They were probably removed with the horn sheath and deposited elsewhere, as was the case at Thetford (Jones 1984 and 1993). Otherwise, all parts of the skeleton and many ribs were deposited.

Evidence of chopping up the carcass was common. Heavy chop-marks probably breaking the bone were more common than superficial, lighter cuts from filleting or carving. Chop-marks were commonest on the distal humerus and around the acetabulum of the pelvis. Chopping up of the scapula blade was frequent, though the glenoid and tuber scapulae were often not chopped. Dismemberment may have been done through the softer bone of the proximal humerus. Several humeri, radii, and metapodials seem to have been split lengthwise from one end. Rixson has observed that it is easier to cut a long bone and then split it lengthwise, to reach the bone marrow, than to chop across the thick compact bone of the shaft (pers. comm.). Vertebrae were sometimes chopped through transversely, suggesting that the spinal column was being chopped into sections.

Ageing data are shown on Table 10 (microfiche). Both mandible data and the long-bones show that few remains from calves were found. The mandible data gives tenuous evidence for later mortality during Periods III1 and III2, with nearly half the specimens in the latest stage.

The meat supply came as often from culled working and breeding animals as from young beasts. Proportions of unfused and late-fusing long bone epiphyses show little change, though there is confirmation of later slaughter in Period III2 from the vertebrae (late-fusing long-bone epiphyses: I N21, 48% unfused; III1 N9, 44% unfused; III2 N23, 48% unfused; vertebrae: I N43, 67% unfused; III1 N38, 68% unfused; III2 N42, 57% unfused).

In the latest mandible wear stage, the cement-enamel junction of M3 was above the alveolar border, *i.e.* the tooth was very worn. Absence of the second premolar was not observed. The posterior cusp of M3 was reduced or absent in four cases (I, 0 of 10; II, 0 of 1; III1, 2 of 6; III2, 1 of 7, IV, 1 of 2, counting only those M3s within mandibles) (and see Pathology).

The position of the nutrient foramen on the distal shaft was recorded. Occurrence inside the supracondylar fossa was slightly less common than outside (I, 2 inside, 2 outside; III1, 1 inside 3 outside; III2, 5 inside, 5 outside).

Measurements of the cattle bones are summarised on Table 11 (fiche). Numbers of specimens were not large enough for detailed study. There is some slight evidence that cattle from the earliest period (Period I, late ninth-early tenth century) were of good size. Most measurements fall within the range for tenth-century Thetford (Jones 1993) but some show a higher average or upper range; for example, the radius proximal breadth (mean 77.5) and metatarsal greatest length (208, 216, 223, and one at 244 but still unfused).

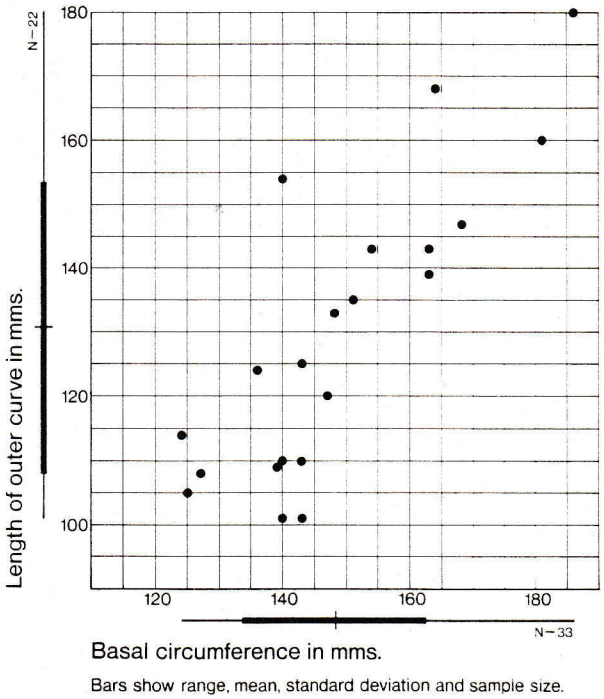
The Period I horncores included one specimen much larger than the rest and showing a forward and somewhat downward direction of horn growth as expected in bulls. The direction of horn growth of the others was forward and somewhat upward, sometimes with some torsion. One partial skull was found. Following Grigson (1976) the frontal profile showed a pointed boss and the intercornual bridge a high double arch. The two horncores were different lengths (138mm and 149mm) but with similar basal circumference (139mm, 138mm). Measurements of the Period III1 and III2 bones fall within the range for the tenth-eleventh centuries at Thetford.

There were too few measurements to attempt a metrical study of sexual dimorphism. Morphological distinctions on the pelvis suggested the presence of thirteen males and seven cows; (Periods I, 4 males, 4 cows; III2, 7 males, 3 cows IV, 1 male; VI, 1 male). More oxen than cows may, therefore, have been sent to market.

The few Period IV, late eleventh- to early twelfth-century, bones included some small specimens. Of note was a tibia with a distal breadth of only 44.4mm (I am grateful to Bruce Levitan for help with checking the identification of this bone).

The Period VI material included two deposits of cattle horncores of late medieval date. Some residual Late Saxon pottery was present, but the horncores are unlikely to be residual. They are probably waste from a horn workshop in the vicinity. High numbers of other bones, *e.g.* phalanges, which might indicate a tannery, were also found. Most of the horncores were still attached to part of the frontal bone. Some bore chopmarks on the horncore base or on the frontal bone.

The sex of the cores was not obvious, either from their morphology or their size (Fig. 23). Most showed a simple forward curve without torsion. A few showed some torsion with a forward/upward direction of growth, and one was quite tightly curved. The horncores were noticeably different from the early medieval ones from Thetford (Jones 1993, fig.167). They tended to have a larger basal circumference for a given length. Their size was less variable (*i.e.* the ranges were smaller). The mean length of the outer curve was larger, and the mean basal circumference was much greater (148.1, compared with 126.1 for tenth century and 130.4 for eleventh-twelfth century Thetford). The basal circumference was nearly always greater than the length (in 19, of 21, cases). In size, all are in Armitage's



Bars show range, mean, standard deviation and sample size.

Figure 23 14th/15th-century cattle horncores.

short group (1982, 43). Although larger than early medieval horncores from the area, they do not approach the seventeenth/eighteenth century unimproved longhorns described by Armitage.

Sheep, goat

The sheep and goat assemblage was striking for its small size, forming only 9% of the total identified bone for Period I (ninth-tenth century) and only 18% in Period VI (late medieval).

Separation of the sheep and goats for the horncore, young mandibles and metapodials is shown on Table 12 (microfiche). Goat was present in nearly every phase. The proportion of goats is highest for the horncore, but this figure may be influenced by trade in horn.

The proportion of goat from the mandibles and metapodials is still fairly high at 13%. It is higher than was found at St Martin-at-Palace, (1 of 32, Cartledge 1987) or Thetford (1 in 34 young mandibles, Jones 1993).

The proportion recorded in *Domesday* for the Norfolk demesne land was 6.1% (Darby 1971). As with the bone assemblage in general, disposal in the river-side area introduces a bias which is difficult to interpret. It is certainly possible that some goats were kept by townspeople (though there is no confirmation from, for example, finds of neonatal goat bones). Such goats would not appear in the *Domesday* accounts, which recorded only demesne holdings. The single adult mandible at stage G (Table 12, microfiche) is probably a goat; the teeth are low-crowned, the mandibular bone is relatively shallow (Rackham, pers.comm.) and the condyle is goat-like with a larger posterior facet than in sheep, probably related to the browsing habits of goats.

The anatomical analysis of the tenth-eleventh century bone (Periods III1 and III2 combined) is shown on Table 9 (microfiche). The pattern of survival and recovery of bone shows some similarities with the cattle bone of these layers. For example, the low number of maxillae with teeth compared with mandibles contrasts with the Period I deposits. Sheep bones are usually less fragmented than cattle, but the more complete bone percentages here suggest little difference, *viz.* 68%, 67%, and 76% for Periods III1, III2, and IV. Sheep bones were less fragmented in the occupation-type, Period IV assemblage. As with the cattle, long-bones often survived as one end plus a substantial length of shaft. For sheep this often consisted of zones 1, 2, 3 and 4, or 3, 4, 5, and 6. Chopping the bones to this extent may have happened after roasting, or the carcass may have been cut into pieces and boiled on the bone, which allows the marrow juices to seep into the liquid. This method is usual in modern Moslem cooking. Butchery marks where the shaft had been chopped across were quite common.

The lack of horncores observed for the cattle in the bone of Periods III1 and III2 did not apply for the sheep and goat. Both the goat horns from III1 and III2 were small, and presumably are from females. At Site 1092 in Thetford (Jones 1984) there were deposits containing cattle horncores and large, presumably male, goat horncores. At Fishergate, horn from nanny goats and from sheep of both sexes was doubtless used; most horncores bore chopmarks. The use of this horn, however, may have been less specialised.

It was noted that for all of the III1 and III2 long-bones the highest zone figure, which show the minimum number of individuals represented, was one of the shaft zones, not the epiphyses (or metaphyses). The most numerous zones were on the radius (zone 3) and tibia (zone 4).

Data on the age of death and size of the sheep and goats were too few for detailed discussion. Considerable variation in size was observed, *e.g.* two radii from Period III2 with greatest lengths of 133mm and 158mm (both probably sheep). Of the same date was a scapula larger than any from Thetford or Hamwih (Bourdillon and Coy 1980), and short-necked (see measurements). The bone bore no characteristics typical of goat or fallow deer.

The few measurements from Period VI were of small to average size in terms of the tenth-eleventh century data, that is typically small, late medieval sheep were present in the fourteenth- and fifteenth-century deposits (there is no evidence from the small amount of thirteenth/fourteenth century Period V bone).

Pig

Pig bones were nearly as numerous, and in some phases and/or methods of calculation, more numerous than sheep bones for the late ninth to eleventh century phases, declining somewhat by the twelfth century, and notably so by the late Middle Ages. Pig bones were generally in a more complete state than those of cattle or sheep, with a higher proportion of bones being recorded on the zone list (76–86% for periods I, III1, III2 and IV, compared with 60–67% for cattle and 68–76% for sheep). Comparison of the Period III1 and III2 sheep and pig bones (Table 9 microfiche) shows that, although the number of bones identified was similar, the parts of the skeleton found were rather different. For both species, bones of the main body were the most numerous, and, as with the sheep, minimum numbers based on long-bone shafts are usually higher than bone ends. For pig, however, a higher proportion is made up of bones of the head, and this is probably a consequence of the greater density and strength of the bones of the skull in the suiformes, rather than a cultural difference. The bones of the foot, in pigs, were very little fragmented, most metapodials being found as whole bones, and this in fact largely explains the difference in the zone percentage between pig and sheep. The number of right mandibles was much higher than for the left side, and although this may have arisen by chance, perhaps some customary method of butchery favoured faster disposal of one side than the other. Chopmarks were common on the mandibles, and the male canines were broken.

The age stages of the mandibles are shown in Table 10 (microfiche). Piglet was a rare delicacy: there were no early-stage mandibles and only one very immature bone in Periods II–III2. Half the jaws were from pigs more than about eighteen months old. No overcrowding of the jaws was observed.

Measurements are similar to those at Thetford and there were no very large pigs from Period VI comparable to the large specimens of fifteenth- to sixteenth-century date from Thetford (Jones, 1993).

Other mammals

Horse bones were very few and all adult. A horse pelvis from Period I was chopped through the iliac, ischial and pubic shafts. Dog and cat were also scarce, and gnaw-marks on the bones were uncommon. Cat and dog bones do seem to be more common in areas of occupation (*e.g.* Thetford, Jones 1993) but it might have been expected that

horse remains would have been better represented in the marsh deposits.

Of note was a dog ulna which was chopped transversely on the upper shaft on the radial groove, as if the radius had been chopped through at this point (Period III2). Perhaps a dog radius would have been useful in bone working?

House-mouse (*Mus musculus*) and rat, probably black rat (*Rattus* cf. *rattus*) were found only in sieved samples. They were present in Periods IV and VI (late eleventh-twelfth century and late medieval).

Bird

Both fowl and goose were present in the late ninth-early tenth century Period I deposits. The largest group of bird bones was from Period IV (late eleventh-twelfth century), nearly all of them poultry, but including also teal (*Anas crecca*) and woodcock (*Scolopax rusticola*). Of the fowl and goose bones, 27% were goose in this period, which compares with 26% (N135) and 29% (N235) at Thetford for the tenth century and eleventh-twelfth century (Jones 1993). Knife marks were observed on the distal femur and distal tibiotarsus of fowl. As at Thetford, variation in size was considerable, some being as small as a modern bantam (*e.g.* as illustrated by Cohen and Sergeantson 1986).

Pathology

Cattle

MANDIBLE (III2, eleventh century); M_3 lacks the posterior cusp; in consequence, the posterior part of the upper tooth has not been worn down, causing deep wear on the distal part of the lower tooth and reduction of the mandibular bone behind the tooth.

VERTEBRA (III1, tenth/eleventh century), thoracic. One of the facets at the base of the spine is reduced in size. There is a round depression 8x6mm above the facet, 2.8mm deep, which may be an abscess cavity.

RADIUS (I, late ninth/early tenth century), proximal fused, distal unfused; abnormal proliferation of the periosteal bone (26x15mm) on the ulnar groove, mid-shaft (the ulna shaft is not fused to the radius).

PELVIS (III1): area 18x7mm of eburnation on the pubic part of the acetabulum. The morphology of the bone indicates a male.

PELVIS (III2): three further specimens with similarly-placed eburnation and with some degeneration (pitting) of the articular surface, but without proliferation of the bone around the joint. The bones were too fragmentary to judge their sex.

METATARSAL (I): a rounded swelling 18x22mm on the lateral shaft, with a central depression 5x2mm, 1.9mm deep (bone cavity normal).

METATARSAL (I): distal end; eburnation, grooving and some destruction of bone on the external part of the medial condyle, affecting an area 16x7.5mm.

METATARSAL (III1): similarly placed area, 19x10mm of polish and grooving with alteration of the bone around the articulation.

METATARSAL (III1), proximal end: almost complete disorganisation of the proximal facets, but apparently without fusion to the tarsal bones; much surrounding bone alteration.

Most of these pathologies are of the joints, and of these all affected the hind limb. They are probably stress and/or age-related.

Sheep, Goat

MANDIBLES. Periodontal disease was not observed. In one mandible (III1, tenth-eleventh century) P4 and M1 were strongly angled and the anterior half of M1 was worn away.

METACARPAL (III2, eleventh century); healed fracture of the proximal shaft, set at a slight angle, with swelling of the bone, and nodules of extra bone ventrally.

Pig

METATARSAL IV (III2, eleventh century): gross enlargement of the shaft. The bone cavity has probably also suffered alteration. The alteration suggests a localised or systemic infection.

Pathologies suggesting injuries to the foot in pigs were observed at Thetford in tenth/eleventh-century deposits (Jones 1984 and 1993) providing circumstantial evidence of sty husbandry.

Goose

1st phalanx, pes (IV, eleventh/twelfth century): extensive patches of periosteal, porous extra bone.

Cattle, sheep and pig from Norwich

Figure 24 shows the proportions of the bones of the three main species (the total of identified fragments) for three recent sites in Norwich: at Fishergate, just north of the River Wensum; Whitefriars, on the south bank (Cartledge 1983); and the Magistrates' Courts site, also on the south bank (Cartledge 1987).

Comparison of the early medieval groups from Fishergate and Whitefriars demonstrates variation within the city, with cultural and/or depositional differences giving higher percentages of cattle at Fishergate. Proportions of pig and sheep are much less contrasting with pig numbers quite close to, or equalling, sheep in most groups.

In the Norfolk *Domesday* record, the amount of woodland in the more densely settled south-eastern part of the county was low, contrasting with the higher records of woodland in mid-Norfolk. This latter area includes North Elmham where pig bones recovered from excavations amounted to between 23 and 32% of the bone assemblage (Noddle 1980).

'Curiously enough, the village with the largest amount of wood was in (the) eastern part of the county; Thorpe next Norwich had wood, sufficient to support 1200 swine (folio 137b),' (Darby 1952, 127). It is possible that Thorpe could therefore have been used for the keeping of pigs specifically to meet the needs of Norwich.

III. Fish bones

by Alison Locker

Introduction

The fish bones from Fishergate were all recovered from sieved samples (including some very small samples from localised fish-bone concentrations) except for contexts *20* and *94*, which are shown in Table 13. Only identifiable bones are included.

748 bones were identified to species or group level and the following taxa were identified; Elasmobranch indet., spurdog (*Squalus acanthias*), ray indet. (Rajidae), eel (*Anguilla anguilla*), herring (*Clupea harengus*), cf. smelt (*Osmerus eperlanus*), bream (*Abramis brama*), Cyprinidae, cod (*Gadus morhua*), haddock (*Melanogrammus aeglefinus*), whiting (*Merlangius merlangus*), sandsmelt (*Atherina presbyter*), stickleback (*Gasterosteus aculeatus*), scad (*Trachurus trachurus*), cf wrasse (Labridae), mackerel (*Scomber scombrus*), plaice (*Pleuronectes platessa*) and flounder (*Platichthys flesus*). The terms 'large and small gadoid' were used for bones not specifically identified that probably belong to the cod family.

Period II

A 1kg sample was taken from context *90* (the fill of a linear feature). In this feature a whiting articular was from a fish of approximately 29cm in length, the lower end of the normal size range of 30–40cm (Wheeler 1978, 153). The remaining whiting bones were vertebral centra. Herring,

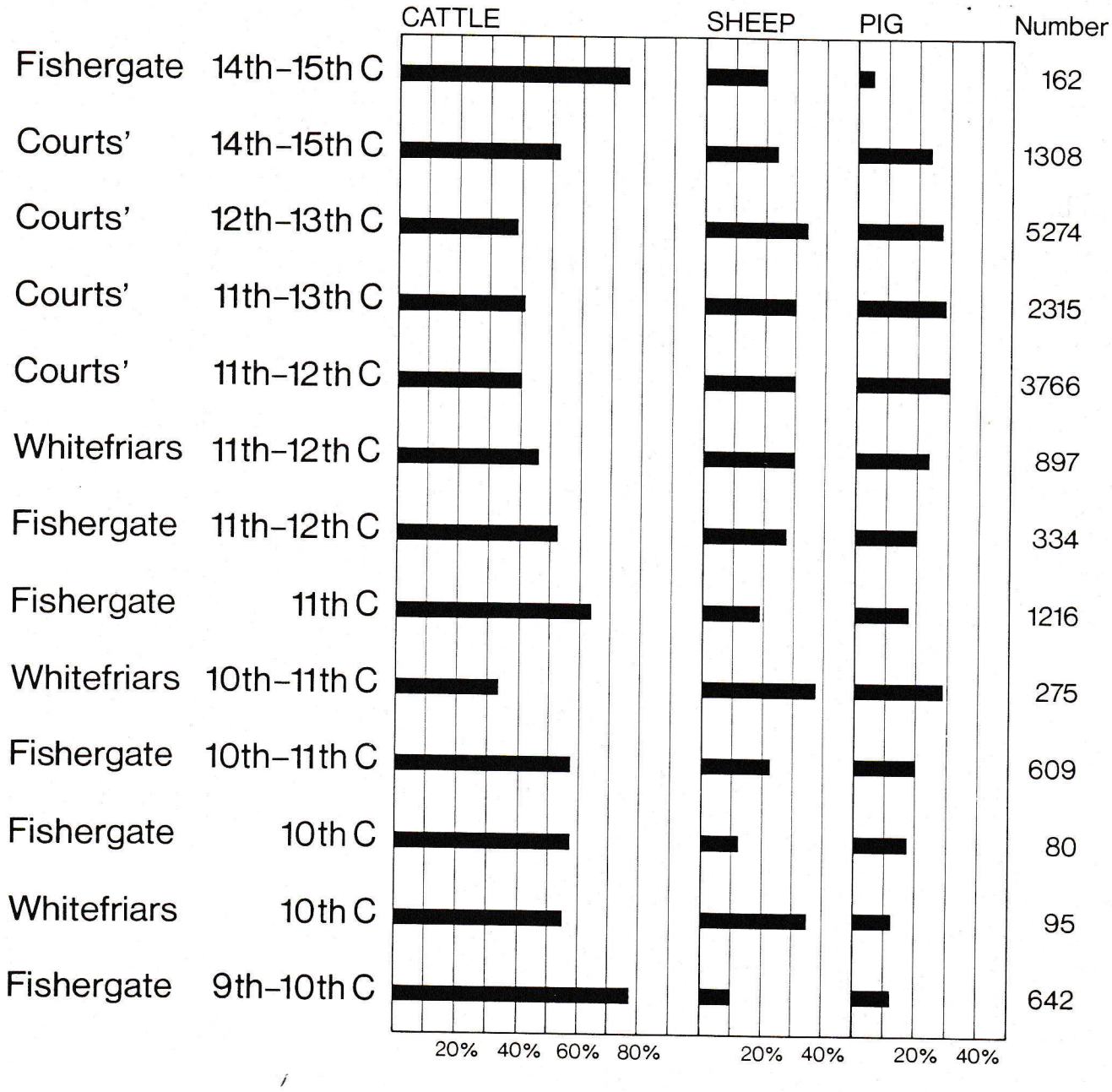


Figure 24 Cattle, sheep and pig from Norwich.

the most commonly occurring species throughout all periods, was identified from nine vertebral centra and an operculum fragment. Mackerel, eel and plaice were identified from vertebral centra.

Period III1

In Period III1, of tenth/early eleventh century date, some sixty-five fish bones were identified from six different contexts of variable sample size ranging from 1kg to 150 gm. These indicate a variable density of fish bone since the smallest sample was from context *111* which contained the most fish. Herring is again the most numerous species with ray, eel, cod, whiting, scad, mackerel and plaice occurring in small numbers.

Period III2

In Period III2, of eleventh century date, contexts *20* and *94* are the only unsieved contexts shown on the table and have a depleted fish assemblage represented by a herring dentary, a bream pharyngeal and a cod vertebral centrum (excluding six indeterminate branchiostegal and fin rays) from *20* and one whiting otolith from *94*. Context *78* was a homogeneous thick deposit, from which 70 litres of material was sieved, producing the largest sample and greatest number of fish species for the site. Herring is again the most numerous species, although a large number of eel bones was also identified. Some small flounder bones include a pair of dentaries, a premaxilla and a preoperculum, which may be from a single fish of under 15cm in

Period	II	III1						III2			IV			VI		
Context	90	95	96	99	108	111	121	20	78	94	51	52	55	162	163	Total
Elasmo	-	-	-	-	-	-	-	-	4	-	-	-	-	-	1	5
Spurdog	-	1	-	-	-	-	-	-	-	-	1	-	-	-	-	1
Ray	1	2	-	-	-	-	-	-	4	-	-	1	-	-	-	6
Eel	10	2	3	1	8	20	1	-	179	-	-	2	-	5	-	189
Herring	-	-	-	-	-	-	-	1	239	-	-	8	65*	1	1	360
cf Smelt	-	-	-	-	-	-	-	-	23	-	-	-	-	-	-	23
Bream	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1
Cyprinid	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1
Cod	-	-	-	-	-	3	-	1	24	-	-	1	9	-	-	38
Haddock	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	2
Whiting	5	-	2	-	-	-	-	-	1	1	-	-	-	-	-	9
Lge Gad	-	-	-	-	-	11	-	-	4	-	-	-	-	-	-	15
Sm Gad	2	-	-	-	-	1	-	-	-	-	-	-	-	-	1	4
Sandsmelt	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	2
Stickleback	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1
Scad	-	-	-	1	-	-	-	-	2	-	-	-	-	-	-	3
cf Wrasse	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1
Mackerel	7	-	-	-	-	1	-	-	11	-	-	-	-	-	-	19
Plaice	4	-	-	5	-	1	1	-	32	-	-	-	-	-	-	43
Flounder	-	-	-	-	-	-	-	-	13	-	-	-	-	-	-	13
Flatfish	-	-	-	1	-	-	-	-	11	-	-	-	-	-	-	12
Total	29	5	5	8	8	37	2	3	554	1	1	12	74	6	3	748

Lge Gad = Large Gadoid; Sm Gad = Small Gadoid; * = inc 57 fin rays from same fin

Table 13 Fishbones.

length. A cod dentary was estimated to be from a small immature fish of around 35cm (using Wheeler and Jones 1976). Most of the species identified from this deposit were probably eaten except the stickleback and sandsmelt, which may have been caught incidentally, or represent the stomach contents of other larger fish.

Period IV

Three contexts in Period IV (eleventh/twelfth century) contained fish bone. Context *51* produced a spine of spurdog, the only record of this species from the site. Context *52*, a dumped layer from which 1kg was sieved, had ten herring bones, one cod, one ray and two eel. Context *55*, a gully fill, from which 100gm was sieved, contained sixty-five herring bones of which fifty-seven were fin rays from the same fin. Nine cod bones were also found amongst the hand-collected bones, including a premaxilla from a fish of approximately 95cm total length.

Period VI

In Period VI, the fills of a barrel (dated to the thirteenth century onwards), *162* and *163*, produced nine fish bones including elasmobranch, herring, eel and a bone attributed to the small gadoid group.

Fishing methods

Although the number of identified fish bones is not very large and at least half are herring, the other species present are sufficiently numerous to suggest a variety of fishing methods. Norwich is less than 20 miles from Great Yarmouth on the coast, so a wide range of marine fish would have been available in the medieval period. This has also proved to be the case at other Norwich sites such as the Magistrates' Courts (Locker 1987), where much larger samples of fish were identified from deposits of tenth to fifteenth-century date. Herring was the most numerous species at the Magistrates' Courts also, and at this site the range of the less commonly occurring species is similar to that from Fishergate.

The large number of herring bones draw attention to the importance of the herring fishing industry which flourished during the thirteenth and fourteenth centuries, Great Yarmouth being an important port from which the fleets set out. The fish could be salted, pickled or smoked, providing a continuous source of protein, not just confined to the fishing season.

Offshore line fishing would have caught cod and haddock. Whiting were netted and occur in shoals in inshore waters. Mackerel and scad both form large surface shoals and could have been caught on lines or in nets. The other marine species would have been caught close to the shoreline. Spurdog, rays and flatfishes could be caught on lines on the bottom, or the latter were often trapped at high tide on the shoreline.

Smelt are coastal/estuarine fish which enter fresh water to spawn. They are a seasonal catch and can be netted in large numbers. Smelt were also identified from the Magistrates' Courts. Similarly eels can be trapped in freshwater or estuaries as they migrate to the sea.

The only freshwater species to be identified is bream, found in slow flowing rivers and ponds, but an indeterminate fragment of cyprinid pharyngeal was also found.

This small collection of fish bone from Fishergate is of value in adding further to the data from other sites in Norwich regarding the availability and consumption of fish during the medieval period.