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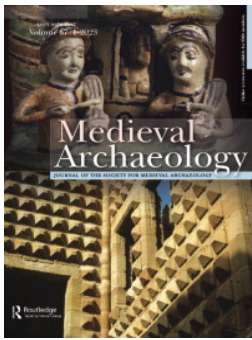
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## Active Whaling, Opportunistic Scavenging or Long-Distance Trading: Zooarchaeological, Palaeoproteomic, and Historical Analyses on Whale Exploitation and Bone Working in Anglo-Saxon *Hamwic*

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# Active Whaling, Opportunistic Scavenging or Long-Distance Trading: Zooarchaeological, Palaeoproteomic, and Historical Analyses on Whale Exploitation and Bone Working in Anglo-Saxon *Hamwic*

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*THE ANGLO-SAXON SITE OF HAMWIC (modern Southampton, Hampshire, UK) has been identified as a major bone-working centre. Besides antler and terrestrial mammal bone, cetacean bone has been recovered in high quantities. These specimens primarily represent working waste. Using peptide mass fingerprinting of bone collagen (ZooMS), it was determined that the majority of these specimens derive from the currently highly endangered population of North Atlantic right whale (Eubalaena glacialis). Limited historical sources appear to suggest that whaling was undertaken by the Anglo-Saxons, or by the Normans on the other side of the English Channel prior to the eleventh century AD. Nevertheless, the primary method of acquisition for whale bone was through opportunistic scavenging and trading.*


The population sizes of many cetacean species have dropped significantly over the last centuries (especially from the seventeenth century onwards) due to whaling and other anthropogenic activities, such as ship strikes, pollution, and industrial noise. As a result of these actions, one species that is facing extinction is the North Atlantic right whale (*Eubalaena glacialis*). This species is now confined to the western Atlantic, with estimates as low as 300–400 individuals (Pettis et al 2020). Before the European population was extirpated, several European cultures hunted the species relentlessly. The Basques, Normans, Flemish, and Norse are all examples of cultures that, in different spatio-

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temporal settings and with varying intensity, hunted the North Atlantic right whale (van den Hurk 2020). In addition to these groups, the Anglo-Saxons have occasionally also been linked to whaling activities (Gardiner 1997).

Archaeological excavations at the Anglo-Saxon site of *Hamwic* (modern Southampton) suggested that the site was once a well-established bone- and antler-working location. Large quantities of worked terrestrial mammal bone and antler are evidence of the importance of this Anglo-Saxon centre. Of even more interest are the hundreds of fragments of whale bone, which appear to have been used as a raw resource for bone working (Riddler 2014; Riddler and Trzaska-Nartowski 2014). It has been suggested that the abundant whale-bone material from *Hamwic* derives from just a single or a small number of stranding events (Riddler and Trzaska-Nartowski 2014). Alternatively, while this is certainly a possibility since the skeleton of a large adult whale contains many tonnes of bone, might it be possible that the bones derive from multiple whale individuals that were actively hunted?

Up until now it has remained unclear from which species these bones were derived. By the application of collagen peptide mass fingerprinting (or Zooarchaeology by Mass-Spectrometry—ZooMS), it was possible to taxonomically identify a subset of these putative whale bones. Through an interdisciplinary approach, combining biomolecular analysis, zooarchaeological assessments of previously published archaeological reports, and historical analysis, a better understanding of Anglo-Saxon cetacean exploitation was created. Most particularly, it is suggested that the Anglo-Saxons relied upon trade and on the scavenging of stranded cetaceans to acquire whale-meat and bone. Active whaling by the Anglo-Saxons was probably only opportunistically undertaken and played a relatively minor role in cetacean resource acquisition.

Throughout this paper the term ‘Anglo-Saxon’ is broadly used to describe a broad cultural group who inhabited England in the Early Middle Ages (AD 400–1066).

## HAMWIC BACKGROUND

The site of *Hamwic* lies in the eastern part of modern Southampton, adjoining the river Itchen. It was founded in the late sixth century or early seventh century AD and developed into a large trading and production centre from c AD 670 onwards, equipped with a network of streets, houses and cemeteries. Abundant material culture is present in the pits and ditches surrounding the structures, the coins and ceramics in particular indicating close links with the continental Europe (Riddler and Trzaska-Nartowski 2014, 2016).

Previous research on the zooarchaeological material from *Hamwic* (Fig 1) has revealed over 240 whale-bone fragments distributed across 17 separate sites. Eleven of these sites are located in the northern part of *Hamwic* and the remaining 6 in the southern part. The largest number of specimens derive from the northern part of *Hamwic*, particularly from the small site at Ascupart Street (101 pieces) and the much larger series of 6 sites at Six Dials (104 pieces). The whale-bone pieces generally represent triangular or rectangular blocks or strips and have been cut and sawn at one or both ends (Fig 2; Riddler 2014; Riddler and Trzaska-Nartowski 2014, 2016). Whale bone appears to have been a substitute for antler in worked-bone objects, though found in far lower densities. Eighteen out of approximately 700 unfinished

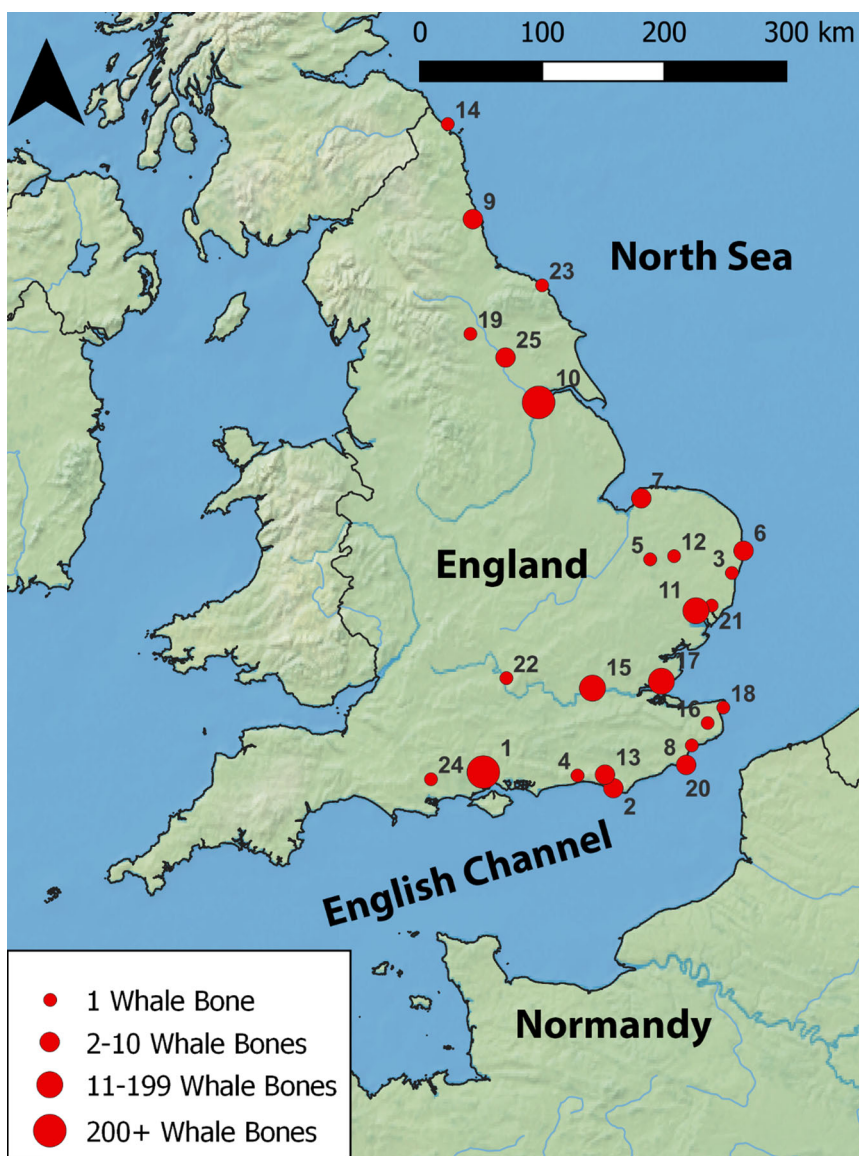


FIG 1

Map of Anglo-Saxon sites with cetacean remains. (1) Hamwic, Hampshire; (2) Bishopstone, East Sussex; (3) Blythburgh, Suffolk; (4) Botolphs, West Sussex; (5) Brandon, Suffolk; (6) Carlton Colville, Suffolk; (7) Chalk Pit Field, Norfolk; (8) Dengemarsh, Kent; (9) Jarrow, Tyne and Wear; (10) Flixborough, Lincolnshire; (11) Ipswich, Suffolk; (12) Larling, Norfolk; (13) Lewes Priory, East Sussex; (14) Green Shiel, Northumberland; (15) London, Greater London; (16) Nonington, Kent; (17) Prittlewell, Essex; (18) Ramsgate, Kent; (19) Ripon, North Yorkshire; (20) Sandtun, Kent; (21) Sutton Hoo, Suffolk; (22) Wallingford, Oxfordshire; (23) Whitby Abbey, North Yorkshire; (24) Witchampton, Dorset; (25) York, North Yorkshire.

comb-tooth segments made out of whale bone have been identified, and several composite combs made out of whale bone have been recovered.

The Anglo-Saxon occupation of *Hamwic* has been subdivided into five phases. Phase 1 of c AD 600–670 consists largely of cemetery evidence and, as of yet, it has not



FIG 2  
Whale bone specimens from Hamwic—Melbourne Street.  
*Photograph by I Riddler.*

provided any whale bone. The majority of the whale bone derives from phase 2 (AD 670–720; 66.5%) and to a lesser extent phase 3 (AD 720–770; 25.5%). The settlement expanded to around 50 hectares during the course of Phase 2, with structures largely set beside a network of streets extending from the waterfront. The church of St Mary's may have been built in this phase, eventually becoming the principal burial site for the settlement. Phase 3 may have been a highpoint for the settlement, with bone and antler working practised in an increased number of structures, set in two locations in the north and south of the settlement. By phase 4 (AD 770–850) the craft was concentrated in a smaller number of structures, but large quantities of waste are present, although there are fewer specimens of whale bone (7%), which suggests a further decline in its use. The coin evidence suggests that the settlement may have been in decline by this time but the ceramics and other material culture indicate that substantial areas were still occupied. Phase 5 (AD 850–900) has not been studied extensively and includes fewer features as of yet, providing a large quantity of bone and antler offcuts but only small amounts of whale bone (1%). It seems likely that only a small part of the settlement remained in use at this time (Riddler and Trzaska-Nartowski 2014, forthcoming).

## MATERIAL AND METHODS

In order to reconstruct Anglo-Saxon whale exploitation activities (active whaling, opportunistic scavenging of stranded whales, or trade with foreign whalers), historical analysis was undertaken, assessing any previously analysed and published Anglo-Saxon source mentioning cetacean exploitation. Moreover, historical sources concerned with Norman cetacean exploitation activities on the other side of the English Channel were also assessed. Norman whaling sources are more abundant and provide a valuable resource with which to compare the Anglo-Saxon data. For all historical sources, specific attention was given to active whaling or opportunistic scavenging activities, the scale of whale exploitation activities, and the whale species (or the size of the whales described in the sources) exploited. This was done in order to put the zooarchaeological specimens into a historical context.

As assessment of zooarchaeological cetacean bones from Anglo-Saxon sites (AD 400–1066) was undertaken. This was based on an extensive literature review of published zooarchaeological reports. These data were used to assess which species were exploited during the Anglo-Saxon period, whether spatial differences occurred in the exploitation and where and when tools and artefacts were manufactured from whale bone, especially in comparison to the site of *Hamwic*.

To assess which whale species are represented in the *Hamwic* assemblage, 20 samples of bone were selected from the zooarchaeological material (Tab 1; Fig 3). Of these 20, 19 were worked pieces of whale bone chopped into small blocks or strips (Fig 2), deriving from six different sites in *Hamwic*, including City College, Melbourne Street, St Mary's Place, St Mary's Street, Ascupart Street, and Six Dials. All pieces derive from contexts ranging from AD 670–900. As these pieces have been chopped into small blocks, identification to a species level based on morphology, let alone identification of the skeletal element, is effectively impossible. The 20th specimen is a large vertebra deriving from Chapel Road that had been used as a chopping block.

Samples of 0.03 g were taken from the specimens and analysed at BioArCh at the University of York, UK. Collagen extraction, purification, mass spectrometry and peptide mass fingerprinting identifications followed the method outlined by Buckley et al (2009) as modified by Rodrigues et al (2018) to remove the fractionation step. Briefly, the bone was demineralised in 0.6 M hydrochloric acid, and the resulting collagen gelatinised through incubation in 100  $\mu$ l of 50 mM ammonium bicarbonate at 65 °C for one hour. The collagen was digested through incubation with 0.4  $\mu$ g of trypsin overnight at 37 °C and purified using a 100  $\mu$ l C18 resin ZipTip® pipette tip (EMD Millipore). Each sample was spotted in triplicate with a matrix of  $\alpha$ -cyano-4-hydroxycinnamic acid on a 384 spot MALDI target plate, with calibration standards and run on a Bruker ultraflex III MALDI TOF/TOF mass spectrometer. Averaged spectra were created from the replicates for each specimen using mMass software (Strohalm et al 2008), and then compared to published m/z markers for mammals, as presented in Buckley et al (2009), Kirby et al (2013), Buckley et al (2014), and Hufthammer et al (2018). A minimum signal to noise (s/n) ratio of 3.0 was applied to the spectra, and a 'probable' identification was assigned if a key peptide marker was identifiable but below this threshold.

TABLE 1  
Specimens analysed and zooms identifications.

Sample ID	Location	Specimen	Description	Date	Zooms ID
WH700	City College	Sou1484, F61 c.514	Waste Block	AD 670-850	Balaenidae
WH701	City College	Sou1484, F70 c.526	Waste Strip	AD 670-850	Probable Balaenidae
WH702	Melbourne Street	Sou4, F111	Waste Block	AD 720-770	Balaenidae
WH703	St Mary's Place	Sou1715, c.552	Waste Block	AD 670-850	Probable Balaenidae
WH704	Chapel Road	Sou14, F28 2	Vertebra	AD 770-850	Balaenidae
WH705	St Mary's Street	Sou1553, F417 c.418	Waste Block	AD 670-770	Probable Balaenidae
WH706	Ascupart Street	Sou1176, F104 c.111	Waste Strip	AD 670-720	Fin whale/Balaenidae (very poor quality in m/z 1600s)
WH707	Ascupart Street	Sou1176, F91 c.113	Waste Block	AD 670-720	Balaenidae
WH708	Ascupart Street	Sou1176, c.126, U/S	Waste Strip	AD 670-720	Balaenidae
WH709	Six Dials	Sou30, F1068 28, c.4436	Waste Block	AD 670-720	Balaenidae
WH710	Six Dials	Sou30, F1068 35, c.4517	Waste Block	AD 670-720	Fin whale/Balaenidae (very poor quality in m/z 1600s)
WH711	Six Dials	Sou31, F2083 5, c.5543	Waste Strip	AD 670-720	Balaenidae
WH712	Six Dials	Sou31, F2006 L5, c.4920	Waste Block	AD 720-770	Red deer/Fallow deer/Elk
WH713	Six Dials	Sou31, F3035 3, c.5826	Waste Strip	AD 720-770	Goat/Reindeer
WH714	Six Dials	Sou31, F2006 14, c.5269	Waste Strip	AD 720-770	Probable goat/reindeer
WH715	Six Dials	Sou31, F2057 6, c.5641	Waste Strip	AD 770-850	Sheep/Deer
WH716	Six Dials	Sou31, F3035 1, c.5857	Waste Strip	AD 850-900	Bovid/Cervid (not cattle; poor high molecular weight peaks)
WH717	Six Dials	Sou31, F1007 1, c.4737	Waste Block	AD 850-900	No ID, poor spectra
WH718	Six Dials	Sou31, F4003 4, c. 5907	Waste Block	AD 720-770	Balaenidae
WH719	Six Dials	Sou31, F4003 5, c.5908	Waste Block	AD 670-720	Balaenidae

## RESULTS: HISTORICAL ANALYSIS

Previous historical research on whaling has focussed on a number of cultural groups, e.g. the Basques, Flemish, Portuguese, Norse, and Normans. The historical assessment below focuses specifically on the Anglo-Saxons and the Normans.



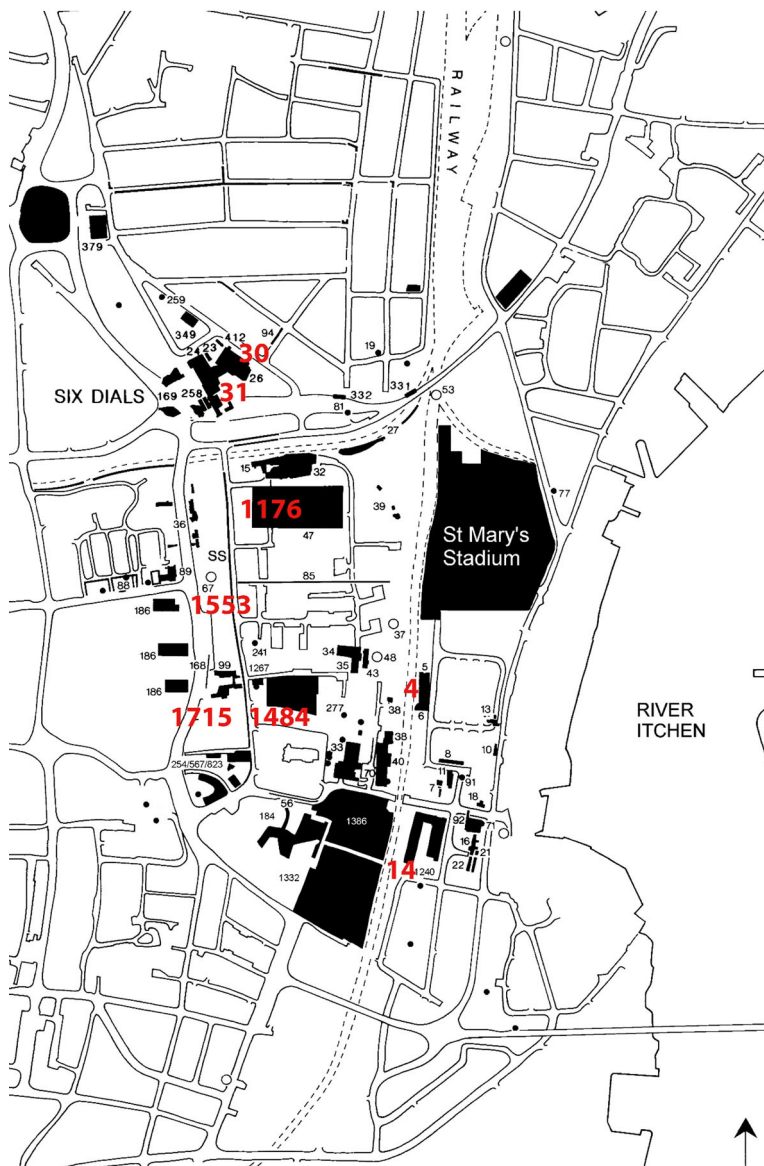


FIG 3

Hamwic map with site numbers in red for which specimens were analysed using ZooMS (see Tab 1).

Map by Ian Riddler.

### Anglo Saxons

Gardiner (1997) examined historical evidence for whale exploitation by the Anglo-Saxons and the English and states that, 'The Anglo-Saxons not only knew little of whales, but they seem to have had only slight knowledge of the practice of whaling'. Indeed, whales and whaling are only sporadically mentioned in a handful of Anglo-Saxon sources.

The Anglo-Saxon source most frequently linked to whaling activities is *Aelfric's Colloquy*, written by the Abbot Aelfric of Eynsham (AD 955–1010). It is a text used to teach Latin vocabulary and grammar. One particular section is concerned with a fisherman having a dialogue with a master:

Teacher: What sort of fish do you catch?

Fisherman: I catch eels, pike, minnows and dace, trout, lamprey and any other species that swim in the rivers, like sprats.

Teacher: Why don't you fish in the sea?

Fisherman: Oh, I do sometimes, but it is seldom as I have to make a long trip by river in order to get to the sea.

Teacher: What do you catch in the sea?

Fisherman: I catch herring, salmon, dolphins, sturgeon, oysters, crabs, mussels, cockles, flatfish, plaice, lobsters and such like.

Teacher: Would you like to catch a whale?

Fisherman: No, I don't think so.

Teacher: Why not?

Fisherman: Because catching whales is a dangerous business. I find it is far safer for me to go to the river with my spear than to go to the sea with many ships to hunt whales.

Teacher: Why is that?

Fisherman: Because it is better for me to catch fish than to kill a more powerful one, as it could drown and kill with one blow, not only me but my friends as well.

Teacher: But many men catch whales and escape danger, as well as obtaining a large price for their catch.

Fisherman: You speak the truth but I would not dare sail on account of my fears. (Trans Watkins 2010)

The text seems to imply that active whaling was undertaken, though it is not mentioned whether this was by the Anglo-Saxons themselves, or which species were hunted. Szabo (2008, 57) has argued that this text is referencing the practice of drive hunting, whereby multiple boats were used to drive a pod of small whale species into a bay where they could subsequently be killed. *Aelfric's Colloquy* is, however, a didactic text. It is therefore problematic to be relied upon as clear evidence for active Anglo-Saxon whaling activities and should not be taken too literally.

Furthermore, in his work, the *Historia Ecclesiastica*, dating to AD 731, the Venerable Bede (Fig 4) provides a description of Britain and Ireland and, in particular, a section mentions whaling activities, 'Britain (...) has the greatest plenty of salmon and eels; seals are also frequently taken, and dolphins, as also whales' (trans Wallace-Hadrill 1988). Based on this source, it seems that whaling was undertaken in Britain itself and that the Anglo-Saxons were not reliant on other cultures for their supply of whale resources. However, Bede's description of Britain has been described as Edenic, idealised, and commodified (Clarke 2006), making any interpretations based on it



FIG 4

The Venerable Bede in an illustrated manuscript, depicted writing his *Ecclesiastical History of the English People*. Photograph by Engelberg, Stiftsbibliothek, © CC-PD-Mark (E-codices <<http://www.e-codices.unifr.ch/de/bke/0047/1v>>).

problematic. Therefore, any of his descriptions, including this very brief mention of whaling, should not be taken too literally either.

Another early source that should be considered is the Franks Casket. The Franks Casket is a small box made out of whale bone and produced in early 8th-century Northumbria (Hough and Corbett 2013, 106). It is contemporary with the material from *Hamwic* and provides valuable information regarding the procurement of whale bone. One of the panels contains a transcription of runes which have been translated, 'The flood cast up the fish on the mountain-cliff; The terror-king became sad where he swam on the shingle. Whale's bone'. (Hough and Corbett 2013, 106). This indicates that the bone, from which the casket was made, derives from a stranded whale (Hough

and Corbett 2013, 106) and clearly shows that the Anglo-Saxons exploited stranded whales.

In later periods, following the Norman Conquest (AD 1066), cetaceans are more frequently mentioned in historical documents, but even for these later texts active whaling is rarely mentioned in England. Stranded cetaceans and large fish were claimed by the crown as ‘royal fish’, as recorded in The *Leges Henrici Primi*, dating to AD 1116–1118 (Gardiner 1997). Many administrative rolls from England record cases dealing with rights to stranded cetaceans, but very few record actively caught specimens (Gardiner 1997). An exception to this is a hearing dating to AD 1255, in which the Bishop of Norwich claimed a ‘great monstrous fish’ landed in his lordship. The ‘fish’ was caught by six boats at sea and the king argued that since this was the case it could not be treated as ‘wreck of sea’. Gardiner (1997) has argued that based on the confusion regarding this case, active whaling was not regularly undertaken and this might have been a standalone event.

Van den Hurk (2020) assessed entries in *The Calendar of Patent Rolls*, dating from AD 1216 to 1452, and discovered 52 entries concerned with rights on whales. Of these, 51 were concerned with stranded whales, while one entry dating to March 29th 1300 might be indicative of active whaling activities, though even for this text it is not entirely clear whether active whaling was undertaken:

The like to William de Sutton and John de la Lee, on complaint by the bailiffs and commonalty of the town of Colecestre, that whereas they recently caused a whale to be taken in the water near Colecestre, co Essex, within the liberty of the town, and ordered it be kept to the king’s use until his further order, Richard de Ripariis, the prior of Mereseye, Nicholas Bisuthe, Walerand de Rocheford and Andrew Attefeld and others, assaulted the said bailiffs and other men of the town disputed to the custody thereof, and after the king had commanded, upon being informed hereof by the said bailiffs, that the whale should be brought to him at Westminster, carried the whale away. (Boynton 2016)

Thus, taken together, the evidence from Anglo-Saxon sources suggests that active whaling may have been undertaken sporadically, but that accessing stranded or drift carcasses was likely much more common.

#### NORMANS

While *Aelfric’s Colloquy* and the *Historia Ecclesiastica* appear to suggest that active whaling was undertaken, the scarcity of historical sources mentioning whaling practices stands in stark contrast to the situation on the other side of the English Channel, where sources on whaling are abundant, particularly noting that whaling was undertaken from the late eleventh century onwards. Some sources also suggest that whaling was undertaken as early as the ninth century (Lestocquoy, 1948). However, just like their Anglo-Saxon equivalents, these older sources should probably not be taken too literally and it is often unclear whether whales or smaller porpoises or dolphins are meant.

This is, for example, the case with a document dating to AD 832 mentioning whaling being undertaken on the Cotentin Peninsula (Normandy). It is mentioned that the abbey of Saint-Denis owned a place there, where ‘*crassus piscis*’ were caught (Lestocquoy, 1948). ‘*Crassus piscis*’ or ‘*craspois*’, literally means ‘fat fish’ and is often used to describe a variety of whales, dolphins, porpoises, and even large fish.

Another 9th-century source is the *Life of Saint Philibert* written by the monk Ermentarius dating to c AD 863. In this work, the advantages of the site of the monastery at Jumièges are pointed out, and one of which was the presence of large marine animals, up to 50 feet long, which could be used for fuel for lamps and whose flesh fed the monks. Based on the description of the fuel use as well as the size, only large whales can be meant by this reference, though it is not clear whether these were actively hunted or opportunistically scavenged (Musset 1964). Moreover, De Smet (1981) suggested that actually marine animals of five feet long are described, making it more likely that porpoises are meant.

A slightly earlier reference to whaling can be found in *The Life of Saint Vedast*. Saint Vedast was an early bishop in the Frankish realm who died in AD 540. *The Life of Saint Vedast* was written in Latin and dates to AD 875 (Musset 1964). In the text, a communal effort of whalers is described aligned to several abbeys. A competition between two rival whaling groups was started, and eventually the group that prayed to Saint Vedast caught the whale. While this is one of the earliest references to active whaling, it remains unclear whether this text provides an accurate description of contemporary whaling activities or whether it should just be considered as a religious text not be taken too literally.

While it is not clear whether active whaling was indeed already undertaken during the ninth century, it is known that opportunistic scavenging of stranded cetaceans was practised during this period and that the clergy had a particular interest in the consumption of cetacean meat in the Normandy region. Charles the Bald, King of West-Francia (AD 843–877) granted the abbey of Saint Ouen in Rouen all fish (including whales) and other things cast up by the sea (Giry and Prou 1952, 410).

Just as is the case for England, from the end of the eleventh century onwards, whales are more frequently mentioned. In contrast to England, however, for Normandy there is much clearer evidence for active whaling activities from this period onwards (Musset 1964; De Smet 1981; Proulx 1986). A charter dating to the late eleventh century AD, specifies an agreement made between the abbots of Caen and Fécamp on the division of sturgeons and *Craspois* taken at Dives-sur-Mer by a society of whalers (Proulx 1986, 10). Both the Abbot of Caen and the Abbot of Fécamp contributed ships to the society. Musset (1964) has suggested that drive hunting with nets and spears was performed at the shore to hunt dolphins. However, another source dating to AD 1098, describes a corporation of ‘*wallmanni*’ (whalers) from Normandy. They are noted to have presented baleen plates to the Abbey of Montebourg, making it clear baleen whales were already hunted by the end of the eleventh century AD (Lestocquoy 1948).

Abbots in particular appear to have had an interest in whaling activities and these activities were controlled by ecclesiastical institutions from at least the early twelfth century onwards (besides Dives-sur-Mer, whaling activities were undertaken at Saire, La Hougue, Saint-Vaast, Lestre, Quineville, and Saint-Marcouf) (Musset 1964). This is further underlined by a charter of the Priory of Héauville, dating to the early twelfth century AD, that states that restrictions were implemented on whaling activities taking place at the port of Cape La Hague and that the inhabitants of Héauville were responsible for guarding caught whales from people trying to take pieces, and were ordered to bring the tongue to the monks of Marmoutier:

As soon as a cetacean is captured, particularly that of the *craspois* (whale, dolphin or porpoise), for which the monks of Marmoutier are accustomed to receive the tongue of, hurry towards the place where one will have announced its capture, they will defend against the children (*ab juvenclis*) this part of the fish which we have just mentioned and will bring it to the house of the monastery in Helleville and from there they will prepare, at their own expense, three draft animals to cart it to Brittany. (Translated by the authors from Musset 1964)

For the early twelfth century, more information regarding whaling techniques is also provided. Raul Tortaire, a poet and monk, took part in a whaling expedition on the Bessin coast in Normandy around the year AD 1115. He notes that whaling was undertaken in shallow waters in wintertime and that nets and boats were used to surround the whales. Noise was used to pursue the whales and three-pronged spears were used to strike the animals (Musset 1964; Proulx 1986, 10).

By the thirteenth century, it appears that whales and sturgeons were exclusively ‘Royal fish’, as detailed in a judgement of the Exchequer of Saint-Michel in 1292, ‘The sturgeon and the whale are exclusively royal fish, and no one can have them, however privileged, unless they have letters that explicitly state otherwise’ (passage of a judgement of the Exchequer of Saint-Michel in 1292, trans by the authors from Musset 1964).

Of most interest to this study is the law code known as ‘*IV Aethelred*’. In this law code, merchants from Rouen were taxed in order to sell *craspois* or ‘fat fish’ (presumably cetacean meat) in London (Middleton 2005). This law code has now been dated to the aftermath of the Norman Conquest (AD 1066; Naismith 2019), and clearly indicates a commercial interest in whaling as well as trading enterprises between England and Normandy. The late eleventh century is also the period from which the majority of documents mentioning active whaling originate, suggesting that the *craspois* sold in London likely derived from actively hunted whales.

In summary, these sources detail an interest in whale meat in the Normandy region dating back to at least the mid/late ninth century AD up until at least the thirteenth century AD (Musset 1964). Taken together, there is clear evidence that active whaling was undertaken by at least the late eleventh century, but limited proof for earlier whaling endeavours.

## RESULTS: ZOOARCHAEOLOGICAL ANALYSIS

### ZOOARCHAEOLOGICAL ASSESSMENT

Whale bone has been found in at least 36 archaeological sites dating (at least partially) to the Anglo-Saxon period (AD 400–1066) with a total of 1,186 identified specimens (Supp Tab 1; Figs 1 and 5). Numbers of identified specimens per site range from just one specimen to several hundred. Especially high numbers are found at the site of *Hamwic* itself, but also at Flixborough (Lincolnshire), Ipswich (Suffolk), *Lundenwic*, York (N Yorkshire) and Prittlewell (Essex). A large range of species appear to have been exploited as well. The common bottlenose-dolphin remains exclusively derive from the site of Flixborough (Dobney et al 2007), while 57 of the 59 sperm-whale bone pieces (previously identified through ZooMS) represent gaming pieces from Prittlewell (Blackmore et al 2019). The Balaenidae specimens derive from *Hamwic* (see ZooMS results), and Dengemarsh (Kent) (Gardiner et al 1998) and are the third best represented group. The largest group of 255 specimens has merely been identified as ‘unknown

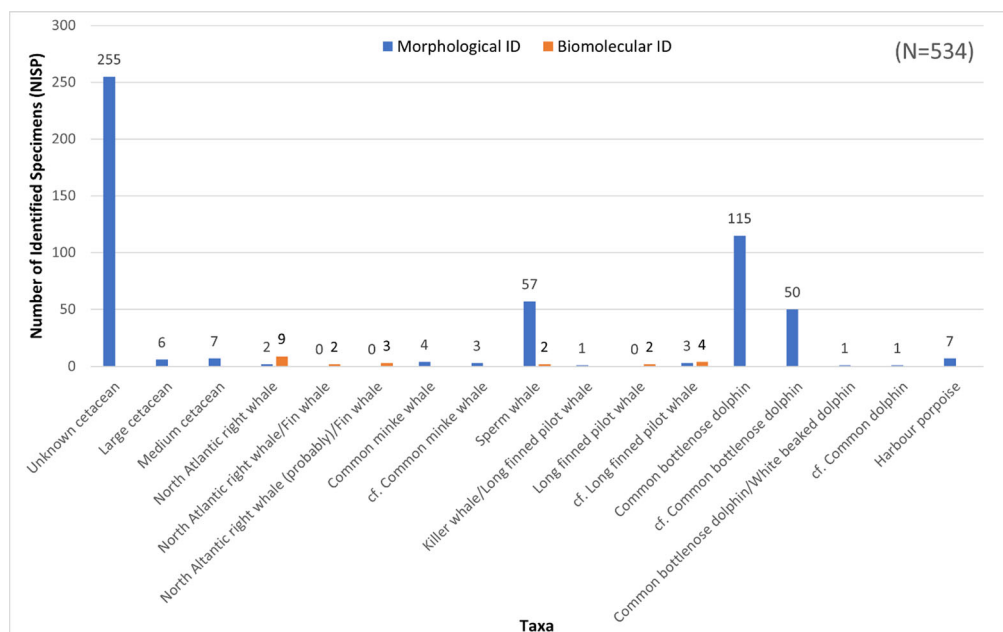


FIG 5

Number of Identified Specimens (NISP) of hand-collected cetacean specimens from all 36 sites considered. Figure by Youri van den Hurk.

cetacean', stressing the difficulties that come with identifying cetacean remains to the species level.

While *Hamwic* has produced a lot of working waste specimens, Flixborough has produced specimens of various species that have been identified as consumption waste. Among the species identified at Flixborough, the common bottlenose dolphin (*Tursiops truncatus*) is the most abundant, but common minke whale (*Balaenoptera acutorostrata*) and either long-finned pilot whale (*Globicephala melas*) or killer whale (*Orcinus orca*) have also been identified (Dobney et al 2007). Keith Dobney et al (2007) have raised the possibility that harpoons were used for hunting cetaceans in the Flixborough region, primarily targeting the common bottlenose dolphin and occasionally juvenile individuals of other species.

The site of Ipswich has provided a number of working waste specimens of whale bone highly comparable with the remains from *Hamwic*, albeit in lower quantities, dating from the Middle Saxon period up to the late medieval period (Riddler et al forthcoming). A partially burnt whale-bone clamp also derives from Ipswich, alongside a vertebral chopping block and several pieces of gaming equipment (Riddler 2014; Riddler et al forthcoming). Most recently, four specimens were identified at the site of Stoke Quay in Ipswich (Rielly 2020). There, three cetacean specimens came from the middle Anglo-Saxon period (early-8th to mid-ninth century AD) and one specimen from the late Saxon period (mid-9th to late eleventh century AD). All specimens represent working waste and likely derive from a small whale species (Rielly 2020).

Saxon *Lundenwic* (modern London) also has provided a number of whale-bone specimens. Middle-Saxon period contexts from Hare Court (Bendrey 2005) and the

Royal Opera House (Rielly 2003) have provided cetacean remains. Moreover, an 8th-century context from Bedford Street has provided a whale-bone tooth segment blank for a comb (Riddler and Trzaska-Nartowski 2013).

The site of Fishergate in York, has provided some worked whale bone as well, but all of these post-date the Saxon period (O'Connor 1991). Moreover, one sword pommel and a double-sided comb from Coppergate in York are of a probable Saxon date but ended up in later contexts (Bond and O'Connor 1999).

#### ZOOMS

ZooMS analyses were conducted on 20 specimens from the *Hamwic* site to taxonomically identify a subset of the fragmentary bone waste. The ZooMS analyses provided mixed results (Tab 1; Figs 6–8). Nine specimens were clearly identified as Balaenidae—a family which includes three right-whale species (genus *Eubalaena*), and the closely related bowhead whale (genus *Balaena*); these species cannot be differentiated with ZooMS (Buckley et al 2014). Balaenidae can be differentiated from the other Mysticeti by the presence of a diagnostic peptide at COL1 $\alpha$ 2 502–519 (Brown et al 2021; Peptide C in Buckley et al 2014) at  $m/z$  1682. Additionally, three specimens were identified as being ‘probable Balaenidae’, having spectra that were consistent with Balaenidae, however the  $m/z$  1682 was present below the signal-to-noise threshold. Finally, two specimens were identified as either fin whale (*Balaenoptera physalus*) or Balaenidae. The fin whale and the Balaenidae have similar ZooMS spectra, differentiated only at COL1 $\alpha$ 2 502–519 where fin whales present a peak at  $m/z$  1652. For these two specimens, no visible peak was present for this peptide due to poor spectral quality, making it impossible to distinguish the two taxonomic groups.

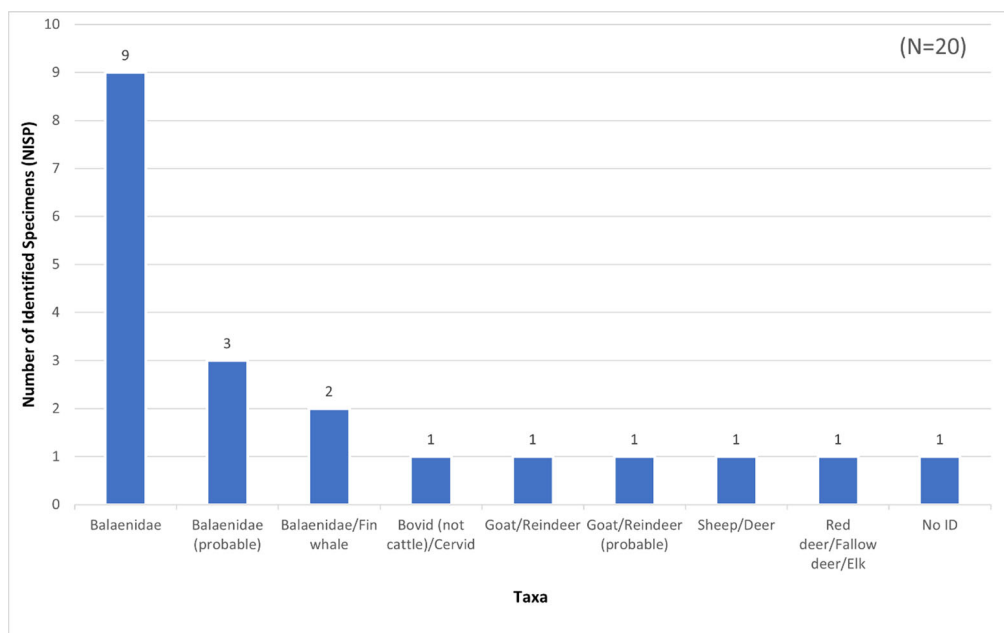


FIG 6

ZooMS identifications of the 20 specimens analysed. *Figure by Youvi van den Hurk.*



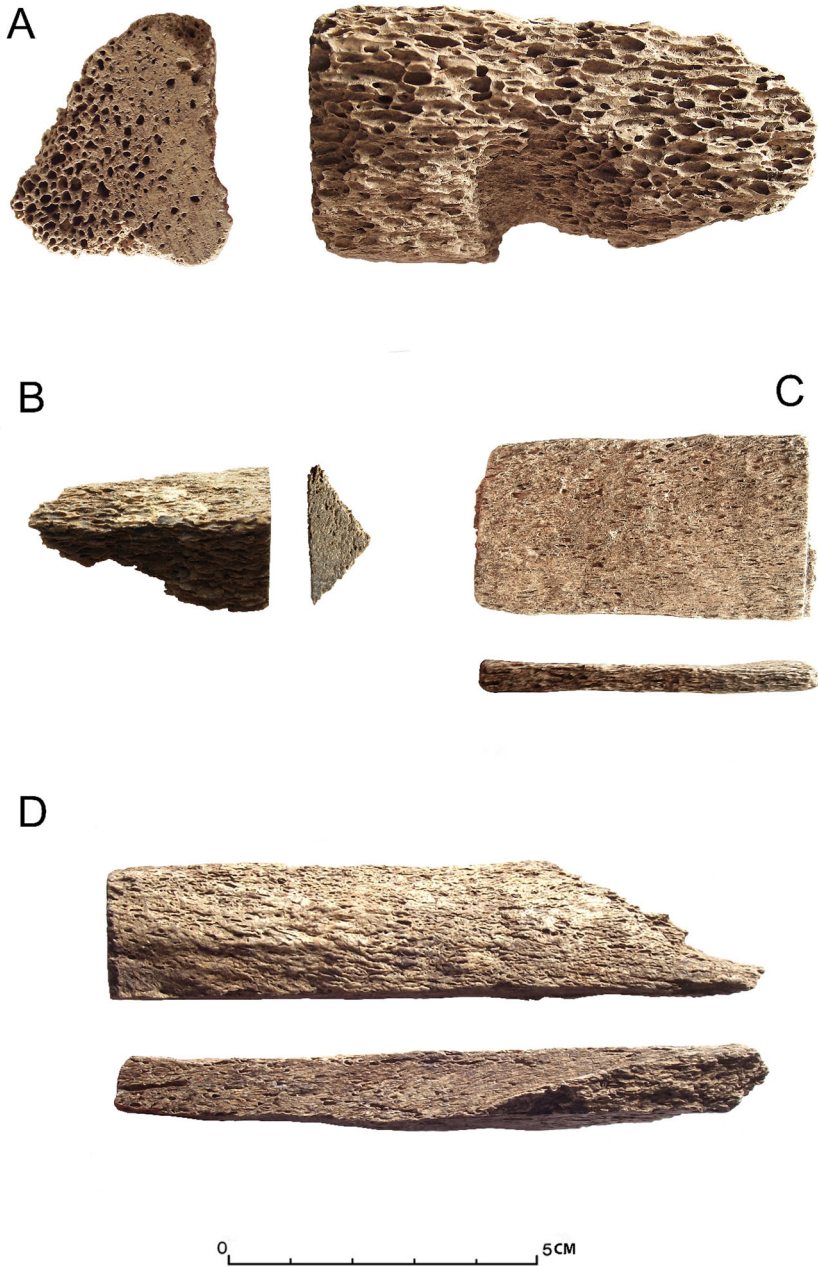


FIG 7  
Worked whale bone specimens analysed using ZooMS.  
(A) *SOU1553 F147*; (B) *SOU30 F1068*; (C) *SOU1484 F70*; (D) *SOU31 F2083*. Photograph by I Riddler.

An additional six samples did not belong to any whale species and were identified to either 'Red deer/Fallow deer/Elk', 'Sheep/Deer', 'Goat/Reindeer', or 'No ID' categories. It is likely that these specimens represent antler or horncore which are of a similar bone

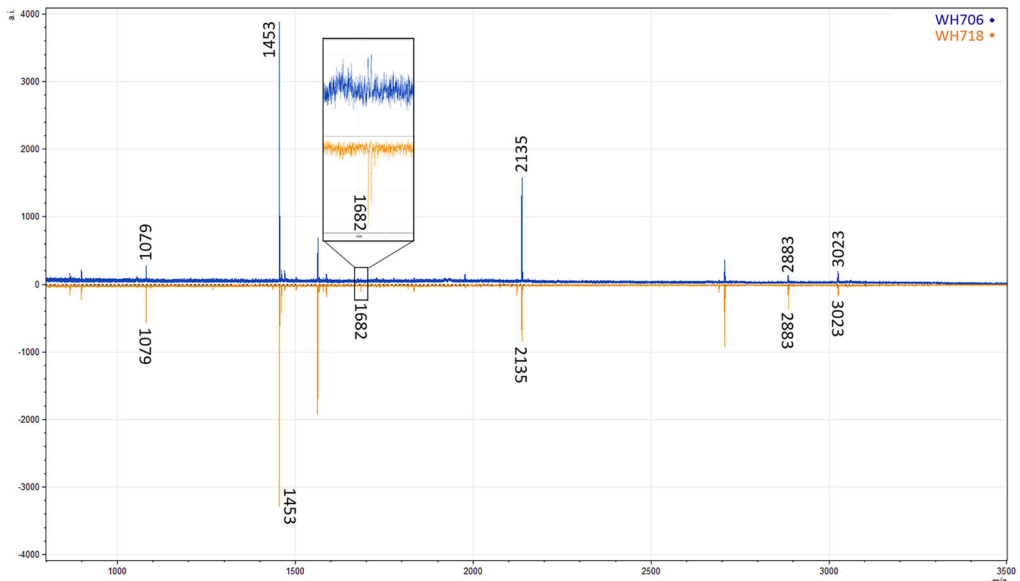


FIG 8

ZooMS spectra for WH706 (fin whale/*Balaenidae* identification) and WH718 (*Balaenidae* identification), highlighting the 1682 spectra marker characteristic for the *Balaenidae*. Note the lack of a clear peak at Peptide C for 706, making it impossible to identify the specimen as either fin whale or *Balaenidae*. Figure by Camilla Speller.

structure and can be confused with whale bone, especially when fragmented. Buckley et al (2014) also reported on this and “highlighted the ability of ZooMS to resolve this taxonomic issue”.

## DISCUSSION

The presence of at least nine *Balaenidae* specimens at *Hamwic*, identified through ZooMS, is intriguing. Based on the geographic location of *Hamwic*, it is highly probable that the *Balaenidae* specimens represent North Atlantic right whale. Other members of the family *Balaenidae*, the southern right whale (*Eubalaena australis*) and the North Pacific right whale (*Eubalaena japonica*), inhabit different ocean basins and can therefore be excluded. The bowhead whale (*Balaena mysticetus*) also inhabits the North Atlantic, but usually occurs further north in Arctic waters. The species can be found in the waters of Svalbard, Jan Mayen and Iceland but normally does not occur in northern Scandinavia (Shirihai and Jarrett 2011). It cannot be entirely excluded that an individual bowhead whale ventured to more southern waters and ended up in *Hamwic*, or that whale-bone specimens were brought to *Hamwic* as part of a trading network from more northern areas; nevertheless, the most parsimonious explanation is that the majority of the specimens represent the local North Atlantic right whale.

The North Atlantic right whale is currently critically endangered and only found in the western North Atlantic Ocean. At least a millennium of whaling has almost completely annihilated the species, but remains are frequently found in archaeological contexts along the western European coastline (Rodrigues et al 2018). The species is known

to be migratory, and the eastern North Atlantic population is known to have travelled to coastal waters off Western Sahara in winter, and migrated northwards to feeding grounds for summer (Rodrigues et al 2018). The English Channel, which *Hamwic* faces, is highly likely to have been a portion of the species' migration route, suggesting that the species was frequently present in the waters off *Hamwic*.

Although it is likely that the specimens identified as Balaenidae/fin whale actually represent Balaenidae alone, it cannot be completely ruled out that some of these specimens derive from the fin whale. In 2004, a fin-whale carcass stranded in the Solent Strait area (Sabin et al 2005). This might have happened in the past as well, with the inhabitants of the region eagerly taking advantage of this event, eventually resulting in the bone material ending up in the archaeological record at *Hamwic*. It is unlikely this species was hunted during the Anglo-Saxon period. Only by the mid-nineteenth century, after several technological advancements had been made, were rorquals (e.g. blue whale (*Balaenoptera musculus*), fin whale (*Balaenoptera physalus*), sei whale (*Balaenoptera borealis*), etc.) systematically targeted by whalers (Clapham and Baker 2018).

Two specimens dating to the later period of AD 850–900 proved not to represent whales, but other terrestrial mammals. Therefore, the vast majority of the whale bone derives from contexts dating to the period AD 670–770. Why whale bone was used especially during this period at *Hamwic*, remains unanswered. Potential explanations may be that: (1) antler might have been in short supply during this period; (2) whale bone was available in higher quantities due to active whaling practices being conducted during this period; (3) there were higher numbers of opportunistic stranding activities; or 4) due to increased long-distance trade with foreign whalers. The latter three points will be discussed here.

#### OPPORTUNISTIC SCAVENGING

The presence of the high numbers of Balaenidae (probably North Atlantic right whale) specimens make it likely that this species was present in considerably higher numbers than today, and thus stranded more frequently. Since the species is naturally buoyant and lives close to shore, it is possible that carcasses stranded more frequently than was the case for other taxa, making their skeletal remains more easily accessible. This theory is impossible to assess using modern strandings as a proxy. North Atlantic right whale numbers, as well as North Pacific right whale and southern right whale numbers, are diminished due to centuries of whaling, probably leading to a global under-representation of the family within stranding records. Moreover, modern strandings are hard to compare to historical stranding trends, due to an increase in anthropogenic causes of strandings, such as entanglement in nets and ship strikes.

Since the specimens derive from a set of spatio-temporally clustered contexts, it is possible that the whale bones derive from a single animal or handful of stranded individuals. Skeletons of whales are massive and provide large quantities of bone suitable for working. It is possible the whale-bone pieces were cut into smaller pieces and distributed and used throughout *Hamwic*. Genetic analysis of the bones might shed light on the minimum number of individuals represented by the remains. Two North Atlantic right whale skeletons with clear signs of butchery have been found at Dengemarsh, just over 150 km to the east of *Hamwic*, and dating to the late 9th-/early eleventh century AD (Gardiner et al 1998). During the Anglo-Saxon period, whales were not yet classified as

‘royal fish’ (Gardiner 1997), though based on the transcription on the 8th-century Franks Casket, it is clear that stranded whales were stripped of their valuable raw resources. This might have been the same for *Hamwic* and instead of systematically exploiting stranded whales, the whale bones might have derived from just one stranded individual.

A case study involving the use of ZooMS on medieval cetacean remains from the Netherlands and Flanders (for which it is also assumed the majority derived from opportunistically stranded individuals), also reported high numbers of Balaenidae specimens (15 out of 40) (van den Hurk et al 2022). Another case study that performed ZooMS on 167 cetacean specimens from late Iron Age-Late Norse Bornais, South Uist, Outer Hebrides, Scotland (for which it is also assumed the majority derives from stranded individuals) reportedly identified 18 Balaenidae specimens, making them the second largest group after the sperm whale (of which 66 were identified) (Evans 2021). Several other ZooMS case studies have highlighted that Balaenidae consistently make up a high, if not the highest, number of cetacean bone specimens analysed. Buckley et al (2014) reported on four Balaenidae specimens out of 20 cetacean specimens analysed from Scotland. Rodrigues et al (2018) reported on three out of ten specimens from Spain and Morocco, and van den Hurk and McGrath (2021) reported on nine out of 35 specimens from northern Scotland.

#### ACTIVE WHALING

*Aelfric’s Colloquy* and Bede’s *Historia Ecclesiastica* seem to suggest that active whaling was undertaken during the late Saxon period. The texts are, however, both problematic and probably should not be taken too literally, probably presenting inaccurate or idealised descriptions of Anglo-Saxon whaling activities (Clarke 2006; Szabo 2008). Moreover, only highly sporadic mentions of active whaling exist for later periods for England (Gardiner 1997; van den Hurk 2020), suggesting that active whaling might only have been undertaken very opportunistically.

The sites of Flixborough, *Lundenwic*, Ipswich, York, and Prittlewell have all produced highly diverse zooarchaeological cetacean assemblages, not clearly pointing in the direction of a well-developed and uniform whaling practice. It is therefore unlikely that the Anglo-Saxons performed active whaling on a regular basis. The only exception would be the site of Flixborough, for which very high numbers of small cetacean specimens clearly seem to suggest that active whaling was undertaken locally.

#### LONG-DISTANCE TRADING

The third possibility is that it was not the Anglo-Saxons who practised the whaling themselves, but that instead they relied on supplies brought by foreign traders. The ‘*IV Aethelred*’ law code makes it clear that trade in whale resources was undertaken between the Normandy region and England (Middleton 2005). Although the whale-bone material from *Hamwic* predates this law code, it raises the possibility that it did not derive from whaling activities undertaken by the Anglo-Saxons, but from whaling activities performed on the other side of the English Channel, in Normandy.

While some sources seem to suggest that whaling was conducted relatively early in Normandy, documents describing active whaling only become more frequent from the end of the eleventh century (Musset 1964; De Smet 1981; Proulx 1986). It is not clear

whether this documented active whaling had been previously undertaken during the 7th and 8th centuries in Normandy.

Trade between Normandy and the Anglo-Saxons in whale bone, whether from actively caught or opportunistically stranded whales, is a possibility. There are very close relationships in the material culture of *Hamwic* and *Quentovic*, the principal emporium of northern France, although limited interventions at the latter site have not, as yet, provided any evidence of whale bone (Oueslati 2012; Riddler and Trzaska-Nartowski forthcoming). As at *Hamwic*, a number of comb segments have been unearthed (Soulat et al 2019). None of these have been identified as cetacean, but as this study also has highlighted, species identification of worked bone is difficult. It might therefore be possible that some of these comb segments from here, as well as other regions, *are* made out of whale bone. Comb segments (as well as a large number of other artefacts and tools) recovered from Bornais, Scotland, dating to the Norse period, have also been identified as being made of whale bone (Evans 2021).

A case study by Henniuss et al (2018) on gaming pieces in Vendel and Viking-Age Sweden, analysed five gaming pieces and identified them as *Balaenidae*. Henniuss et al (2018) argued that these specimens are highly unlikely to derive from Baltic Sea waters and suggest that whale bone was a valuable raw resource exchanged through pre-urban trading routes across Scandinavia and Europe 200 years prior to the onset of the Viking Period. The identification of *Balaenidae* remains used for bone working strengthens the theory that right whale carcasses were comparatively widely available and that bone was extracted from these carcasses, traded over long distances, and used for bone working.

The high quantities of antler at *Hamwic* used for antler-working also support the notion that trade in raw materials was essential for the craftsmen of *Hamwic*, as it is unlikely that the hundreds of pieces of antler came from the direct vicinity and were instead more likely acquired through trade.

## CONCLUSION

Research on whale bones from archaeological contexts will always be met with the unsolvable enigma of whether they derive from opportunistically exploited strandings or actively caught whales. The biomolecular analysis in this study has determined that the North Atlantic right whale was the most numerous whale species recovered from archaeological contexts in Anglo-Saxon *Hamwic*. The scarce historical evidence to support Anglo-Saxon whaling activities, and pre-eleventh century Norman whaling activities, makes it likely that the Anglo-Saxons either relied on the exploitation of stranded whales or trade (with foreigners) to acquire whale bone for working. Whale bone was used for working, especially in the production of combs. It might have been a valuable substitute for antler working, but since strandings do not occur regularly and are hard to predict, and trading was probably not always an option due to the limited availability, whale bone might only have been available infrequently. Future research may consider the possibility of applying genetic analysis to the whale bones from *Hamwic* to assess whether the specimens derive from one or multiple individuals. This might shed more light on Anglo-Saxon cetacean exploitation activities.

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*Résumé*

**Pêche active à la baleine, charognage opportuniste ou commerce au long cours : analyses zooarchéologiques, paléoprotéomiques et historiques de l'exploitation des baleines et du travail de l'os sur le site anglo-saxon de Hamwic** par Youri Van Den Hurk, Ian Riddler, Krista Mcgrath et Camilla Speller

Le site anglo-saxon de Hamwic (de nos jours, Southampton, Hampshire, R.-U.) a été identifié en tant que centre majeur de travail de l'os. Outre les bois de cerfs et les os de mammifères terrestres, des quantités importantes d'ossements de cétacés ont été découvertes. Ces spécimens représentent principalement des déchets de production. L'empreinte peptidique de masse du collagène osseux a permis de déterminer que ces spécimens proviennent en majorité de la population de baleines franches de l'Atlantique Nord (*Eubalaena glacialis*), une espèce qui est, de nos jours, menacée d'extinction. Les sources historiques limitées semblent suggérer que les Anglo-Saxons ou les Normands, de l'autre côté de la Manche, pratiquaient la pêche à la baleine avant le 11<sup>e</sup> siècle. Néanmoins, la principale méthode d'acquisition d'ossements de baleine passait par le biais du charognage opportuniste et du commerce.

*Zusammenfassung*

**Aktiver Walfang, opportunistisches Plündern oder Fernhandel: Zooarchäologische, paläoproteomische und historische Analysen zur Walnutzung und Knochenverarbeitung im angelsächsischen Hamwic** von Youri Van Den Hurk, Ian Riddler, Krista Mcgrath und Camilla Speller

Die angelsächsische Stätte Hamwic (das heutige Southampton, Hampshire, UK) wurde als wichtiges Zentrum der Knochenverarbeitung identifiziert. Neben Geweih- und Landsäugetierknochen wurden auch Knochen von Walen in großen Mengen geborgen. Bei den Exemplaren handelt

es sich großteils um Arbeitsabfälle. Mit Hilfe der ZooMS-Analyse zur massenspektrometrischen Identifizierung des Fingerabdrucks von Knochenkollagen wurde festgestellt, dass die meisten dieser Exemplare der derzeit stark gefährdeten Population des Nordkapers (*Eubalaena glacialis*) angehören. Begrenzte historische Quellen scheinen darauf hinzudeuten, dass die Angelsachsen oder die Normannen auf der anderen Seite des Ärmelkanals vor dem 11. Jahrhundert n. Chr. Walfang betrieben. In erster Linie erfolgte die Beschaffung von Walknochen jedoch durch opportunistisches Plündern und durch Handel.

*Riassunto*

**Attività di caccia alla balena, ricerca opportunistica di materiale utilizzabile e commerci a lunga distanza: analisi zooarcheologiche, paleoproteomiche e storiche sullo sfruttamento della balena e sulla lavorazione delle ossa nell'anglosassone Hamwic** di Youri Van Den Hurk, Ian Riddler, Krista Mcgrath e Camilla Speller

Il sito anglosassone di Hamwic (l'odierna Southampton nell'Hampshire, RU) è stato identificato come centro di primaria importanza per la lavorazione delle ossa. Oltre alle corna ramificate e alle ossa di animali terrestri sono state ritrovate grandi quantità di ossa di cetacei. Principalmente questi esemplari rappresentano scarti di lavorazione. Mediante l'uso delle impronte peptidiche del collagene la cui massa viene determinata con spettrometria di massa (ZooMS, *Zooarchaeology by Mass Spectrometry*), si è stabilito che la maggior parte dei campioni proveniva da specie di *Eubalaena glacialis*, le cosiddette balene franche nordatlantiche, oggi ad alto rischio di estinzione. Le limitate fonti storiche sembrano indicare che gli anglosassoni o i normanni praticassero la caccia alla balena sull'altra sponda del Canale della Manica prima dell'XI secolo d.C. Tuttavia l'acquisizione di ossa di balena avveniva principalmente tramite la ricerca opportunistica di materiale utilizzabile e i commerci.