walrus because its large size is a handicap for transport. A result of disarticulation is the presence of cut marks located on articulations (Binford 1981; Lyman 1987; Lech *et al.* 2011). Unfortunately, no traces of disarticulation were identified on the walrus bones of the Tayara collection. At this stage of the *modus operandi,* it is very difficult to know whether walruses were transported whole to the camp where they were subsequently butchered in portions or if they have been quartered at the kill site and then transported in pieces to the camp.

If the second hypothesis could be considered the best in terms of energy expenditure, Mathiassen (1927) reported that Sadlermiut hunted walrus by thrusting the harpoon through the animal's lips and dragging it by the tusks, whereupon they broke its neck by bending the head back. They dragged the walrus to the houses to flense them, and one man could pull a whole walrus in this way; they had no sledge or dogs. This example is a evidence against the "Schlepp effect" being a factor in this case (*i.e.*, the difficulty of transporting such large dead weights in one piece, Perkins & Daly 1968).

Nevertheless according to the ethnographic literature and storytelling, a walrus is normally cut into parts from two to seven pieces close to the kill site. As the pieces are generally of roughly similar weights (100-120 kg), the number of cut pieces is generally determined by the size of the carcass (Fig. 6; Freeman 1974-1975: 151). For instance, Diagram A represents a very large adult (> 800 kg) that may be cut into seven portions or five portions (Diagram B) whereas Diagram F (*ca* 300 kg) represents an immature or calf walrus bisected immediately posterior to the last ribs. It was during this operation that all the abdominal viscera could be recuperated and transported in parts or consumed locally.

THE SECOND STAGE OF BUTCHERING:
THE REDUCTION OF THE WALRUS CARCASS

Butchering can be defined as a human reduction and modification of an animal carcass into consumable parts. In this definition "consumable" is broadly construed to mean all forms of use of the

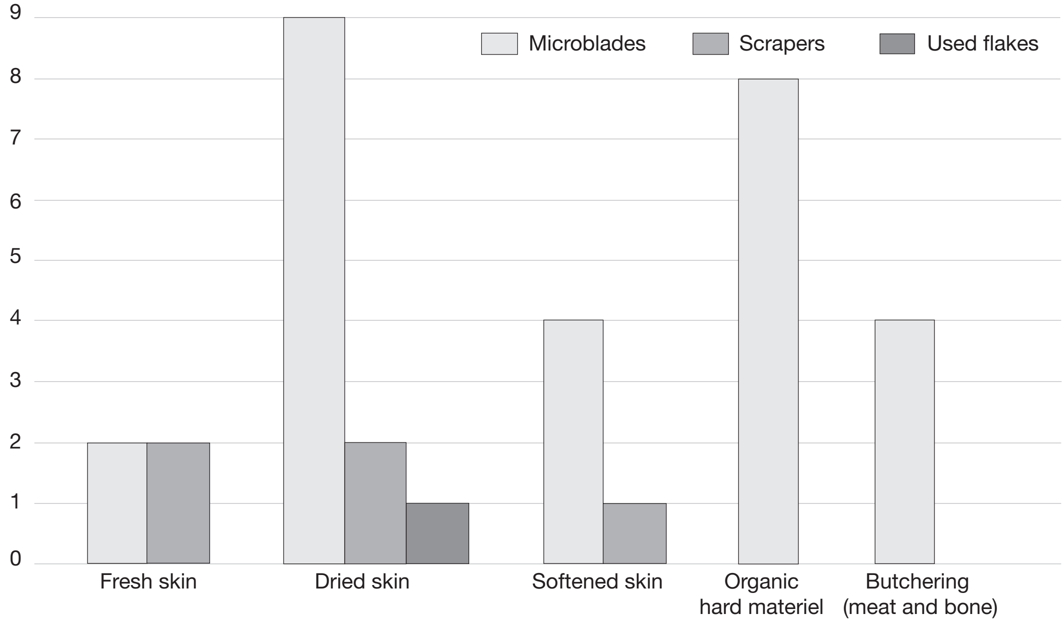

FIG. 7. — Type of worked material revealed by use wear analysis on selected tools (n = 34).

carcass products, including but not restricted to consumption as food (Lyman 1987: 252). So walrus were mostly exploited for their skins (hide), sinew (tender and ligament for rope), meat, blubber, mattak, bone (*e.g.*, baculum, maxillary), teeth (post-canine, tusks) and viscera (liver, brain, intestines, heart) (Kuhnlein & Soueida 1992). Finally, some Inuit consider molluscs in walrus stomachs to be a delicacy (Dunbar 1949).

Skinning and defleshing activities

The thick skin of the walrus (up to 10 cm around the neck and shoulders of males), and especially calf skin, is widely used by Inuit; and this was almost certainly the case for the Palaeoeskimo for summer tent covers, ropes and/or *kamik* (boot) soles. Skinning is the most difficult activity to detect in cut mark analyses because there are very few positions where the handling of the skins brings the butcher's tool in contact with the bone. The fatter the animal, the more difficult it will be to see signs of skinning (Lech *et al.* 2011). Unfortunately, none of these traces have been identified on the bones of the Tayara walrus remains. However, nine bones (two ribs, three lumbar vertebrae, one thoracic vertebra, one femur and two tibia) exhibit cut marks made by lithic tools relating to defleshing or filleting activities (Lyman 1987).

In the ethnographic record meat is typically shared in the community among different families, and meat may be boiled and eaten fresh, frozen for winter consumption, or fermented to make *igunak* (references in Cosewic 2006). *Igunak* is made by sewing the meat and blubber of walruses caught in Summer into a walrus skin bag, burying it on the beach (or in caches), and then recovering and eating the contents in the Spring after it has fermented and aged. Walruses killed too late in the Fall to be used for *igunak* are frozen and eaten during the winter. The average walrus weight about 675 kg and provides approximately 236 kg of meat (Foote 1967 cited by Riewe and Amsden 1979).

If some Inuit occasionally hunted walrus in the past to feed dog teams and only ate walrus when there was no other food (Riewe & Amsden 1979; references *in* Cosewic 2006), it does not appear that this was the case everywhere and particularly during the Dorset period. In addition, the presence of do-

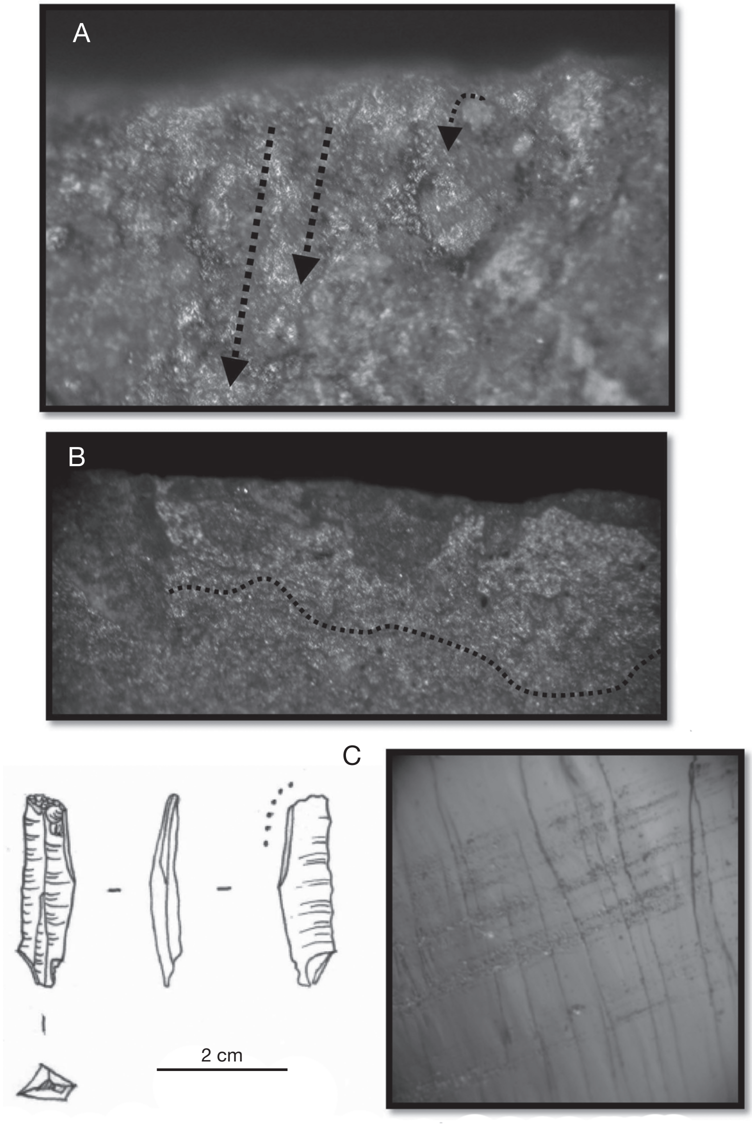

FIG. 8. — Evidence of use-wear of initial processing of carcasses and skin treatment: **A**, chert scraper used to softened the skin, as shown by the mat and dense polish with perpendicular orientation from the edge, and the rounfding of the edge (100x) ; **B**, Chert microblade used to skinning a caracasses or defleshing a fresh skin as shown by the diffused polish mixed with oblique scars along the edge (100x) ; **C**, Quartz microblades used as a burin, to engrave a hard and dry material like bone or ivory, as shown by the abraded area, linear and discontinouous, observed on the modidied part of the edge (400x).

mestic dogs at this time is still under debate. From the authors' personal impression, walrus products such as meat, ivory and perhaps penis bone may have been highly valued during the Dorset period.

Use wear evidence of initial processing of carcasses and skin treatment

Understanding the functions of the Tayara tool kit is a significant way to highlight the technical activities related to the exploitation of walrus at Tayara. Use

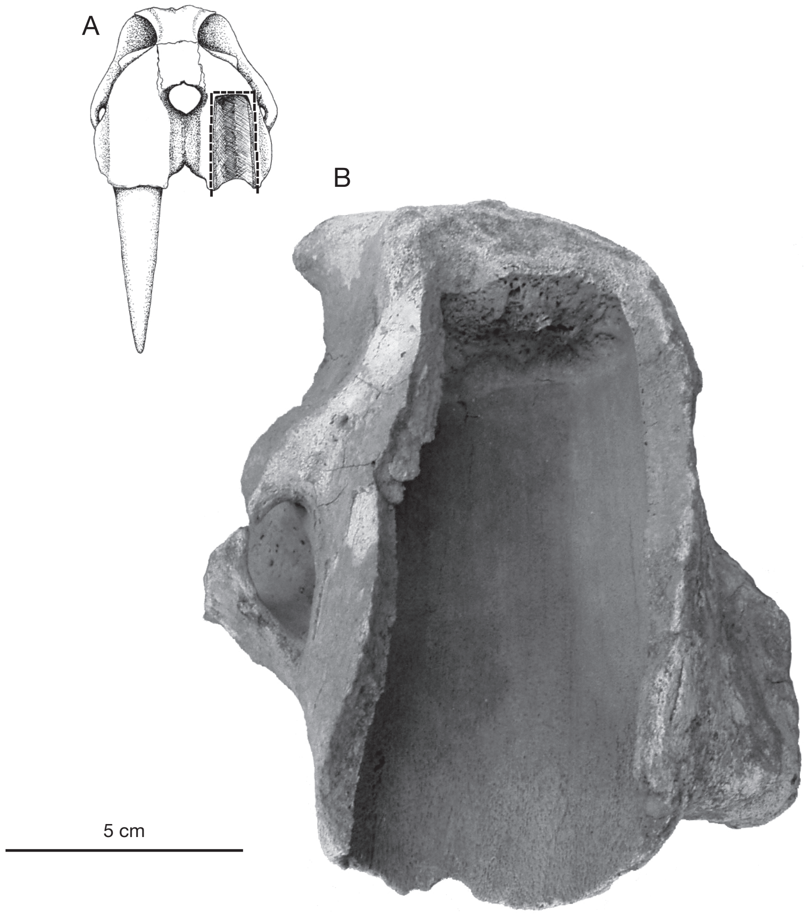

FIG. 9. — Anterior view of walrus skull showing grooving longitudinally and transversely for tusk extraction: **A**, drawing after LeMoine & Darwent 1998: 77; **B**, Tayara fragment (AD 202-444).

wear analysis observes edge and surface wear using a metallographic microscope with high power magnification (100x to 500x). Functional diagnosis is made from identification of trace patterns. Patterns consist of specific microwear traces distinguished by their morphology, position and direction. The wear pattern on the used part of the tool will be specific to: the texture of the worked material (which can be soft or hard), its properties (if its dry or wet) and nature (is it fresh or dried skin, leather or hard organic material?) and the function of the tools (butchering, skinning, defleshing, stretching, manufacturing) (Dionne 2012; Estevez & Urquijo 1996; Knutsson 1988).

Microwear analysis of a sample that represents 9 % of the total lithic assemblage, and selected on the basis of their morphological features, was carried out (n=80). Tools selected for use-wear analysis had a length of more than 2 cm, good preservation of the edges, and integrity of the tool (presence of significant parts). Analysis of 70% of the tools sampled (n=56) from Level II led to the observation of use wear on portions of the working edge, while the use wear analysis allowed identification of the nature of the worked materials for 60 % of these tools (n=34) made from chert and quartz (Fig. 7). The tools selected for the analysis (microblades, used flakes, and scrapers)

TABLE 3. — List of the artefacts by walrus anatomical elements for Level II of Tayara site.

	Walrus tusk	Walrus maxillary	Walrus baculum	Other species or unidentified material	N
Harpoon heads	27			1	28
Needles	10			55	65
Smoothers (?)	8			16	24
Pendants	8			4	12
Support pieces for tool handles	8				8
Barbed points	7				7
Perforated flat objects	7				7
Animal figurines	5				5
Perforated teeth	4			6	10
Human figurines	3				3
Foreshafts	3				3
Lance head	1			2	3
Shaman mouth piece	1				1
Flint flakers		3			3
Wedges			3	3	6
Awls				4	4
Sled shoes				2	2
End scraper				1	1
Miscellaneous	22			16	36
Total	**114**	**3**	**3**	**110**	**230**

TABLE 4. — Types of products from walrus elements for Level II of Tayara site.

	Walrus elements		All species	
	NISP	%	NISP	%
Débitage wastes	44	13.2	59	10.4
Shaping wastes	18	5.4	22	3.9
Resharpening wastes	7	2.1	8	1.4
Other wastes	28	8.4	37	6.5
Blanks	4	1.2	25	4.4
Preforms	12	3.6	15	2.6
Preforms or end products	20	6.0	31	5.5
End products	125	37.6	230	40.5
Unidentified	75	22.5	141	24.8
Total	**333**	**100**	**568**	**100**

were singled out on the basis of their importance in processing hides. However, the majority of the tools consists of microblades (53 %), a raw-edged tool, potentially representing *in situ* manufacturing and use. The microblade can be considered as an all-purpose tool, and only use wear will determine its specific function in any given case.

The results of the use-wear analysis indicate that the material worked was mostly dried skin (n=12) (Fig. 8A), followed by hard organic materials (e.g., antler, bone or ivory (n=8)). Moreover, we can observe that fresh (n= 4) and softened skins (n=5) were also worked at the site (Fig. 8B). There is also evidence of butchering on some microblades (n=4). Although the tools used to work the skins cannot be directly associated with the processing of a particular species, they nevertheless indicate the importance of these types of activity at the site.

The functional analysis that follows reveals that the manufacture of clothing and equipment (64%) is more highly represented than the acquisition and processing of fresh resources (36%). Thus, while skinning and scraping fresh hides were carried out at Tayara, it seemed that treatments (drying, softening) and skin cutting would have played a more important role in the organization of activities during the successive occupations of this site (Dionne 2012).

Tusk Extraction: techniques to open the jaw to release the tusk

As observed in some Late Dorset sites on Little Cornwallis Island (LeMoine & Darwent 1998), the skulls present in Tayara appear to have been broken and open by a heavy blow to the top of

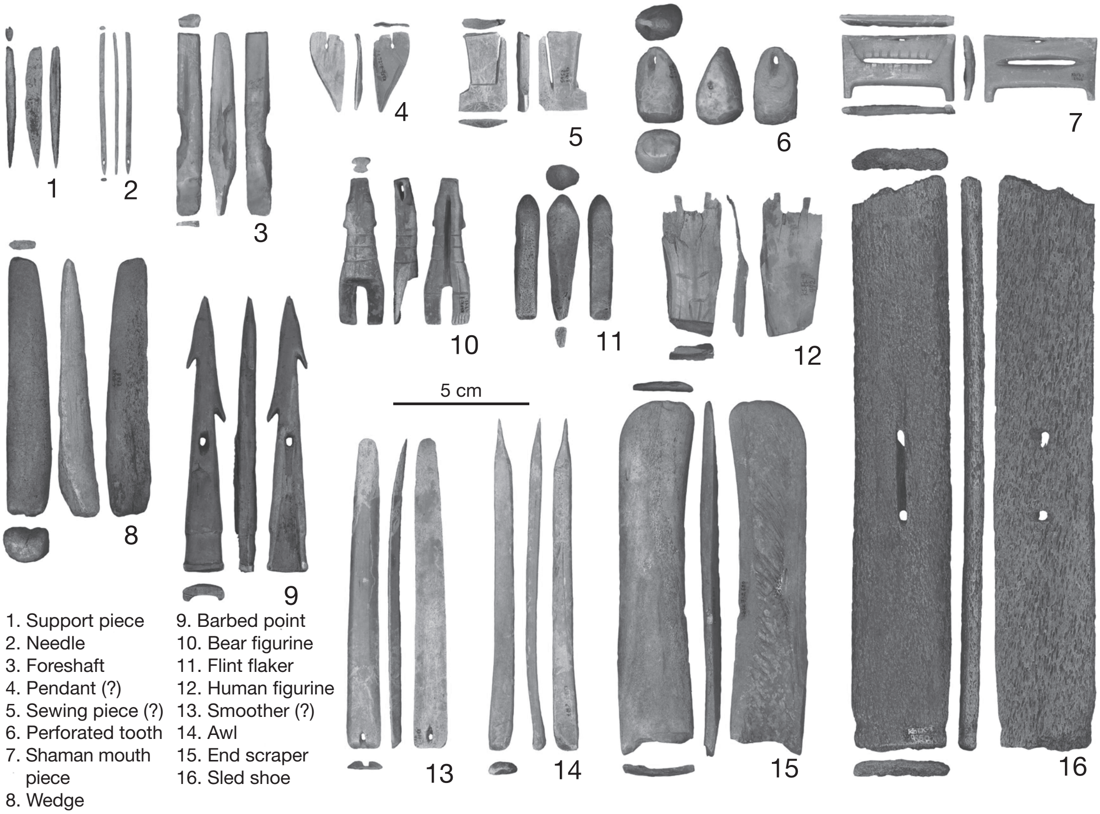

FIG. 10. — Artefacts discovered in level II of the Tayara site.

the skull, in the sinus region. Skulls were typically broken into a minimum of four pieces —right and left maxillae and right and left calva split sagittally. In addition, the base of the cranium was usually removed, probably to facilitate brain extraction. To extract the ivory, the anterior portion of the maxilla-alveolus was removed by a chopping (Fig. 9) or grooving operation *(e.g.*, parallel grooves were cut along either side of the anterior alveolus).

Contrary to what has been observed by LeMoine and Darwent (1998: 78), during the initial reduction, defined as the beginning of the process of manufacture, the thin ivory and enamel around the base of the pulp cavity seems not to be removed by percussion. This method appears to be specific to Late Dorset assemblages. The tusks are carefully grooved longitudinally, sometimes with a special recovery of the pulp cavity to produce ornaments and/or a part of the cement is removed by grooving (cf. *infra*).

Walrus anatomical elements used as raw material for tool manufacture

From a technological point of view, walrus anatomical elements were treated like those of other species, but were not used to produce the same functional categories. Hunting gear and objects with symbolic value are most frequently produced using walrus ivory (Houmard 2008, 2011a).

Despite the presence of whole carcasses at the site, it is interesting to observe the highly selective choices made in terms of raw material selection. Dorset craftsmen largely preferred walrus ivory (n=309) and, in some cases, maxillaries(n=8), bacula (n=6) and

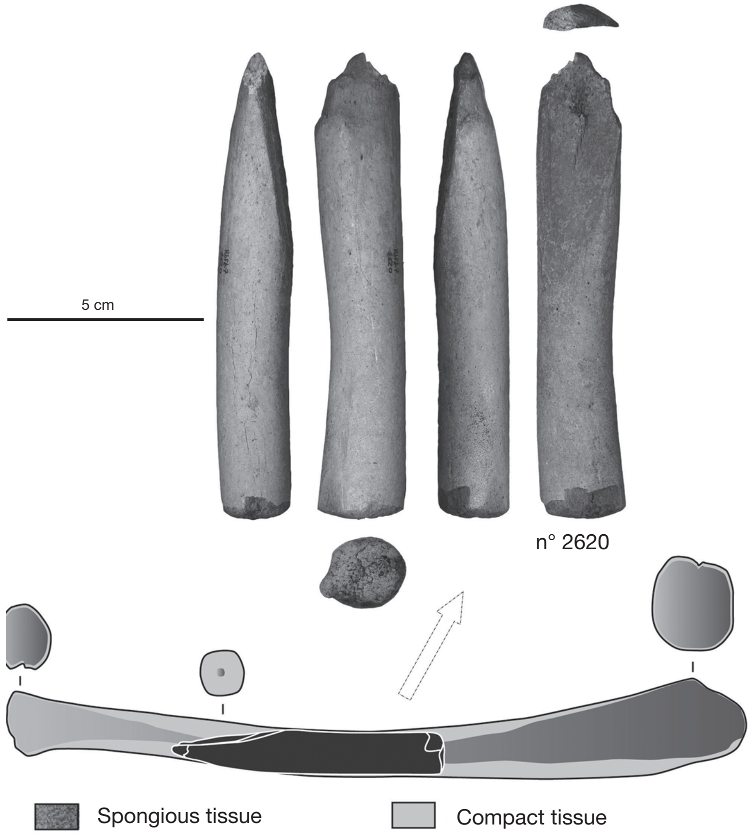

FIG. 11. — Production of a wedge from a walrus baculum (Houmard 2011a).

post-canines (n=4). Adult walrus tusks are generally preferred even if some juvenile tusks were sometimes used (n=8), mostly for the production of harpoon heads (6 of the 8, the two others are *débitage* wastes).

Varied use of walrus tusks for tool production
Walrus tusks are not only the preferred anatomical elements for the Dorset tool-kit, they are also selected for varied functional purposes: hunting gear, domestic tools, ornaments, human and animal figurines, and so-called shaman's mouth pieces (Fig. 10: 7). In comparison, walrus maxillaries are only used as flint flakers, and bacula for wedges (Table 3).

Manufacturing processes
In general terms, the assemblage (n=568) is mostly composed of end products (n=230), with manufacturing waste also present. A few blanks and preforms were also identified. The distinction between preforms and end products is not obvious. The same is observed when the walrus elements are isolated from the other kinds of materials, with a slightly higher frequency of waste and preforms, which is evidence of *in situ* production (Table 4). However the blanks are less represented than for the other raw materials.

The concepts and techniques used to produce all the ivory artefacts coming from the walrus tusks, as well as the bone artefacts coming from the walrus maxillary and baculum are the same as for the other species and anatomical elements. The walrus post-canines are the only elements which are used whole, perforated perpendicularly at the level of the root. In few cases, a part of the anatomical elements is used in its natural morphology, (*e.g.,* the baculum

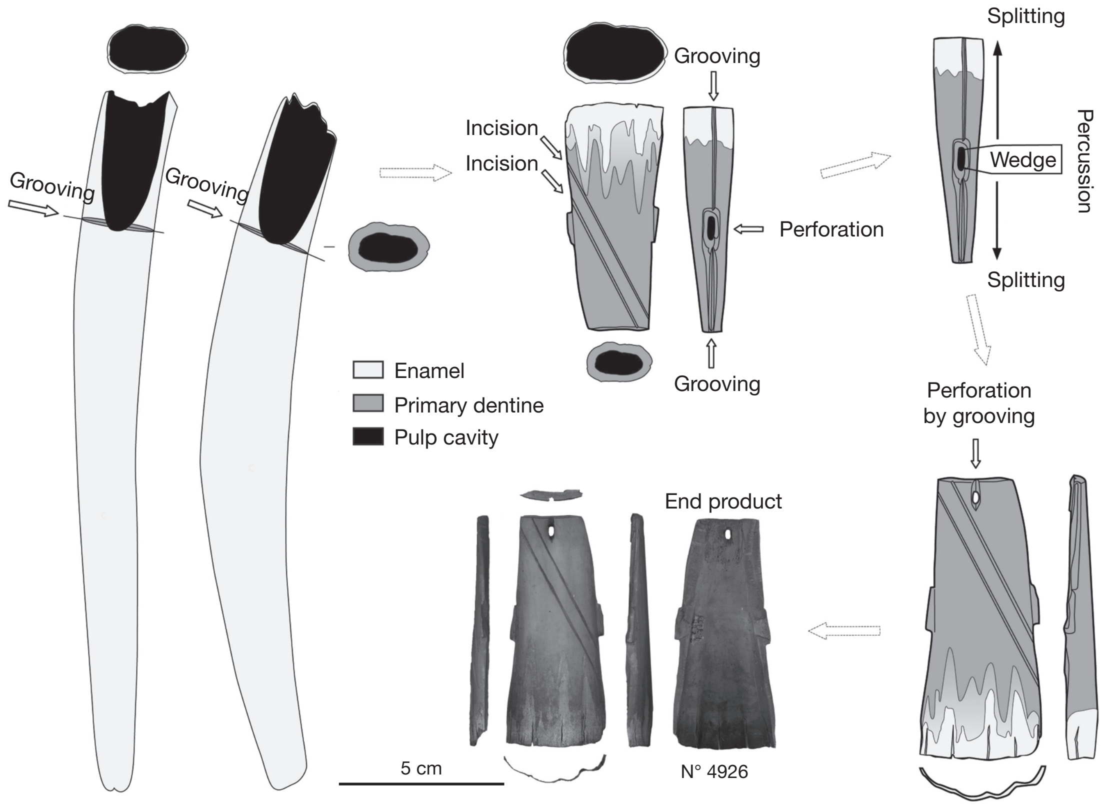

Fig. 12. — Production of a pendant from the pulp cavity of a walrus tusk (Houmard 2011a).

to produce one wedge) (Fig. 11) or the pulp cavity of the walrus tusk to produce pendants (Fig. 12).

In all other cases, the anatomical element (*e.g.,* walrus tusk, maxillary or baculum) has been fragmented along the longitudinal axis by grooving to obtain rods of different sizes. For flint flaker production, these were produced using the part of the maxillary that surrounds the tusk. The same process is also observed for some wedges. A more complex reduction sequence has been implemented for the walrus tusk, producing a greater quantity of *débitage* fragments. Four different kinds of wastes linked to the reduction sequence were identified:
– Those which include the brittle secondary dentine (n= 32) generally removed, either as little pieces of concretions or as rods;
– Those which include a part of the pulp cavity (n=14);
– Those which include the cement which surrounds the external part of the tusk (n=2), in some cases, judged too irregular to be kept;
– In one case, a piece which seemed to be prepared for the extraction of a series of thin rods for probable needle production (Fig 13).

From the proportions of the different functional artefact categories, and the presence of characteristic triangular shaping waste fragments, harpoon heads appear to have occupied a prominent place in the production process. The harpoon head types also influenced the choice of the rod used: most of the Frobisher Grooved harpoon heads originate from the external part of the tusk, including, sometimes, a residue of cement, whereas the Tayara Sliced and Kingait Closed Socket types (Fig. 14) are often positioned in the internal part of the tusk; the posterior part of the tusk seemed to be preferred for the

Dorset Parallel type with a central line of secondary dentine on the face opposite the line hole. The different parts of the harpoon heads (*e.g.,* slotted distal end, perpendicular or parallel line hole, sliced or closed socket) are very carefully shaped, combining grooving and scraping techniques, sometimes with the use of abrading on the proximal part of the harpoon head just before removing the thin triangular shaping waste, which composes the closed socket of the head.

Use wear evidence of manufacturing process on antler, bone or ivory (?)

It was possible to observe that the working of hard materials such as bone, antler or ivory, is well represented by the lithic use wear data (n=8). Furthermore, it appears that quartz microblades, more than ones made from chert, are particularly suited for this task. There is also a quartz microburin (see Fig. 8). It seems that quartz microblades were probably used to scrape or engrave antler, bone or ivory, during the finishing step of tools or handycraft manufacture. Indeed, the delicate but strong microblade seems to be particularly efficient for making fine grooves or perforations that are characteristic of Dorset material culture (Dionne 2012).

DISCUSSION AND CONCLUSION

Walrus seem to have been one of the key resources for the subsistence of Dorset people who stayed at Tayara, as shown by the analysis of the Level II remains, dated between 1900 and 2100 B.P. This level highlights the hunting of at least 6 walruses: three adult males, two females and one juvenile. The entire skeleton was present at the campsite and the individuals were probably transported whole or, more likely, in butchered portions. Among the hunted species, walrus ranks only in fourth position in terms of individuals after the common eider, foxes and seals, while in terms of quantity of material available (skin, fat, and meat), it is the dominant species.

Results from the lithic use-wear analysis tend to support a diversified exploitation of walrus carcasses. Quartz microblades were used to cut and butcher the walrus and to work the skins. This activity could also have involved the use of unmodified flakes or end scrapers. Quartz microblades were also used to work hard materials like bone or ivory. While all the parts of the walrus carcass seem to have been exploited, tusks, post-canines, maxillary and penis bones seem to have been preferred for technical purposes. The ivory from walrus tusks was by far the preferred raw material for manufacturing objects, especially hunting gear and objects of symbolic value.

The estimated number of post-canines, maxillaries and bacula needed to produce the wedges and the flint flakers in Level II is comparable to the estimated number of walrus individuals and might suggest they represent an exploitation of bone elements directly from hunting activities carried out near Tayara. It is more difficult to assess a similar conclusion for the walrus tusks because they were heavily cut down to manufacture a wide variety of small pieces (most of them measuring less than 7 cm). The manufacturing processes employed have produced some typical waste (e.g., cement and/or pulp cavity and/or secondary dentine), which have been identified and described in the literature for the first time. This paper also demonstrated that the different parts of the tusk were chosen with the specific type of objects to be manufactured in mind, and this is especially true for harpoon heads.

Integrated analyses similar to the one presented here need to be performed on more sites and in different areas, time periods and using different species to establish comparisons and draw more general implications. Even if the Tayara site was characterized by an important exploitation of walruses, the diversity and richness of the faunal assemblage, with other species such as foxes, seals, caribou and birds, would merit a broader analysis of the animals' exploitation (Houmard & Monchot in prep). A holistic approach to the exploitation of each species, as well as a comparative approach to the full spectrum of species, could lead to a high resolution understanding of species availability, as well as the needs and activities of the occupants of the Tayara site.

As mentioned in the introduction, during the Dorset period there is an increase in walrus hunting

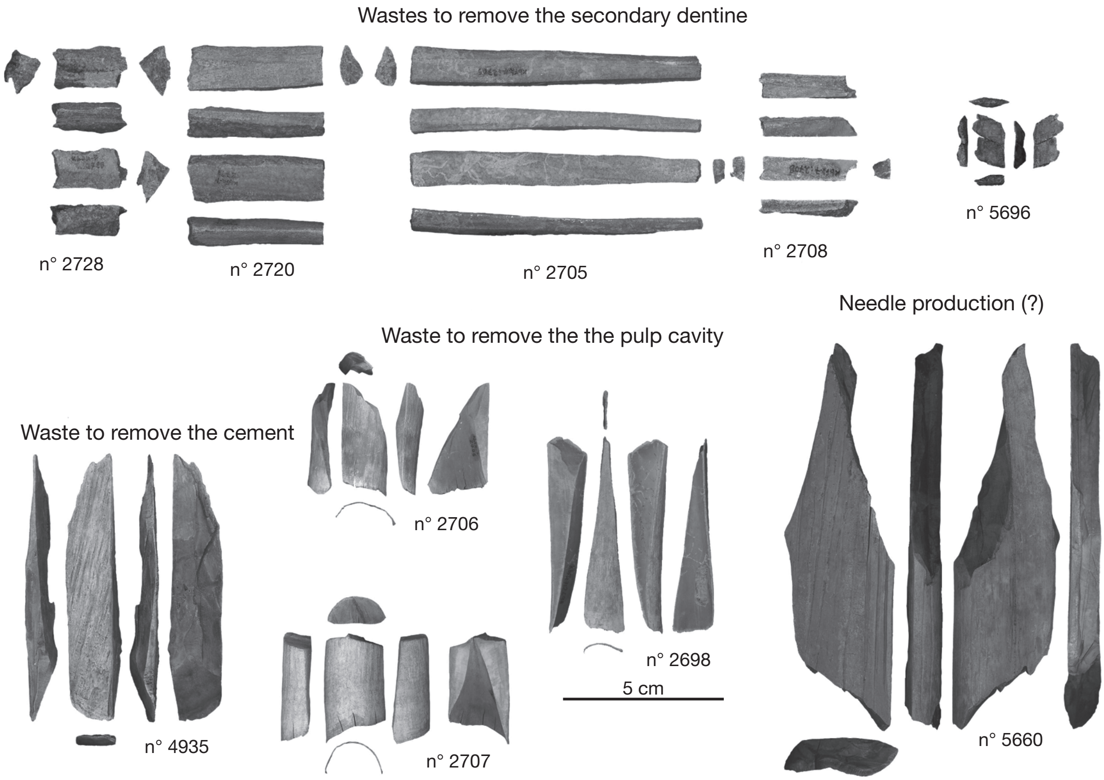

FIG. 13. — Typology of the debitage waste fragments coming from a walrus tusk (Houmard 2011a).

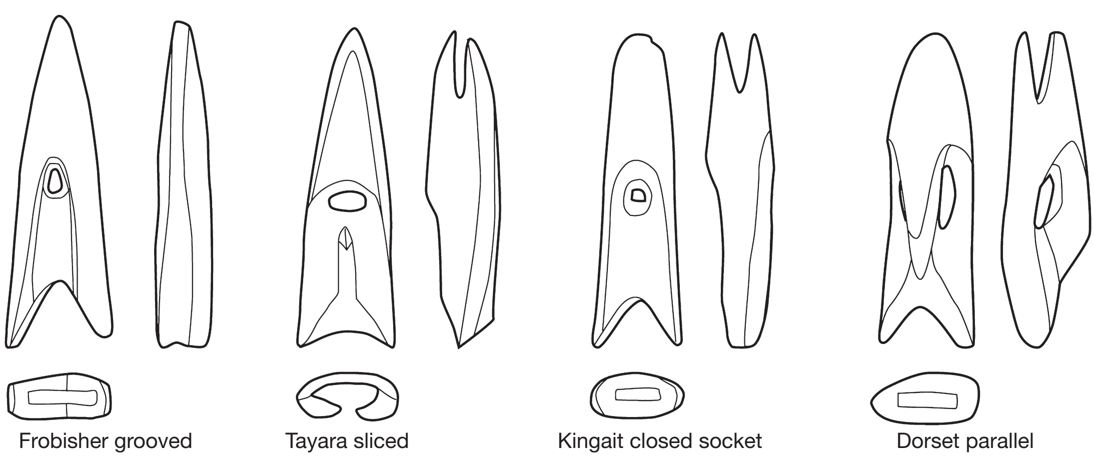

FIG. 14. — Typology of the harpoon heads found in Level II of the Tayara site (Taylor 1968; Houmard 2011a, 2011b).

(Darwent 2004; Dyke *et al.* 1999; Murray 1996, 1999; Houmard 2011a, 2011b). Data from Level II at the Tayara site reflect this general trend towards a more regular hunting of larger marine animals. According to Darwent (2004: 70) this sudden appearance of walrus bones in faunal assemblages does not correlate with climatic warming, but rather results from technological innovations, which allowed their incorporation into the Palaeoeskimo diet. Our results from the typological and technological analyses of the Tayara objects also point in that direction with the appearance of harpoon heads with sliced or closed sockets. The relative decline of walrus use in subsequent warmer periods may relate to an overall broadening of the diet and a more frequent use of local resources with less focus on one particular marine resource.

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