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Ancient Monuments Laboratory
Report 56/95

THE FISH BONE FROM LAUNCESTON CASTLE, CORNWALL

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Summary

A total of 6861 fragments of fish bone have been identified from Launceston Castle in Cornwall. Fish bones were present in layers ranging from 1068 AD to 1939 AD but the majority came from two periods; the late 13th century and the 15th century.
The most commonly represented species in all periods was hake (Merluccius merluccius) and this species is studied in detail. A modern comparative group of hake is used to see if any relationship between bone dimension and total length of the fish can be established. Processing techniques are looked at and it is concluded that hake were the 'stockfish' of the Cornish fishing industry, and that the assemblage at Launceston reflects a local fishery. The presumed high status of the castle is reflected only in the exploitation of a few rarities such as a very large flatfish. However, as the staus of the castle declined the proportion of fish also declined.

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Introduction

Launceston Castle is situated in north-eastern Cornwall, just over the border with Devon. The town of Launceston is located on the River Kensey and is 14 miles from the nearest coast (Albarella and Davis 1994). Construction of the castle began immediately after the Norman conquest, and the castle remained in use until the 1840s when the grounds were converted into a public park. The castle was excavated between 1961 and 1982 by Andrew Saunders (Saunders 1973). The mammal and bird bones have been studied by Umberto Albarella and Simon Davis (1994) and this report concentrates on the 6861 fragments of fish bone recovered during excavation. The nature of the assemblage will be studied to see if the presumed high status of the castle is reflected in the species exploited. The source of the fish will also be considered to determine whether the fishery was local. The size of the fish will be determined, where possible, and processing and storage methods discussed.

A brief historical outline is given below including the periods assigned during excavation and used in this discussion of the assemblage.

Historical outline (Albarella and Davis 1994)

c1067: Probable date of construction to put down a revolt against William the Conqueror. The town was also established.

Late 11th-12th centuries: A period of stable and intensive consolidation and building. The internal structures, initially built of timber, were reconstructed using stone foundations. Local culture was being fused with new fashions brought in by an alien military aristocracy.

1227-1272: Richard of Cornwall was granted the earldom of Cornwall by his elder brother King Henry III. This marks the high point in the castle's history. Richard was among the wealthiest and most powerful men in the kingdom. He reorganised and rebuilt the castle and constructed a new great hall.

1272: Death of Richard of Cornwall. His son Edmund moved the kingdom's administration to Lostwithiel, closer to the regions of tin production, which marks a decline in the importance of Launceston. In 1337 it was noted that the castle walls were in ruins and the buildings in a state of neglect.

1341: Repairs of the castle were initiated which appear to have continued throughout the 15th century. The castle increasingly takes on a function of administering justice.

1539: Visit of Leland who mentions the "hall for syses and sessions".

1642-1649: (Civil War): Town and castle held for the King except for two occasions and finally captured by Fairfax's army in 1646. Despite some repair of the castle defences, a 1650 parliamentary survey indicates that only a small part of the castle remained habitable, and that the defences were in a state of decay and buildings had disappeared.

18th century: The constables lodgings and the north tower were demolished in 1764 and at about this time much of the area was landscaped. The prison remained in use until its demolition in 1842. It consisted of three cells for women and four for men with an apartment for the governor. Within the castle there were pigsties and cabbage plots. Hangings were carried out in the bailey, the last of which was in 1821.

1840s-1939: The transfer of the assizes to Bodmin 1840-1939 led to the demolition of the gaol and the conversion of the castle into a park.

The following publication periods were designated:

Period 1	1068-1075
Period 2	1075-1104
Period 3	1104-1175
Period 4	1175-1227
Period 5	Mid 13th century
Period 6	Late 13th century
Period 7	14th century
Period 8	15th century
Period 9	16th century-1650
Period 10	1660-1840
Period 11	1840s-1939
Period 12	1944-present

Data from periods 10 and 11 have been combined as bones from period 11 are presumed to be residual from period 10 (Albarella and Davis 1994).

Method

Selected elements were identified to species where possible using the comparative collection of the Faunal Remains Unit at the University of Southampton. The sea breams (Sparidae) were identified by Sheila Hamilton-Dyer who also advised on other identifications where necessary. The selection of elements to be identified was based on their robusticity and diagnostic features. The list below details those bones which were selected:

vomer
premaxilla
maxilla
dentary
articular
quadrate
hyomandibular
parasphenoid
pharyngeal
opercular
ceratohyal
basioccipital
cleithrum
post temporal
first precaudal vertebra (atlas)
precaudal vertebra
caudal vertebra
ultimate vertebra

The side was recorded in the case of the dentary, articular, maxilla and premaxilla. Other elements were recorded as midline where appropriate. The side was not recorded for the remaining elements as determination of this would have been too time consuming.

The completeness of each identified bone was recorded using the following categories:

complete bone
<100 % >75 % present
< 75 % >50 % present
< 50 % >25 % present
< 25 % present

Post-mortem detail such as carnivore damage, erosion and burning was also recorded as was any evidence of butchery.

Selected measurements were taken, these are shown in table 1.

Species present

A wide variety of fish was found at Launceston Castle with 26 different species represented (table 2). Hake (*Merluccius merluccius*) were the most common fish found across the whole site in all periods. Conger eel (*Conger conger*), cod (*Gadus morhua*) and whiting (*Merlangius merlangus*) were also found in reasonable numbers. Other species can best be described as occasional finds as their occurrence was erratic and numbers low.

As Launceston Castle is 14 miles from the nearest coastline and all fish were brought to the castle from a distance, an interesting line of enquiry will be the processing methods employed prior to transportation to the site, and the possible trade routes employed.

The assemblage

Albarella and Davis (1994) consider that the standard of recovery was comparable throughout all periods as the proportion of loose mammal incisor teeth compared to the other mammal teeth remains similar. However, although the hand recovery was of a similar standard throughout all periods there is no information available about sieving on site.

Some samples were taken from all periods, but the number of samples taken and the mesh size used to sieve them is not known. This poses a particular problem with the interpretation of an assemblage of fish bones as it is not clear how much the relative numbers of different species may be masked by different methods of recovery across the site. In an attempt to clarify possible biases the distribution of hand recovered fish bones through time was compared to the distribution of bone retrieved from the sieve (figures 1 and 2). The overall pattern is similar with the majority of fish found in periods 6 and 8. No hand retrieved fish bone was found from period 3.

The distribution of hand recovered fish bone was then compared with the distribution of hand retrieved mammal and bird bone by period (figure 3). Most bone of all classes came from periods 6 and 8,although period 6 yielded the largest number of fish bone, whereas period 8 produced the greatest number mammal and bird bone. Periods 9 and 10 differ in that they contained a moderate amount of bird and mammal bone but very little fish.

When the species found in the sieved and unsieved material are compared (figures 4 and 5) it can be seen that the overall pattern is similar. Whiting was mostly found from sieved material as were eel and herring. This would suggest that these species are under-represented across the site. However, broadly speaking the assemblages are similar.

Albarella and Davis (1994) point out that mammals increase in number through time relative to both birds and fish. This decline in the number of fish bones is particularly marked in periods 9 and 10. Albarella and Davis suggest that this reflects the demise in the aristocratic use of the castle and its increasing tendency to become part of the town (1994 p34)

Due both to the small quantities of fish bone from all periods other than 6 and 8, and the lack of detailed knowledge of the sampling strategy employed, it is difficult to make any meaningful comments about changes in the exploitation of fish through time. Periods 6 and 8 can be compared and this report will focus on these two periods. A summary of the material found from all periods can be found in tables 3 - 12.

Description of the assemblage

Period 6 (late 13th century)

The majority of fish bones recovered were from this period. Hake was the most numerous species both from the sieve and the hand recovered material. Conger eel, whiting and cod were present in smaller numbers and a variety of other species were present (figure 6). The majority of whiting bones were recovered from the sieved samples and this species may be under-represented.

The minimum number of individuals has been calculated for the four most abundant species (table 13). A straightforward count of the most frequent element where side had been recorded was made. Size was not taken into account during this calculation. Hake are still the most common species but the difference between hake and the second most common species (Conger) is reduced. Conger eel head bones are very robust and may have preferentially survived.

When the elements present are studied, for all species, there appears to be a gap in the skeleton. All species are well represented by vertebrae (both caudal and pre-caudal) and bones from the front of the head (the dentary, articular, premaxilla and maxilla). However, those bones from the neurocranial region and the junction between the head and neck are under-represented. There are two possibilities to account for this pattern: either these latter bones are less robust and have therefore not survived, or they are less easily identifiable to species than other elements. However, bones such as the cleithrum, which are missing from this assemblage, are distinctive to species and unlikely to have been placed in the 'not further identified' fraction. Cleithra are also fairly robust bones and may be expected to survive reasonably well, although other elements which are poorly represented such as the opercular series are fragile. This question will be discussed in more detail later in this report.

Very little evidence of butchery has survived. Only 29 fragments were recorded as cut or chopped (table 14).

Period 8 (15th century)

This is the only other period to have a significant number of fish bones. Hake, cod, conger and whiting again dominate the assemblage and there is little evidence of any significant change in the species exploited at Launceston (figure 7).

The limited range of skeletal elements noted for period 6 is also in evidence for this period (table 15).

Only four bones bear any evidence of butchery, two conger eel dentaries and two flatfish anal pterygoids had been chopped.

Hake size

The assemblages from both periods yielded sufficient measured bone to enable a fairly detailed study of size to be undertaken. Two aspects of fish size have been studied. First, an estimate was made of the total length (TL) of the fish in order to see whether this shed light on the source of the assemblage or the processing method used. Second, the vertebrae were looked at to see if the measurements demonstrate that all precaudal vertebrae were present or whether any evidence of processing techniques can be noted.

A sample of 20 modern hake of known total length (TL) was available. Those measurements which had been taken most frequently on the archaeological material were reproduced on the modern material. The measurements were, the greatest height of the premaxillae, the width of the ascending ramus of the premaxillae (M4), the greatest breadth of the anterior end of the dentary (M5), the greatest breadth of the articular surface of the articular and the greatest height and greatest breadth of the basioccipital (Morales and Roselund 1979, Hamilton-Dyer pers comm).

Using the total length of the fish as the dependent variable, regression equations were derived for each of the measurements to determine the degree of the relationship, if any, between the bone dimensions and the total length of the fish. Regression was carried out using Quattro Pro (Borland International Inc.), and the resulting regression equations and coefficients of determination (Shennan 1988, p130) are as follows:

Measurement	Factor	r^2
Premaxilla GH	TL=(GH x 56.70) + 49.96	0.95
Premaxilla M4	TL=(M4 x 63.84) + 7.73	0.94
Dentary M5	TL=(M5 x 88.15) - 30.55	0.87
Articular GB	TL=(GB x 93.10) + 111.97	0.95
Quadrate GB	TL=(GB x 85.36) - 0.12	0.89
Basioccipital GH	TL=(GH x 75.60) + 80.22	0.95
Basioccipital GB	TL=(GB x 51.72) + 159.67	0.98

This would indicate that there is a relationship between the measurements taken and the total length of the fish.

The results of the regression analysis were applied to the archaeological material from Launceston. and the TL was calculated where possible. The frequency distribution of these lengths was then plotted for the premaxilla (GH and M4), dentary and articular (figures 8, 9, 10 and 11). There were insufficient data to produce such a graph from the measurements of the other elements. Absolute figures have been plotted and the raw data can be found in table 16.

The smallest predicted TL is 371 mm from the dentary and the greatest is 1207 mm from the premaxillae (M4). However, there is a concentration between 800 mm and 1000 mm from all elements except the dentary. This suggests that the some size selection took place.

The lengths obtained from the dentary are generally smaller than those obtained from other elements. The relation between the measurement taken from the dentary on the modern specimens and the TL of the hake was the least reliable and the number of observations the lowest. It would seem most likely that the smaller lengths obtained from the dentary are as a result of the weakness of the relationship between the measurement and the TL of the fish.

The measurements from the precaudal vertebrae of hake were also studied to see if it was possible to test whether the entire vertebral column was present. The height of each vertebra was divided by the breadth and the results plotted as a frequency graph for both periods 6 and 8 (figures 12 and 13). The frequency graph was compared to that obtained from four modern specimens (630 mm, 420 mm, 749 mm, 430, figures 14, 15, 16 and 17). The graph from Launceston was skewed to the left compared to the modern data, suggesting that there was a lack of vertebrae with small breadth compared to height. This may be affected by the TL of the fish as the two smaller modern specimens do have some vertebrae towards the left of the graph. However, the estimation of the TL described above suggests that most of the hake were larger than the comparative specimens, so this bias would not necessarily affect the assemblage. The precaudal vertebrae of hake vary in shape, from flat near the neck to long near the abdomen. The shape of the frequency graph suggests that the vertebrae near the head are under-represented. This, coupled with the absence of head bones from the back of the head suggests that there is a real absence of part of the fish skeleton.

Other fish size

There was insufficient modern comparative material for other species to carry out a similar exercise and an inadequate number of hake from any other period. The metrical data for all other species is presented in tables 17 - 22. The range of measurements from all species is limited, which suggests that there was some selection of all fish with regard to size.

Incidental species

The assemblage at Launceston was dominated by hake, conger eel, cod and whiting. However, a wide range of other species was also present throughout all periods. These are described below.

Spurdog (*Squalus acanthias*)

Only three fragments identified, two from period 6 and one from period 10. All three fragments were spines which, as the species is cartilaginous, is not surprising. Spurdogs inhabit shallow water and are relatively easy to catch (Jones and Wheeler 1989 p86) thus they may have been taken by line by local fishermen rather than forming part of the larger scale trade in fish. The spines survive well and the low number of this species represented is probably an accurate reflection of the situation rather than a reflection of survival.

Ray (*Rajidae*)

Eight rays were recovered from period 6 and one from period 8. There are a variety of species of this cartilaginous family and it was not possible to say which of these were present at Launceston. The family was represented by bucklers and vertebrae. The most common species, thornback ray or roker (*Raja clavata*) is more usually caught today by trawling but it is possible to catch them by line fishing.

Sturgeon (*Acipenser sturio*)

Two fragments of scutes from sturgeon were retrieved from period 8. Neither of the fragments was complete enough to make any inference as to size, so it is not possible to infer whether the fish were caught being spawned in a river or later in their life-cycle from the sea.

Herring (*Clupea harengus*)

Ten caudal vertebrae of herring were retrieved from period 6. If this is a true reflection of the number of fish at Launceston rather than a result of preservation or retrieval, then it would appear that herring did not form a major part of fish consumption at the castle.

Salmon (*Salmo salar*)

Five fragments of salmon were recovered, four from period 6 and one from period 5. Again it is not possible to say at which point in the life cycle the fish were caught.

Eel (*Anguilla anguilla*)

Five eel vertebrae were recovered from period 6. All were retrieved from the sieve and the same caution must be applied when interpreting the relative importance of this species as that discussed for the herring.

Pollack (*Pollachius pollachius*)

Only one fragment of pollack, a premaxilla from period 6, was positively identified.

Saithe (*Pollachius virens*)

Three fragments of saithe were recovered from period 6, all were premaxillae.

Haddock (*Melanogrammus aeglefinus*)

The only haddock bone is a vertebra from period 3.

Ling (*Molva molva*)

Twelve fragments of ling were recovered from period 6 and two from period 8. Twelve of these are vertebrae and two articulars. Ling are now usually caught by lines (Wheeler 1978).

Scad (*Trachurus trachurus*)

Two vertebrae of scad were recovered from period 6. Wheeler (1978) makes the point that scad today is not an important food fish for humans, but is important for several other fishes and sea birds.

Bass (*Dicentrarchus labrax*)

One vertebra of bass was identified from period 10.

Sea bream (*Sparidae*)

A total of 54 bones of sea bream was identified from periods 3, 6, 8, 9 and 10.

Couch's sea bream (*Sparus pagrus*)

Four fragments of this species were identified from period 6 and 8 from period 8. Only one vertebra was recovered, the rest of the bones coming from the head. Wheeler (1978) suggests that couch's sea bream are rare today in northern Europe.

Red sea bream (*Pagellus bogareveo*)

One dentary and one premaxilla of this species were found from period 6. The species is occasionally caught today by anglers.

Gilthead bream (*Sparus aurata*)

Ten fragments from period 8 and one from period 9 were identified to this species. All were vertebrae. Wheeler again suggests that this species is rare in northern waters.

Sea breams are rarely found on post Roman sites (Hamilton-Dyer 1993) and their presence at Launceston may reflect a period of warmer sea temperature as they, along with wrasses, are directly influenced in their migration routes by sea temperatures. The consistent, low level presence of the sea breams suggests sufficient 'good years' for a number of the species to be present at Launceston.

Wrasse (*Labridae*)

Twelve fragments were identified from periods 6 and 8.

Ballan wrasse (*Labrus bergylta*)

Four fragments were recovered from period 6 and one from period 8. Wheeler (1978) suggests that the wrasses are of little food value today so it is interesting to see that they were considered worth transporting to the castle. Wrasse are affected by sea temperature and suffer badly during bad winters thus rendering the potential catch very low (Hamilton-Dyer 1993), so in a local fishery the occasional presence of wrasse may reflect an interest in an unusual fish present in good summers.

Mullet (*Liza sp.*)

One vertebrae was recovered from period 9.

Mackerel (*Scomber scombrus*)

One mackerel vertebra was recovered from period 8. In view of the major importance of the mackerel fisheries today, it is interesting that there is no evidence of it at Launceston. Survival and retrieval of the bones may be a factor here or mackerel may have been imported as fillets.

Gurnards (*Triglidae*)

A total of 55 fragments were identified from periods 4, 5, 6 and 8. The relative importance of these species may be over emphasised because the bony plates from the head are very distinctive and prone to fragmentation.

Grey gurnard (*Eutrigla gurnardus*)

Twenty four fragments were positively identified to this species; one from period 4, 17 from period 6 and 6 from period 8. One premaxilla, and one vertebra were identified, the other fragments being from the bony plates of the head.

Wheeler (1978) comments that grey gurnards are not usually exploited for food today, but are often caught incidentally during trawls.

Flatfish (*Pleuronectidae*)

A total of 16 flatfish were identified from periods 6 and two from period 8.

Turbot (*Scophthalmus maximus*)

Three fragments were recovered from period 6. Two vertebrae and one articular were identified. The articular was recorded as larger than that from a comparative specimen of 550 mm in length. Turbot is described by Wheeler (1978) as a valuable food fish.

Plaice (*Pleuronectes platessa*)

One large plaice vertebra was recovered from period 6. It was recorded as larger than any of the vertebrae from a modern comparative measuring 584mm

Halibut (*Hippoglossus hippoglossus*)

Five halibut were recovered from period 6 and one from period 8. All fragments were vertebrae.

All of the flatfish species present have been described as valuable food fish (Wheeler 1978) and most are caught on line although they may sometimes be trawled. The very small number of flatfish may suggest that line caught fish were not generally used at Launceston.

Discussion

Processing techniques

Hake

The presence of head bones, pre-caudal and caudal vertebrae of hake indicates that the fish were brought to the site whole. If fillets had been transported far fewer head bones would have been expected. However, the fact that the head is primarily represented by bones from the mouth area coupled with the indication that hake vertebrae from the cranial portion of the vertebral column are under-represented indicates that some processing may have taken place. Alternatively, the pattern may be a result of survival of the bones within the archaeological record and their subsequent retrieval.

While many of the bones which are lacking from the hake bone assemblage at Launceston are insubstantial and therefore may not survive, there are a few notable exceptions. There is no reason to suppose that vertebrae near the cranial end of the column would survive less well than those at the caudal end. Similarly, the cleithrum is a distinctive and relatively robust element. The bones from the opercular series may not have survived well but the articulation may be expected to survive and would have been retrieved in the sieve. It appears that the lack of certain bones may be the result of processing techniques.

It has already been suggested that the presence of any head bones indicates that the entire fish were imported to the site. This would seem to suggest that the fish may not have been preserved. The main methods of fish preservation are smoking, salting, drying, or pickling. All of these methods would have involved some processing prior to preservation. Frequently, the head is removed before the fish is preserved as it is of little food value. However, Seeman (1986) describes a method of preparing herring which does remove a portion at the back of the head and has been carried out in Holland since the 14th century.

> 'The fish is cut behind the gills and by a twist of the knife, the gills and stomach are removed, leaving the intestines behind to improve the taste......
> The herring is immediately salted down in barrels'

Whilst it is obviously not possible to infer that the same method was used to process the fish at Launceston it does lend support to the argument that the uneven pattern of elements found may be a result of processing techniques.

Cutting (1955) makes the point that, inland, fresh fish was considered a luxury and cost substantially more than preserved fish. As Launceston was still a site of relatively high status during periods 6 and 8 it may be that the fish were not preserved in any way but were transported to the site fresh. If this was the case, then the processing discussed above must have taken place on site. Presumably if the fish were preserved on site the bones removed during preparation for consumption would remain on site. Admittedly, the possibility that dogs or other scavengers may have removed these 'waste bones' from the archaeological record must be considered. However, the almost complete absence of some bones would suggest that they never arrived on site rather than they were destroyed.

Whilst hake is represented strongly in this assemblage it is rarely mentioned in documentary records pertaining to this area. *The Expenses of the Judges of Assize Riding the Western and Oxford Circuits in 1596-1601* make no mention of hake although other species are documented. It seems likely that hake may have been the 'stockfish' of this area as the other likely candidate, cod, is in fact mentioned by name in the same sentence as stockfish;

> 'of Mr Sheriff, one hogshead of beer, 2 pieces of ling, 2 millwells, 2 stock fish, 2 mullets, 4 haddocks, 4 whiting, 1 salmon peal, 3 puffins, one cod fish, 2 eels and 8 herrings' (Camden Miscellany IV,1859, 21-39)

This would lend support to the suggestion that the fish were processed and then traded to Launceston as stockfish. Anderson Smith (1882) describes the origin of the term stockfish thus,

> 'Stock-fish, so called from *stocken*, sticks or poles, on which the fish are dried'

A local inhabitant of the Isle of Wight also recalls seeing fish dried on poles passed between the opercular series. If the hake were dried by being hung on sticks in this manner then the bones in the caudal portion of the skull may well have been damaged. This could account for the lack of these bones in the assemblage from Launceston.

Cod

A similar pattern can be noted for cod at Launceston, in that the bones from the caudal portion of the head are under-represented suggesting a similar method of processing discussed for hake. It has already been suggested that a fairly uniform size of fish was exploited. This would indicate that the cod at Launceston had been preserved, possibly in much the same manner as the hake.

Conger eel

Conger eel head bones are more strongly represented than for the other species. This may partly be a product of the greater robusticity of these bones. The butchery noted on conger eel was predominantly chop marks to the dentary and premaxillae which may suggest that the fish were split longitudinally. There are parallels for this from The Mary Rose (Hamilton-Dyer fc) where conger eel were found which had been cut down the length of the fish, either side of the vertebral column and through the processes. One conger eel vertebra bearing evidence of a very sharp knife mark was found at Launceston which may indicate similar processing techniques, although one cut mark is inconclusive.

Whiting

The distribution of skeletal elements of whiting is very similar to that described for hake and cod. This implies similar processing techniques were used for this species.

Other species

The range of species present at Launceston is wide. However, the number of fragments from many of the species is low which precludes any discussion of processing techniques. There are a number of mechanisms which may be responsible for the presence of the incidental species. The occasional presence of small fish such as the herring may be as a result of transport to site as the prey of animals other than humans. Hake, cod and conger eel all feed on small fish. Birds may also have transported fish to the site, however, given the distance inland this is unlikely.

Many of the incidental species can be caught either by line or as part of a trawl for other species. Those at Launceston may have been caught by local fishermen as an activity totally separate from the wider trade in fish. Alternatively, they may have been caught as part of the trawl and traded as 'special' fish. This may be more likely for the large turbot and plaice than for the occasional herring.

Source of the fish

There seems to be very little change through time when periods 6 and 8 are looked at. Both assemblages are very similar in terms of species composition, element representation and the size of fish exploited. The trade in fish seems to have continued unchanged for some considerable time. In fact the uniformity of the two assemblages is marked and suggests that the same source for the fish was retained despite the change in the castle's fortunes which would have occurred with the move of much of the function of the castle to Lostwithiel.

The decrease in the number of fish exploited after period 8 is marked and in contrast to the pattern found in the mammal assemblage. The castle steadily declined in status from period 8 onwards and the decrease in the use of fish may reflect this. The inhabitants of the castle may have had to rely on food produced in the immediate area rather than trading further afield.

The emphasis on hake and the presence of breams and mullets reflects the local fishing grounds rather than international trade which generally came through large ports such as Exeter. *The Local Customs Accounts of the Port of Exeter 1266 - 1321* (Kowaleski 1993)makes no mention of hake although other species are mentioned by name which may suggest that Exeter was not the source. There are a large number of ports at which fish may have been landed ,and whilst it is probably safe to assume that the local nature of the fish assemblage indicates that the catch is not coming through one of the large, international ports, it is probably impossible to pinpoint which local port was the source of the assemblage in the absence of documentary records.

Conclusion

A local fishery has been identified with fish caught off the Cornish coast, processed and brought to Launceston. The pattern of exploitation remains fairly constant through time suggesting that the source of this trade remains the same. The high status of the site is only reflected in the fish bone assemblage by a few rarities such as the large flatfish. The fish may have represented part of the staple diet for the inhabitants of Launceston Castle with the high status dishes formed of meat.

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List of tables

Table 1: Measurements taken

Vomer	Greatest breadth (GB)
Basioccipital	Greatest height (GH) Greatest breadth (GB)
Dentary	Greatest length (GL) Greatest height (GH) Inside length (M3) (Hamilton-Dyer pers comm) Anterior height (M4) (Hamilton-Dyer pers comm) Tooth row width (M5) (Hamilton-Dyer pers comm) Greatest breadth anterior end (M6) (Hamilton-Dyer pers comm)
Articular	Greatest breadth of the articulation (GB)
Premaxilla	Greatest length (GL) Greatest height (GH) Chord (M3) (Hamilton-Dyer pers comm) Width of ascending ramus (M4) (Hamilton-Dyer pers comm) Greatest breadth anterior end (M5) (Hamilton-Dyer pers comm)
Quadrate	Greatest breadth of the articulation (GB)
Opercular	Greatest height of the articulation (GH) Greatest breadth of the articulation (GB)
Precaudal vertebrae	Greatest height (GH) Greatest breadth (GB)
Atlas	Greatest height (GH) Greatest breadth (GB)

Measurements follow Morales and Rosenlund (1979) unless otherwise indicated

Table 2: Summary fragments count, all periods

		Sieved	Hand retrieved	Total
Species				
Spurdog	*Squalus acanthias*	2	1	3
Ray	*Rajidae*	5	4	9
Sturgeon	*Acipenser sturio*	1	1	2
Herring	*Clupea harengus*	10	0	10
Salmon	*Salmo salar*	1	3	5
Eel	*Anguilla anguilla*	5	0	5
Conger Eel	*Conger conger*	77	313	391
Cod Fishes	*Gadidae*	21	25	45
Whiting	*Merlangius merlangus*	154	11	165
Pollack	*Pollachius pollachius*	1	1	2
Saithe	*Pollachius virens*	2	1	3
Cod	*Gadus morhua*	39	146	186
Haddock	*Melanogrammus aeglefinus*	1	0	1
Hake	*Merluccius merluccius*	509	1261	1765
Ling	*Molva molva*	14	10	24
Scad	*Trachurus trachurus*	3	0	8
Bass	*Dicentrarchus labrax*	1	0	1
Sea Breams	*Sparidae*	7	22	29
Couch's Sea Bream	*Sparus pagrus*	0	12	12
Red Sea Bream	*Pagellus bogaraveo*	0	2	2
Gilt Head	*Sparus aurata*	9	2	11
Wrasse	*Labridae*	7	0	7
Ballan Wrasse	*Labrus bergylta*	1	4	5
Mullet	*Liza sp.*	0	1	1
Mackerel	*Scomber scombrus*	1	0	1
Gurnard	*Triglidae*	22	10	31
Grey Gurnard	*Eutrigla gurnardus*	10	14	24
Flatfish	*Pleuronectidae*	3	3	6
Turbot	*Scophthalmus maximus*	1	2	3
Plaice	*Pleuronectes platessa*	0	1	1
Halibut	*Hippoglossus hippoglossus*	0	6	6
Fish not further identified		3894	203	4097
Total		4801	2059	6861

Table 3: Summary fragments count period 1

		Sieved	Hand retrieved	Total
Species				
Spurdog	*Squalus acanthias*			0
Ray	*Rajidae*			0
Sturgeon	*Acipenser sturio*			0
Herring	*Clupea harengus*			0
Salmon	*Salmo salar*			0
Eel	*Anguilla anguilla*			0
Conger Eel	*Conger conger*			0
Cod Fishes	*Gadidae*			0
Whiting	*Merlangius merlangus*			0
Pollack	*Pollachius pollachius*			0
Saithe	*Pollachius virens*			0
Cod	*Gadus morhua*			0
Haddock	*Melanogrammus aeglefinus*			0
Hake	*Merluccius merluccius*		5	5
Ling	*Molva molva*			0
Scad	*Trachurus trachurus*			5
Bass	*Dicentrarchus labrax*			0
Sea Breams	*Sparidae*			0
Couch's Sea Bream	*Sparus pagrus*			0
Red Sea Bream	*Pagellus bogaraveo*			0
Gilt Head	*Sparus aurata*			0
Wrasse	*Labridae*			0
Ballan Wrasse	*Labrus bergylta*			0
Mullet	*Liza sp.*			0
Mackerel	*Scomber scombrus*			0
Gurnard	*Triglidae*			0
Grey Gurnard	*Eutrigla gurnardus*			0
Flatfish	*Pleuronectidae*			0
Turbot	*Scophthalmus maximus*			0
Plaice	*Pleuronectes platessa*			0
Halibut	*Hippoglossus hippoglossus*			0
Fish not further identified			1	1
Total		0	6	6

Table 4: Summary fragments count period 2

		Sieved	Hand retrieved	Total
Species				
Spurdog	*Squalus acanthias*			0
Ray	*Rajidae*			0
Sturgeon	*Acipenser sturio*			0
Herring	*Clupea harengus*			0
Salmon	*Salmo salar*			0
Eel	*Anguilla anguilla*			0
Conger Eel	*Conger conger*		1	1
Cod Fishes	*Gadidae*			0
Whiting	*Merlangius merlangus*			0
Pollack	*Pollachius pollachius*			0
Saithe	*Pollachius virens*			0
Cod	*Gadus morhua*			0
Haddock	*Melanogrammus aeglefinus*			0
Hake	*Merluccius merluccius*		2	2
Ling	*Molva molva*			0
Scad	*Trachurus trachurus*			0
Bass	*Dicentrarchus labrax*			0
Sea Breams	*Sparidae*			0
Couch's Sea Bream	*Sparus pagrus*			0
Red Sea Bream	*Pagellus bogaraveo*			0
Gilt Head	*Sparus aurata*			0
Wrasse	*Labridae*			0
Ballan Wrasse	*Labrus bergylta*			0
Mullet	*Liza sp.*			0
Mackerel	*Scomber scombrus*			0
Gurnard	*Triglidae*			0
Grey Gurnard	*Eutrigla gurnardus*			0
Flatfish	*Pleuronectidae*			0
Turbot	*Scophthalmus maximus*			0
Plaice	*Pleuronectes platessa*			0
Halibut	*Hippoglossus hippoglossus*			0
Fish not further identified		1		1
Total		1	3	4

Table 5: Summary fragments count period 3

		Sieved	Hand retrieved	Total
Species				
Spurdog	*Squalus acanthias*			0
Ray	*Rajidae*			0
Sturgeon	*Acipenser sturio*			0
Herring	*Clupea harengus*			0
Salmon	*Salmo salar*			0
Eel	*Anguilla anguilla*			0
Conger Eel	*Conger conger*	6		6
Cod Fishes	*Gadidae*	1		1
Whiting	*Merlangius merlangus*			0
Pollack	*Pollachius pollachius*			0
Saithe	*Pollachius virens*			0
Cod	*Gadus morhua*	12		12
Haddock	*Melanogrammus aeglefinus*	1		1
Hake	*Merluccius merluccius*	45		45
Ling	*Molva molva*	5		5
Scad	*Trachurus trachurus*			0
Bass	*Dicentrarchus labrax*			0
Sea Breams	*Sparidae*	1		1
Couch's Sea Bream	*Sparus pagrus*			0
Red Sea Bream	*Pagellus bogaraveo*			0
Gilt Head	*Sparus aurata*			0
Wrasse	*Labridae*			0
Ballan Wrasse	*Labrus bergylta*			0
Mullet	*Liza sp.*			0
Mackerel	*Scomber scombrus*			0
Gurnard	*Triglidae*			0
Grey Gurnard	*Eutrigla gurnardus*			0
Flatfish	*Pleuronectidae*			0
Turbot	*Scophthalmus maximus*			0
Plaice	*Pleuronectes platessa*			0
Halibut	*Hippoglossus hippoglossus*			0
Fish not further identified		31		31
Total		102	0	102

Table 6: Summary fragments count period 4

		Sieved	Hand retrieved	Total
Species				
Spurdog	*Squalus acanthias*			0
Ray	*Rajidae*			0
Sturgeon	*Acipenser sturio*			0
Herring	*Clupea harengus*			0
Salmon	*Salmo salar*			0
Eel	*Anguilla anguilla*			0
Conger Eel	*Conger conger*			0
Cod Fishes	*Gadidae*	1		1
Whiting	*Merlangius merlangus*			0
Pollack	*Pollachius pollachius*			0
Saithe	*Pollachius virens*			0
Cod	*Gadus morhua*			0
Haddock	*Melanogrammus aeglefinus*			0
Hake	*Merluccius merluccius*	11	2	13
Ling	*Molva molva*	1		1
Scad	*Trachurus trachurus*	1		1
Bass	*Dicentrarchus labrax*			0
Sea Breams	*Sparidae*			0
Couch's Sea Bream	*Sparus pagrus*			0
Red Sea Bream	*Pagellus bogaraveo*			0
Gilt Head	*Sparus aurata*			0
Wrasse	*Labridae*			0
Ballan Wrasse	*Labrus bergylta*			0
Mullet	*Liza sp.*			0
Mackerel	*Scomber scombrus*			0
Gurnard	*Triglidae*			0
Grey Gurnard	*Eutrigla gurnardus*	1		1
Flatfish	*Pleuronectidae*			0
Turbot	*Scophthalmus maximus*			0
Plaice	*Pleuronectes platessa*			0
Halibut	*Hippoglossus hippoglossus*			0
Fish not further identified				0
Total		15	2	17

Table 7: Summary fragments count period 5

		Sieved	Hand retrieved	Total
Species				
Spurdog	*Squalus acanthias*			0
Ray	*Rajidae*			0
Sturgeon	*Acipenser sturio*			0
Herring	*Clupea harengus*			0
Salmon	*Salmo salar*		1	1
Eel	*Anguilla anguilla*			0
Conger Eel	*Conger conger*		1	1
Cod Fishes	*Gadidae*	1		1
Whiting	*Merlangius merlangus*			0
Pollack	*Pollachius pollachius*			0
Saithe	*Pollachius virens*			0
Cod	*Gadus morhua*		1	1
Haddock	*Melanogrammus aeglefinus*			0
Hake	*Merluccius merluccius*	9	4	13
Ling	*Molva molva*			0
Scad	*Trachurus trachurus*			0
Bass	*Dicentrarchus labrax*			0
Sea Breams	*Sparidae*			0
Couch's Sea Bream	*Sparus pagrus*			0
Red Sea Bream	*Pagellus bogaraveo*			0
Gilt Head	*Sparus aurata*			0
Wrasse	*Labridae*			0
Ballan Wrasse	*Labrus bergylta*			0
Mullet	*Liza sp.*			0
Mackerel	*Scomber scombrus*			0
Gurnard	*Triglidae*	1		1
Grey Gurnard	*Eutrigla gurnardus*			0
Flatfish	*Pleuronectidae*			0
Turbot	*Scophthalmus maximus*			0
Plaice	*Pleuronectes platessa*			0
Halibut	*Hippoglossus hippoglossus*			0
Fish not further identified				0
Total		11	7	18

Table 8: Summary fragments count period 6

		Sieved	Hand retrieved	Total
Species				
Spurdog	*Squalus acanthias*	1	1	2
Ray	*Rajidae*	4	4	8
Sturgeon	*Acipenser sturio*			
Herring	*Clupea harengus*	10		10
Salmon	*Salmo salar*	1	3	4
Eel	*Anguilla anguilla*	5		5
Conger Eel	*Conger conger*	54	257	311
Cod Fishes	*Gadidae*	17	11	28
Whiting	*Merlangius merlangus*	134	9	143
Pollack	*Pollachius pollachius*	1		1
Saithe	*Pollachius virens*	2	1	3
Cod	*Gadus morhua*	19	82	101
Haddock	*Melanogrammus aeglefinus*			
Hake	*Merluccius merluccius*	287	860	1147
Ling	*Molva molva*	3	9	12
Scad	*Trachurus trachurus*	2		2
Bass	*Dicentrarchus labrax*			
Sea Breams	*Sparidae*	4	11	15
Couch's Sea Bream	*Sparus pagrus*		4	4
Red Sea Bream	*Pagellus bogaraveo*		2	2
Gilt Head	*Sparus aurata*			0
Wrasse	*Labridae*	7		7
Ballan Wrasse	*Labrus bergylta*	1	3	4
Mullet	*Liza sp.*			
Mackerel	*Scomber scombrus*			
Gurnard	*Triglidae*	19	6	25
Grey Gurnard	*Eutrigla gurnardus*	5	12	17
Flatfish	*Pleuronectidae*	3	1	4
Turbot	*Scophthalmus maximus*	1	2	3
Plaice	*Pleuronectes platessa*		1	1
Halibut	*Hippoglossus hippoglossus*		5	5
Fish not further identified		2495	158	2653
Total		3075	1442	4517

Table 9: Summary fragments count period 8

		Sieved	Hand retrieved	Total
Species				
Spurdog	*Squalus acanthias*			0
Ray	*Rajidae*	1		1
Sturgeon	*Acipenser sturio*	1	1	2
Herring	*Clupea harengus*			0
Salmon	*Salmo salar*			0
Eel	*Anguilla anguilla*			0
Conger Eel	*Conger conger*	17	43	60
Cod Fishes	*Gadidae*	1	7	8
Whiting	*Merlangius merlangus*	18	2	20
Pollack	*Pollachius pollachius*			0
Saithe	*Pollachius virens*			0
Cod	*Gadus morhua*	8	52	60
Haddock	*Melanogrammus aeglefinus*			0
Hake	*Merluccius merluccius*	132	342	474
Ling	*Molva molva*	1	1	2
Scad	*Trachurus trachurus*			0
Bass	*Dicentrarchus labrax*			
Sea Breams	*Sparidae*	1	10	11
Couch's Sea Bream	*Sparus pagrus*		8	8
Red Sea Bream	*Pagellus bogaraveo*			0
Gilt Head	*Sparus aurata*	9	1	10
Wrasse	*Labridae*			0
Ballan Wrasse	*Labrus bergylta*		1	1
Mullet	*Liza sp.*			
Mackerel	*Scomber scombrus*	1		1
Gurnard	*Triglidae*	2	3	5
Grey Gurnard	*Eutrigla gurnardus*	4	2	6
Flatfish	*Pleuronectidae*		2	2
Turbot	*Scophthalmus maximus*			0
Plaice	*Pleuronectes platessa*			0
Halibut	*Hippoglossus hippoglossus*		1	1
Fish not further identified		1183	44	1227
Total		1379	520	1899

Table 10: Summary fragments count period 9

		Sieved	Hand retrieved	Total
Species				
Spurdog	*Squalus acanthias*			0
Ray	*Rajidae*			0
Sturgeon	*Acipenser sturio*			0
Herring	*Clupea harengus*			0
Salmon	*Salmo salar*			0
Eel	*Anguilla anguilla*			0
Conger Eel	*Conger conger*		7	7
Cod Fishes	*Gadidae*		3	3
Whiting	*Merlangius merlangus*			0
Pollack	*Pollachius pollachius*		1	1
Saithe	*Pollachius virens*			0
Cod	*Gadus morhua*		9	9
Haddock	*Melanogrammus aeglefinus*			0
Hake	*Merluccius merluccius*		41	41
Ling	*Molva molva*			0
Scad	*Trachurus trachurus*			0
Bass	*Dicentrarchus labrax*			0
Sea Breams	*Sparidae*	1		1
Couch's Sea Bream	*Sparus pagrus*			0
Red Sea Bream	*Pagellus bogaraveo*			0
Gilt Head	*Sparus aurata*		1	1
Wrasse	*Labridae*			0
Ballan Wrasse	*Labrus bergylta*			0
Mullet	*Liza sp.*		1	1
Mackerel	*Scomber scombrus*			0
Gurnard	*Triglidae*			0
Grey Gurnard	*Eutrigla gurnardus*			0
Flatfish	*Pleuronectidae*			0
Turbot	*Scophthalmus maximus*			0
Plaice	*Pleuronectes platessa*			0
Halibut	*Hippoglossus hippoglossus*			0
Fish not further identified				0
Total		1	63	64

Table 11: Summary fragments count period 10

		Sieved	Hand retrieved	Total
Species				
Spurdog	*Squalus acanthias*	1		1
Ray	*Rajidae*			0
Sturgeon	*Acipenser sturio*			0
Herring	*Clupea harengus*			0
Salmon	*Salmo salar*			0
Eel	*Anguilla anguilla*			0
Conger Eel	*Conger conger*		5	5
Cod Fishes	*Gadidae*		2	2
Whiting	*Merlangius merlangus*	2		2
Pollack	*Pollachius pollachius*			0
Saithe	*Pollachius virens*			0
Cod	*Gadus morhua*		3	3
Haddock	*Melanogrammus aeglefinus*			0
Hake	*Merluccius merluccius*	25		25
Ling	*Molva molva*	4		4
Scad	*Trachurus trachurus*			0
Bass	*Dicentrarchus labrax*	1		1
Sea Breams	*Sparidae*		1	1
Couch's Sea Bream	*Sparus pagrus*			0
Red Sea Bream	*Pagellus bogaraveo*			0
Gilt Head	*Sparus aurata*			0
Wrasse	*Labridae*			0
Ballan Wrasse	*Labrus bergylta*			0
Mullet	*Liza sp.*			0
Mackerel	*Scomber scombrus*			0
Gurnard	*Triglidae*			0
Grey Gurnard	*Eutrigla gurnardus*			0
Flatfish	*Pleuronectidae*			0
Turbot	*Scophthalmus maximus*			0
Plaice	*Pleuronectes platessa*			0
Halibut	*Hippoglossus hippoglossus*			0
Fish not further identified		184		184
Total		217	11	228

Table 12: Summary fragments count period 11

		Sieved	Hand retrieved	Total
Species				
Spurdog	*Squalus acanthias*			0
Ray	*Rajidae*			0
Sturgeon	*Acipenser sturio*			0
Herring	*Clupea harengus*			0
Salmon	*Salmo salar*			0
Eel	*Anguilla anguilla*			0
Conger Eel	*Conger conger*			0
Cod Fishes	*Gadidae*		1	1
Whiting	*Merlangius merlangus*			0
Pollack	*Pollachius pollachius*			0
Saithe	*Pollachius virens*			0
Cod	*Gadus morhua*			0
Haddock	*Melanogrammus aeglefinus*			0
Hake	*Merluccius merluccius*			0
Ling	*Molva molva*			0
Scad	*Trachurus trachurus*			0
Bass	*Dicentrarchus labrax*			0
Sea Breams	*Sparidae*			0
Couch's Sea Bream	*Sparus pagrus*			0
Red Sea Bream	*Pagellus bogaraveo*			0
Gilt Head	*Sparus aurata*			0
Wrasse	*Labridae*			0
Ballan Wrasse	*Labrus bergylta*			0
Mullet	*Liza sp.*			0
Mackerel	*Scomber scombrus*			0
Gurnard	*Triglidae*			0
Grey Gurnard	*Eutrigla gurnardus*			0
Flatfish	*Pleuronectidae*			0
Turbot	*Scophthalmus maximus*			0
Plaice	*Pleuronectes platessa*			0
Halibut	*Hippoglossus hippoglossus*			0
Fish not further identified				0
Total		0	1	1

Table 13: Minimum number of individuals and element representation, period 6

Conger eel
Conger conger

	Left	Right	Midline	Unknown	Total
Dentary	27	24	-	2	53
Articular	10	10	-	-	20
Maxillae	-	-	-	-	0
Premaxillae	27	20	-	-	47
Vomer	-	-	11		11
Hyomandibular	-	-		7	7
Quadrate	-	-	2		2
Ceratohyal	-	-		15	15
Parasphenoid	-	-	3	-	3
Basioccipital	-	-	4	-	4
Atlas	-	-	-	-	
Cleithrum	-	-	-	4	4
Operculum	-	-	-	6	6
Precaudal vertebrae	-	-	98	-	98
Caudal vertebrae	-	-	34	-	34
Vertebrae indet	-	-	7	-	7
Total	-	-	-	-	311

MNI=27

Whiting
Merlangius merlangus

	Left	Right	Midline	Unknown	Total
Dentary	-	3	-	-	3
Articular	3	1	-	-	4
Maxillae	1	1	-	-	2
Premaxillae	2	1	-	3	6
Vomer	-	-	-	-	0
Hyomandibular	-	-	-	-	0
Quadrate	-	-		4	4
Ceratohyal	-	-	-	-	0
Parasphenoid	-	-	-	-	0
Basioccipital	-	-	-	-	0
Atlas	-	-	-	-	0
Cleithrum	-	-	-	-	0
Operculum	-	-	-	-	0
Precaudal vertebrae	-	-	21		21
Caudal vertebrae	-	-	103		103
Vertebrae indet	-	-	-	-	143
Total	-	-	-	-	

MNI=3

Cod
Gadus morhua

	Left	Right	Midline	Unknown	Total
Dentary	1	-	-	-	1
Articular	-	-	-	-	0
Maxillae	1	2			3
Premaxillae	4	3		-	7
Vomer	-	-	1		1
Hyomandibular	-	-	-	-	0
Quadrate	-	-	-	1	1
Ceratohyal	-	-	-	1	1
Parasphenoid	-	-	-	-	0
Basioccipital	-	-	-	-	0
Atlas	-	-	-	-	0
Cleithrum	-	-	-	-	0
Operculum	-	-	-	-	0
Precaudal vertebrae	-	-	60	-	60
Caudal vertebrae	-	-	27	-	27
Vertebrae indet	-	-	-	-	0
Total	-	-	-	-	101

MNI=4

Hake
Merluccius merluccius

	Left	Right	Midline	Unknown	Total
Dentary	18	17	-	-	35
Articular	10	20	11	-	41
Maxillae	26	37	-	-	63
Premaxillae	27	29	-	-	56
Vomer	-	-	-	1	1
Hyomandibular	-	-	-	-	0
Quadrate	-	-	-	11	11
Ceratohyal	-	-	-	1	1
Parasphenoid	-	-	-	-	0
Basioccipital	-	-	8	-	8
Atlas	-	-	11	-	11
Cleithrum	-	-	-	-	0
Operculum	-	-	-	-	0
Precaudal vertebrae	-	-	606	-	606
Caudal vertebrae	-	-	312	-	312
Vertebrae indet	-	-	2	-	2
Total	-	-		-	1147

MNI=37

Table 14: Period 6, butchery evidence

Species		Element	Description	Number
Conger eel	*Conger conger*	Dentary	cranial portion chopped off	5
			chop marks on cranial portion	1
		Premaxillae	ramus chopped off	4
			chop mark on caudal face of ramus	4
		Precaudal vertebrae	lateral chop through centrum	2
			sharp knife on dorso-ventral surface	2
Cod	*Gadus morhua*	Precaudal vertebrae	longitudinal chop through the centrum	1
Hake	*Merluccius merluccius*	Premaxillae	dorso-ventral chop through middle of tooth row	1
		Precaudal vertebrae	lateral chop through centrum	1
			knife mark on dorsal surface	2
			process chopped off	1
			knife mark on ventral surface	3
		Caudal vertebrae	lateral and oblique chop through centrum	1

Table 15: Minimum number of individuals and element representation for hake, period 8

Element	Left	Right	Midline	Total fragments
Dentary	1	1		2
Articular	3	3		6
Maxillae	5	4		9
Premaxilla	6	5		11
Vomer			1	1
Precaudal vertebrae			352	352
Caudal vetrebrae			89	89
Vertebrae indet.			4	4
				474
				MNI=5

Table 16: Hake measurements, period 6

Articular	Atlas		Basioccipital		Quadrate	Vomer
GB	GH	GB	GH	GB	GB	GB
6.01	10.42	4.39	9.16	13.21	14.86	24.28
6.51	13.56	5.90	10.37	13.61	10.18	
6.56	12.96	6.48	11.63	14.38	9.14	
7.15	15.54	6.50	9.59	12.65	9.48	
7.25	13.38	6.87	10.65	14.53	12.35	
7.36	13.95	7.08	10.69	14.43	11.84	
7.38	15.14	7.39	8.70	11.75	10.63	
7.44	9.08	7.50	8.21	10.74	8.61	
7.49	16.41	8.07			10.08	
7.53	13.92	8.86			10.35	
7.56	19.52	10.12				
7.64						
7.64						
7.66						
7.78						
8.35						
8.39						
8.42						
8.52						
9.26						
9.29						
9.43						
9.62						
10.07						
10.60						
10.61						
10.77						
10.77						
10.93						

Dentary		
GB	M4	M5
-	10.70	5.84
-	-	5.90
-	-	7.33
-	-	6.40
-	-	6.25
-	16.72	7.47
-	10.60	5.30
-	13.92	8.68
-	12.62	5.96
-	15.72	7.83
-	12.07	6.67
33.00	15.30	7.30
33.00	15.30	7.30
-	9.48	5.41
-	11.67	7.16
-	16.30	8.27
27.40	13.40	5.90
-	9.87	5.78
-	12.37	6.25
-	14.34	7.14
-	12.07	7.49
-	10.81	5.74
-	13.45	6.24
-	11.65	5.92
-	11.11	5.58
-	10.16	4.83
-	12.28	6.54
-	10.51	5.74
-	9.84	5.08
-	10.11	4.56
35.00	14.10	6.40
-	12.45	7.30
-	9.36	5.17

Table 16: Hake measurements, period 6 (continued)

Premaxillae

GH	M4	M5	M6
17.85	16.65	5.59	-
13.91	12.10	-	-
14.55	14.98	5.36	-
14.52	-	7.90	-
18.71	20.13	5.92	7.22
19.53	20.34	8.33	-
14.00	16.23	6.41	-
13.24	13.40	-	5.56
15.86	15.47	6.47	-
11.29	13.10	5.51	-
12.58	13.47	-	-
-	-	5.76	-
-	-	6.34	-
11.17	-	5.32	-
11.68	12.12	3.90	-
14.70	15.82	6.45	-
12.48	6.52	13.50	-
14.69	-	16.05	6.41
10.41	-	15.85	-
14.74	-	16.12	-
16.66	-	18.08	-
12.75	-	13.00	-
11.78	-	12.39	-
12.68	-	13.47	5.87
-	-	15.39	-
15.10	-	10.00	-
12.25	-	12.85	-
14.12	-	15.11	-
17.22	-	18.16	-
15.40	-	16.51	-
12.68	-	14.64	-
18.20	-	17.96	-
14.09	-	14.34	-
13.66	-	-	-
16.25	-	15.94	-
11.44	-	14.94	-
12.91	-	12.56	-

Precaudal vertebrae

GB	GH	GB	GH	GB	GH
4.16	12.64	8.54	11.36	9.67	13.36
4.76	13.76	8.56	11.78	9.67	10.14
4.84	11.31	8.57	16.40	9.68	10.46
4.94	12.51	8.63	9.80	9.72	10.69
5.37	15.53	8.68	11.24	9.72	10.75
5.40	16.00	8.70	11.49	9.73	13.09
5.56	10.81	8.71	12.36	9.75	13.44
5.59	15.22	8.76	11.12	9.75	13.11
5.88	14.47	8.78	11.58	9.77	10.62
6.10	10.77	8.86	14.88	9.77	10.83
6.26	20.51	8.86	11.79	9.78	13.32
6.30	12.28	8.88	10.73	9.78	10.46
6.32	11.60	8.88	12.10	9.78	13.10
6.44	11.59	8.89	11.30	9.79	11.64
6.58	17.06	8.93	11.81	9.79	14.42
6.78	12.60	8.94	12.49	9.82	11.20
6.95	11.04	8.98	11.56	9.84	13.10
6.95	14.35	9.06	10.92	9.85	11.97
6.96	9.45	9.07	10.62	9.88	12.75
7.04	15.55	9.09	11.35	9.88	12.40
7.28	12.99	9.11	9.79	9.88	13.00
7.42	12.19	9.12	11.89	9.90	11.43
7.60	8.21	9.14	13.07	9.90	11.48
7.66	15.76	9.18	11.08	10.63	10.76
7.66	14.36	9.22	12.77	10.64	13.04
7.71	15.13	9.23	10.22	10.65	12.61

Table 16: Hake measurements, period 6 (continued)

Precaudal vertebrae

GB	GH	GB	GH	GB	GH
7.73	9.60	9.26	12.47	10.65	11.23
7.74	11.28	9.32	12.74	10.66	15.78
7.74	14.67	9.33	19.51	10.68	10.23
7.80	10.99	9.37	12.72	10.70	12.98
7.81	9.51	9.41	14.34	10.71	12.35
7.90	14.44	9.41	11.43	10.72	15.35
7.97	10.14	9.44	11.09	10.72	11.06
8.07	11.95	9.49	12.53	10.72	13.59
8.14	19.05	9.49	11.78	10.74	11.81
8.19	14.40	9.53	10.90	10.74	13.93
8.23	9.48	9.56	12.39	10.75	13.24
8.35	11.10	9.60	14.79	10.75	12.61
8.37	16.29	9.60	14.79	10.76	14.38
8.42	10.24	9.60	11.84	10.76	14.28
8.49	8.58	9.60	10.40	10.78	12.13
8.50	11.30	9.62	11.20	10.79	11.94
8.50	13.04	9.66	12.79	10.79	11.71
9.91	10.56	10.80	11.26	11.32	15.37
9.91	12.37	10.80	12.66	11.33	11.09
9.92	11.74	10.80	10.67	11.33	11.91
9.93	11.89	10.81	16.36	11.34	14.52
9.93	12.89	10.82	10.98	11.36	11.38
9.93	12.96	10.84	13.47	11.37	13.15
9.93	11.91	10.84	12.90	11.37	14.69
9.93	10.83	10.85	12.55	11.37	12.88
9.94	12.26	10.88	12.76	11.37	12.73
9.95	13.63	10.88	11.40	11.37	13.35
9.96	12.07	10.88	15.36	11.38	11.59
9.96	12.90	10.90	11.40	11.40	11.76
9.96	12.78	10.91	14.35	11.40	10.53
9.99	13.00	10.91	13.49	11.40	15.00
10.02	12.04	10.92	17.94	11.40	12.21
10.03	12.26	10.92	12.57	11.41	15.03
10.08	13.07	10.92	11.44	11.43	14.44
10.09	13.95	10.94	15.76	11.45	12.52
10.09	11.28	10.94	11.53	11.46	11.19
10.10	10.82	10.94	12.85	11.46	14.20
10.12	12.59	10.94	12.77	11.47	13.28
10.12	13.84	10.95	19.52	11.49	19.10
10.12	13.69	10.96	14.94	11.50	15.50
10.15	15.22	10.97	12.45	11.50	14.72
10.15	14.00	10.97	12.49	11.51	13.22
10.16	11.50	10.98	15.16	11.52	13.44
10.18	12.41	10.98	15.64	11.52	12.57
10.20	13.67	10.98	16.84	11.53	12.67
10.20	11.67	10.99	16.38	11.56	12.08
10.21	12.97	10.99	11.14	11.56	15.93
10.26	14.91	11.00	12.92	11.56	12.22
10.26	12.58	11.02	11.62	11.57	11.77
10.26	12.08	11.03	13.41	11.58	11.64
10.27	11.92	11.04	12.18	11.59	16.19
10.27	11.85	11.04	12.09	11.60	15.61
10.29	13.04	11.06	12.39	11.60	10.86
10.32	11.76	11.06	11.85	11.64	13.44
10.32	11.49	11.07	13.36	11.65	12.69
10.32	10.39	11.07	14.21	11.65	14.57
10.33	12.28	11.07	13.98	11.65	11.95
10.35	13.09	11.10	12.38	11.66	14.49
10.35	13.36	11.10	12.38	11.66	12.10
10.36	12.40	11.11	12.09	11.68	15.08
10.38	13.06	11.13	14.38	11.69	14.45
10.39	18.26	11.14	13.27	11.70	14.10
10.39	14.85	11.16	16.59	11.71	14.55
10.39	13.19	11.16	15.86	11.71	13.12
10.40	11.38	11.16	14.76	11.73	14.75
10.40	13.46	11.18	11.64	11.73	13.06
10.42	11.12	11.18	11.30	11.74	14.42

Table 16: Hake measurements, period 6 (continued)

Precaudal vertebrae

GB	GH	GB	GH	GB	GH
10.43	13.38	11.19	12.55	11.75	12.55
10.44	13.51	11.24	15.76	11.76	16.24
10.45	12.95	11.26	15.63	11.76	12.04
10.45	11.38	11.26	14.02	11.77	12.64
10.46	12.95	11.26	11.56	11.77	11.06
10.49	12.02	11.26	13.32	11.77	14.81
10.51	11.29	11.28	11.53	11.77	13.65
10.51	11.95	11.28	10.80	11.78	13.42
10.52	13.05	11.30	14.19	11.78	16.22
10.53	13.62	11.30	13.02	11.79	12.07
10.55	11.78	11.30	10.93	11.82	16.53
10.56	11.51	11.31	13.71	11.83	15.50
10.56	11.44	11.31	12.15	11.85	14.32
10.58	12.83	11.31	15.79	11.85	13.18
10.63	14.38	11.32	14.55	11.86	12.97
10.63	13.41	11.32	16.17	11.86	11.24
11.87	14.12	12.83	12.92	13.70	15.20
11.87	14.22	12.84	13.04	13.73	16.26
11.88	13.40	12.86	12.42	13.73	13.36
11.89	11.32	12.86	12.11	13.74	14.58
11.89	12.95	12.86	15.20	13.74	15.30
11.89	12.41	12.87	13.21	13.80	16.26
11.91	13.06	12.89	14.47	13.81	14.97
11.93	14.66	12.90	13.75	13.82	15.11
11.93	12.28	12.90	12.88	13.82	13.38
11.94	12.16	12.92	15.34	13.82	15.68
11.95	12.79	12.96	13.97	13.83	14.45
11.96	15.90	12.96	15.86	13.86	15.22
11.97	14.25	12.98	13.78	13.86	20.00
11.99	12.59	12.98	15.69	13.88	20.40
12.00	11.44	12.99	16.16	13.88	14.67
12.01	12.37	12.99	14.61	13.90	13.68
12.03	14.53	13.00	15.84	13.93	19.86
12.04	15.20	13.00	14.00	13.94	15.18
12.04	12.90	13.00	13.39	13.96	15.43
12.04	11.39	13.01	13.36	13.99	15.46
12.05	11.58	13.02	13.72	13.99	16.42
12.06	14.00	13.05	15.88	14.01	13.92
12.07	13.20	13.06	16.84	14.01	15.19
12.08	17.87	13.07	15.30	14.04	14.56
12.08	15.21	13.11	15.05	14.18	14.50
12.10	14.80	13.11	15.58	14.20	16.97
12.11	12.36	13.12	14.40	14.35	13.21
12.17	15.44	13.13	13.22	14.35	13.93
12.18	12.54	13.14	12.50	14.38	15.78
12.20	15.64	13.15	18.46	14.40	16.60
12.23	12.16	13.16	14.40	14.42	17.31
12.23	12.28	13.18	13.81	14.44	17.87
12.23	16.44	13.18	13.85	14.45	16.80
12.23	15.70	13.18	15.81	14.46	15.48
12.23	14.17	13.20	14.49	14.51	16.13
12.24	15.53	13.20	15.92	14.57	14.43
12.25	15.04	13.22	13.81	14.58	15.11
12.25	15.63	13.22	12.42	14.61	15.33
12.26	16.00	13.23	13.98	14.61	13.94
12.26	11.77	13.26	18.75	14.67	14.26
12.28	15.49	13.29	16.46	14.69	15.59
12.30	14.59	13.30	14.00	14.70	15.70
12.35	15.86	13.34	14.72	14.71	15.08
12.40	12.71	13.35	15.24	14.76	13.24
12.41	18.40	13.36	14.25	14.78	15.28
12.41	14.22	13.36	14.25	14.78	16.02
12.41	12.62	13.36	17.37	14.80	16.96
12.55	16.04	13.36	13.54	14.80	17.30
12.58	14.32	13.37	15.53	14.84	15.89
12.58	12.39	13.37	15.32	14.88	16.08
12.59	12.40	13.39	15.07	14.94	16.44

Table 16: Hake measurements, period 6 (continued)

Precaudal vertebrae

GB	GH	GB	GH	GB	GH
12.62	16.22	13.41	14.32	14.94	16.99
12.63	12.94	13.41	14.88	14.99	15.96
12.64	15.18	13.42	11.99	15.01	15.65
12.66	14.80	13.48	13.78	15.08	14.97
12.69	15.06	13.49	15.06	15.14	19.09
12.70	14.30	13.50	15.46	15.31	15.97
12.70	12.56	13.52	15.13	15.48	17.26
12.72	14.08	13.52	16.52	15.57	20.00
12.73	14.84	13.52	17.22	15.64	18.24
12.78	12.96	13.57	13.50	15.68	16.69
12.78	12.86	13.60	15.31	15.75	15.64
12.79	16.26	13.62	16.60	15.99	15.84
12.81	14.59	13.62	15.78	16.47	20.94
12.82	14.19	13.65	13.95	16.83	16.30
12.82	18.16	13.67	15.10	17.00	17.40

Table 17: Conger eel measurements, period 6

Element	Articular	Basioccipital		Dentary		Opercular		Premaxillae				vomer
Measurement	GB	GH	GB	M4	M5	GH	GB	GL	GH	M4	M5	GB
	8.65	13.45	10.11	6.22	4.73	8.89	9.27	71.27			4.78	7.37
	9.26	11.40	8.89		5.09	0.00	11.71	84.47			5.96	7.67
	9.57	0.00	0.00	6.35	5.25	7.36	7.94	77.41			4.50	7.72
	9.76	11.88	8.87	6.80	5.25	8.15	7.72				5.56	8.04
	9.83				5.26	10.84	11.92				5.36	9.87
	9.84				5.37				11.76	8.09	3.73	
	10.16			6.76	5.50				12.04			
	10.45				5.62			56.38	12.48	9.40	3.63	
	10.93				5.66				12.70		4.74	
	11.04			7.49	5.75			57.36	12.74	9.00		
	11.10			9.17	5.78			70.95	12.75	8.10		
	11.22				5.85			68.85	13.88	9.54	4.42	
	11.26			6.94	5.92				14.41	10.38	4.20	
	11.56			8.48	5.96				14.46	9.34	4.29	
	11.60			8.84	6.03				14.84	10.30	4.39	
	11.71			7.29	6.04				15.16	10.54	4.41	
	12.17				6.11				15.34	11.30	4.32	
	12.38				6.21				15.59	10.54	5.04	
	12.67			7.27	6.22			69.97	15.64	9.76	4.71	
min	8.65				6.32			73.20	15.72	11.82	4.71	
max	12.67				6.36			76.92	15.90	11.86	4.33	
mean	10.80				6.45			81.28	16.09	12.36	5.04	
				8.61	6.47				16.23	10.54	4.50	
				8.52	6.51				16.24	11.08	5.32	
				8.80	6.74				16.47	10.88	4.94	
				8.86	6.77				17.09	11.05	5.36	
					6.77				17.20	13.40	6.00	
				12.06	6.80				18.48	13.49	5.42	
				10.26	6.93				18.48	9.94	5.22	
					6.95				11.76	8.09	3.63	
				10.17	6.97				18.48	13.49	6	
				8.93	7.01				15.07	10.58	4.80	
				9.76	7.02							
				10.38	7.12							
					7.31							
				10.12	7.32							
					7.47							
				10.74	7.50							
					8.19							
				11.00	8.70							
			min	6.22	4.73							
			max	12.06	8.7							

Table 18: Whiting measurements, period 6

Measurement	GL	GH	GB	M4	M5
Precaudal vertebrae	-	8.70	7.56	-	-
	-	8.52	7.56	-	-
	-	8.66	7.44	-	-
	-	8.82	5.76	-	-
	-	6.40	6.15	-	-
	-	7.40	7.20	-	-
	-	7.67	7.07	-	-
	-	7.07	6.53	-	-
	-	7.23	6.98	-	-
	-	6.39	4.98	-	-
	-	7.45	6.37	-	-
	-	8.15	7.03	-	-
	-	7.23	6.87	-	-
	-	7.19	7.15	-	-
	-	7.74	6.72	-	-
min	-	6.39	4.98	-	-
max	-	8.82	7.56	-	-
mean	-	7.64	6.76	-	-
quadrate	-	-	4.75	-	-
	-	-	6.13	-	-
	-	-	5.85	-	-
Premaxillae	-	-	-	5.14	2.58
	-	14.72	-	12.44	5.90
	-	12.77	-	10.12	4.10
Dentary	-	-	-	6.73	3.03
	-	-	-	5.67	2.54
	-	-	-	3.02	2.34
Articular	-	-	4.51	-	-
	-	-	4.96	-	-
	-	-	4.18	-	-

Table 19: Cod measurements, period 6

Measurement	GH	M4	M5
Dentary			8.27
Premaxillae	15.48	15.71	7.08
	23.45	19.41	10.59
	24.06	19.02	9.36
	20.09	16.24	8.85
	23.82	19.73	9.48
	20.58	18.78	10.32
	23.28	19.42	11.02

	GL	GH
Precaudal vertebrae	6.59	9.86
	8.50	13.82
	9.87	13.73
	9.95	20.58
	10.41	13.08
	10.56	13.18
	11.09	16.36
	11.13	15.16
	11.27	14.39
	11.63	17.77
	11.98	15.83
	12.42	16.80
	12.44	19.03
	12.45	21.03
	12.47	16.48
	12.52	15.52
	12.52	16.87
	12.86	12.84
	12.96	17.50
	12.96	19.66
	13.14	23.53
	13.34	18.68
	13.50	14.22
	13.60	21.74
	13.97	18.53
	13.98	17.25
	14.41	18.33
	14.68	16.46
	14.87	18.06
	14.92	20.58
	15.46	19.20
	15.54	19.63
	15.75	19.96
	16.09	19.34
	16.11	20.31
	16.23	20.30
	16.32	20.15
	16.38	19.48
	16.55	22.00
	16.55	22.00
	16.90	21.06
	16.93	19.25
	17.40	24.64
	17.93	20.48
range	6.59-17.93	9.86-2464
mean	13.57	18.06
n	44	44

Table 20: Hake measurements, period 8

	GL	GH	GB	M4	M5
Articular	-	-	9.54	-	-
	-	-	8.76	-	-
Atlas	-	6.41	10.64	-	-
Dentary	-	-	-	12.69	6.21
	-	-	-	16.02	7.09
	-	-	-	14.25	6.57
	-	-	-	12.16	6.93
	-	-	-	16.22	9.82
Premaxillae	-	13.52	-	14.45	-
	-	13.27	-	13.16	-
	-	14.60	-	16.25	-
	-	18.03	-	13.45	-
	-	18.42	-	16.02	-
	-	14.26	-	12.92	-
	-	12.78	-	14.42	-
	-	12.60	-	13.86	-

Table 20: hake measurements, period 8 (continued)

Precaudal vertebrae

GB	GH	GB	GH	GB	GH	GB	GH	GB	GH
8.84	17.27	10.78	13.69	11.84	13.17	13.02	14.22	14.50	18.44
8.88	11.63	10.80	12.38	11.88	15.66	13.02	16.46	14.56	18.40
8.91	12.04	10.84	13.94	11.90	16.02	13.08	15.62	14.66	17.13
9.06	9.42	10.86	12.61	11.94	16.74	13.12	13.04	14.71	16.71
9.06	15.32	10.89	14.92	12.00	14.24	13.13	14.80	14.81	15.25
9.08	17.06	10.90	12.07	12.01	14.60	13.14	16.29	14.88	14.13
9.20	12.78	10.92	12.90	12.03	15.32	13.17	13.98	14.97	15.26
9.22	11.54	10.94	13.04	12.05	14.78	13.18	14.42	14.98	14.52
9.24	12.25	10.94	15.58	12.06	17.24	13.25	14.61	15.00	16.64
9.24	15.36	10.94	16.16	12.08	16.31	13.30	15.46	15.06	16.43
9.28	13.43	10.97	13.14	12.10	12.33	13.31	15.07	15.16	14.69
9.40	11.32	10.97	17.92	12.12	14.68	13.31	17.06	15.20	15.18
9.46	11.44	10.99	15.44	12.13	14.98	13.32	13.83	15.22	15.54
9.48	12.03	11.04	13.16	12.14	17.05	13.33	17.83	15.24	16.26
9.54	15.47	11.06	12.08	12.15	16.41	13.36	15.39	15.32	18.62
9.57	14.38	11.06	12.84	12.17	14.27	13.38	15.46	15.34	18.24
9.58	15.60	11.06	14.11	12.17	14.94	13.42	16.26	15.42	18.16
9.60	11.51	11.07	12.46	12.24	12.88	13.43	15.32	15.54	15.62
9.68	11.24	11.08	13.46	12.26	15.54	13.44	15.23	15.62	16.14
9.68	11.43	11.08	14.96	12.26	16.94	13.44	15.55	15.78	16.94
9.73	16.48	11.10	12.03	12.28	15.53	13.48	15.00	15.91	16.00
9.86	12.64	11.10	15.62	12.29	16.10	13.48	18.03	15.92	16.44
9.87	15.12	11.12	11.79	12.34	14.44	13.49	16.86	16.04	17.32
9.94	16.14	11.13	10.44	12.37	17.78	13.54	16.92	16.10	16.85
9.98	10.83	11.13	12.30	12.39	14.60	13.60	14.80	16.12	15.80
10.01	13.50	11.18	11.82	12.42	16.20	13.61	16.26	16.19	17.77
10.04	12.49	11.21	12.72	12.43	15.08	13.64	16.45	16.56	16.32
10.08	13.00	11.21	14.97	12.44	16.62	13.67	15.64	16.62	17.58
								17.58	17.06

Table 20: hake measurements, period 8 (continued)

Precaudal vertebrae

GB	GH	GB	GH	GB	GH	GB	GH	GB	GH
6.44	11.11	10.08	14.26	11.25	13.92	12.46	16.09	13.70	14.61
6.45	12.42	10.13	12.29	11.30	12.90	12.47	14.57	13.71	15.10
6.55	11.65	10.20	13.63	11.30	14.58	12.48	16.94	13.74	15.36
6.83	12.43	10.23	12.24	11.34	13.94	12.50	14.68	13.74	16.70
6.90	11.33	10.24	14.08	11.38	11.05	12.56	17.62	13.76	17.74
7.10	11.21	10.31	13.56	11.43	16.44	12.60	17.01	13.76	17.74
7.12	12.13	10.32	10.02	11.44	16.36	12.62	16.61	13.78	16.55
7.40	17.44	10.34	13.53	11.44	18.95	12.64	13.48	13.79	14.93
7.53	14.42	10.34	14.24	11.46	10.43	12.66	16.56	13.80	14.59
7.66	10.62	10.36	13.07	11.49	11.76	12.70	18.90	13.80	14.71
7.68	11.42	10.38	13.44	11.49	11.84	12.72	14.55	13.80	16.28
7.75	10.33	10.42	10.56	11.53	13.29	12.72	15.74	13.83	17.99
7.93	15.36	10.45	12.03	11.55	16.41	12.72	16.06	13.89	15.55
8.00	17.12	10.49	11.11	11.56	12.72	12.73	15.35	13.91	16.01
8.12	9.72	10.52	10.82	11.56	16.54	12.74	16.56	13.93	15.58
8.16	17.82	10.53	12.33	11.58	12.60	12.74	17.36	13.93	17.60
8.22	17.01	10.53	13.39	11.58	16.11	12.76	14.14	13.96	14.48
8.26	13.16	10.61	11.58	11.60	17.85	12.77	16.96	13.98	16.58
8.28	11.24	10.66	13.07	11.61	14.87	12.82	12.17	13.99	14.68
8.31	12.26	10.66	13.55	11.61	16.85	12.84	14.41	14.06	14.01
8.48	18.87	10.66	13.58	11.62	15.03	12.84	17.20	14.08	16.22
8.66	12.93	10.70	11.19	11.64	15.42	12.86	15.15	14.08	16.30
8.71	10.29	10.70	12.21	11.65	14.26	12.88	17.54	14.14	15.18
8.73	12.53	10.70	15.57	11.70	11.70	12.92	13.42	14.19	16.62
8.76	12.89	10.72	13.03	11.70	12.08	12.95	16.34	14.20	17.22
8.80	12.70	10.72	14.42	11.74	12.46	12.96	13.85	14.26	16.59
8.81	12.77	10.75	13.84	11.78	13.97	12.98	16.88	14.46	15.42
8.81	12.77	10.76	15.00	11.82	15.96	13.02	13.04	14.48	16.04

Table 21: Conger eel measurements, period 8

Articular	Dentary		Opercular	
GB	M4	M5	GB	GH
13.02	17.38	9.77	7.43	8.76
13.40	7.56	6.62	7.81	7.86
10.19			9.16	8.96
11.05				

Premaxillae			Precaudal vertebrae	
GH	M4	M5	GH	GB
15.82	13.46	5.48	7.55	12.19
15.18	10.70	4.46	7.67	14.76
0.00	0.00	8.44	8.10	10.60
			8.21	15.80
			8.29	12.63
			8.51	16.66
			8.76	13.44
			8.88	13.05
			8.98	15.18
			9.02	12.74
			9.02	17.08
			9.03	16.51
			9.13	16.23
			9.38	19.18
			9.40	17.90
			9.51	17.24
			10.32	17.59
			10.46	17.39
			10.75	18.64

Table 22: Cod measurements, period 8

Precaudal vertebrae

	GL	GH
	6.08	12.78
	7.70	8.90
	9.78	20.79
	12.31	14.00
	12.78	14.58
	13.11	15.02
	13.12	18.36
	13.42	20.89
	13.78	19.51
	13.86	16.99
	13.86	23.06
	13.99	17.37
	14.37	16.75
	14.62	21.15
	14.69	18.13
	14.76	18.32
	14.89	21.46
	15.11	21.56
	15.49	20.50
	15.52	22.67
	15.54	19.14
	15.59	21.72
	15.60	20.91
	15.64	20.90
	15.78	24.16
	16.01	19.57
	16.01	20.08
	16.24	21.10
	16.36	17.46
	16.66	23.20
	16.80	22.05
	16.86	22.16
	16.92	20.83
	18.67	22.24
	18.86	22.65
	19.00	22.41
	19.05	22.66
Min	6.08	8.9
Max	19.05	24.16
mean	14.83	19.62

List of figures

Figure 1: Distribution of the hand retrieved fish bone by period

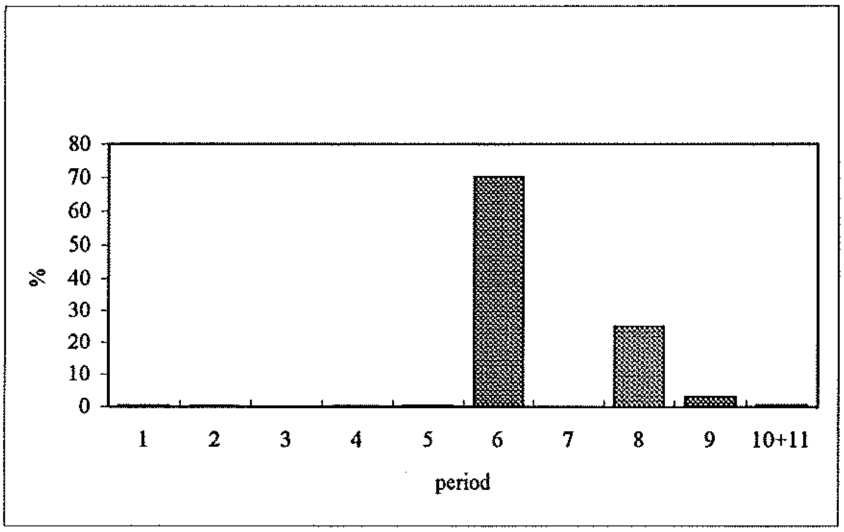


Figure 2: Distribution of the fish bone retrieved from the sieve by period

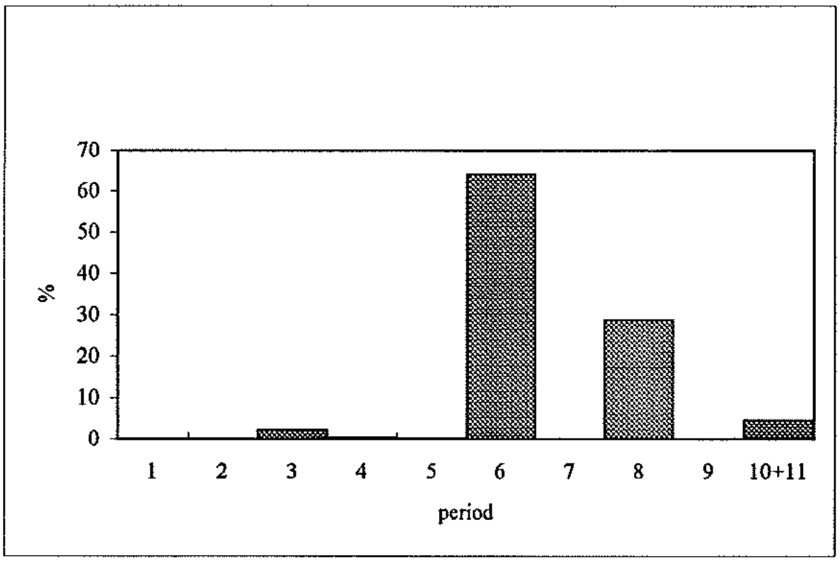


Figure 3: Distribution of the mammal and bird bones by period

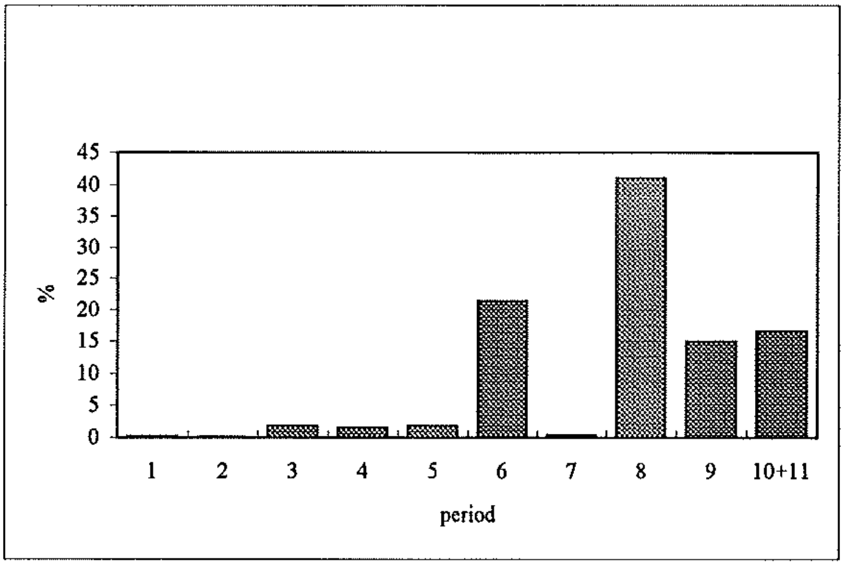
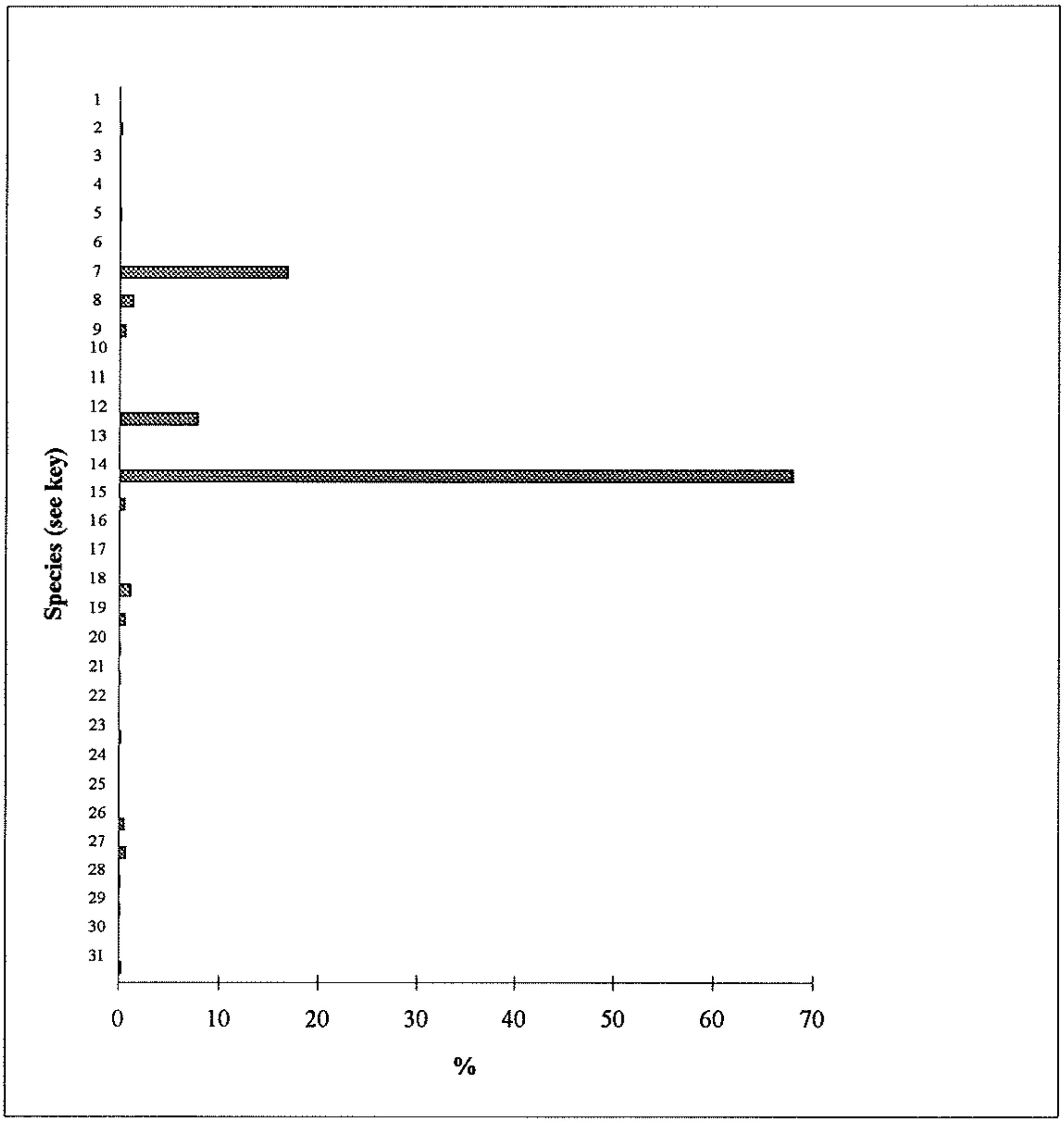


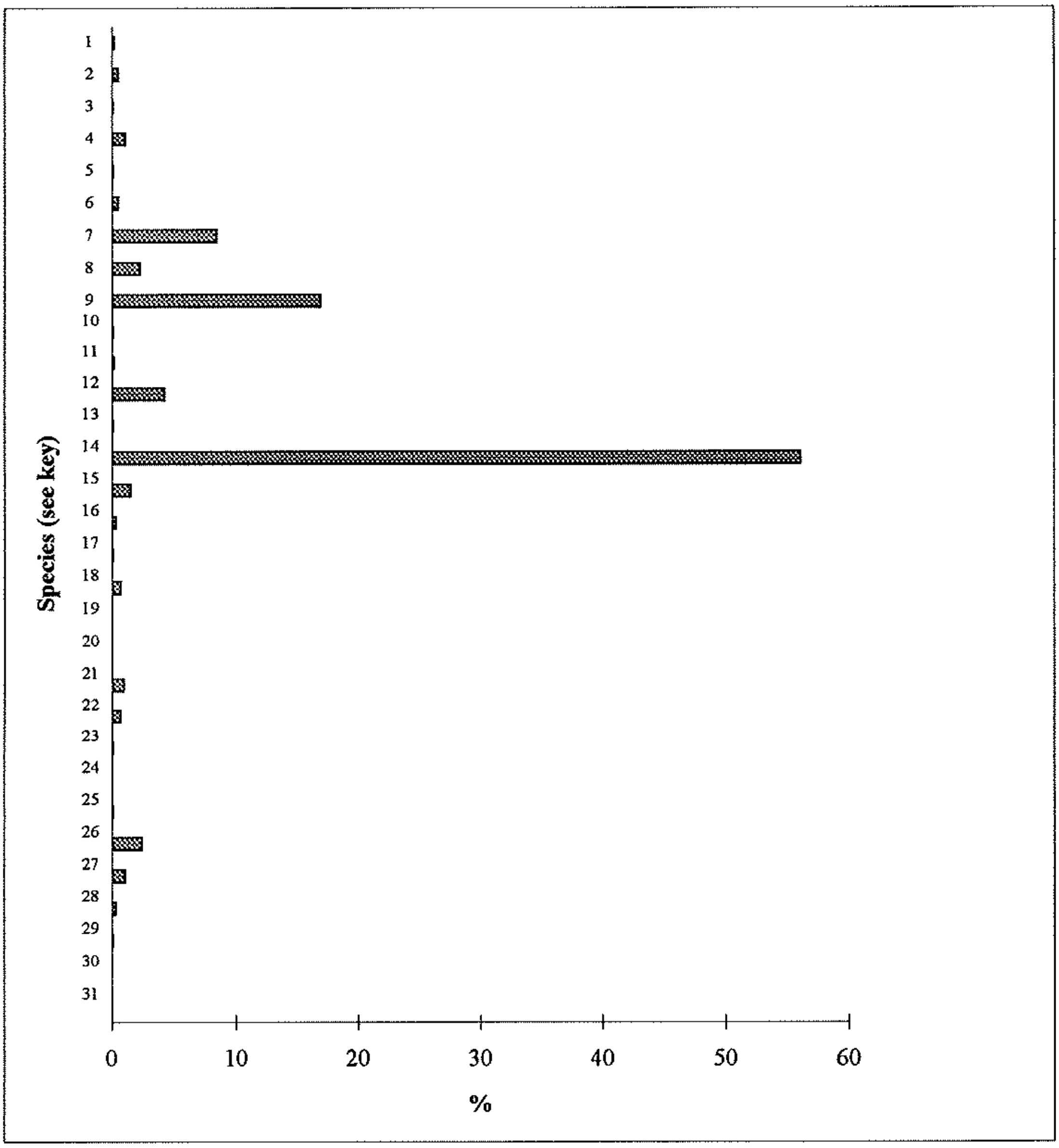
Figure 4: Hand retrieved fish bone, relative proportion of species



Key

1	spurdog	11	saithe	21	gilt head
2	ray	12	cod	22	wrasse
3	sturgeon	13	haddock	23	ballan wrasse
4	herring	14	hake	24	mullet
5	salmon	15	ling	25	mackerel
6	eel	16	scad	26	gurnard
7	conger eel	17	bass	27	grey gurnard
8	cod fishes	18	sea breams	28	flatfish
9	whiting	19	couch's sea bream	29	turbot
10	pollack	20	red sea bream	30	plaice
				31	halibut

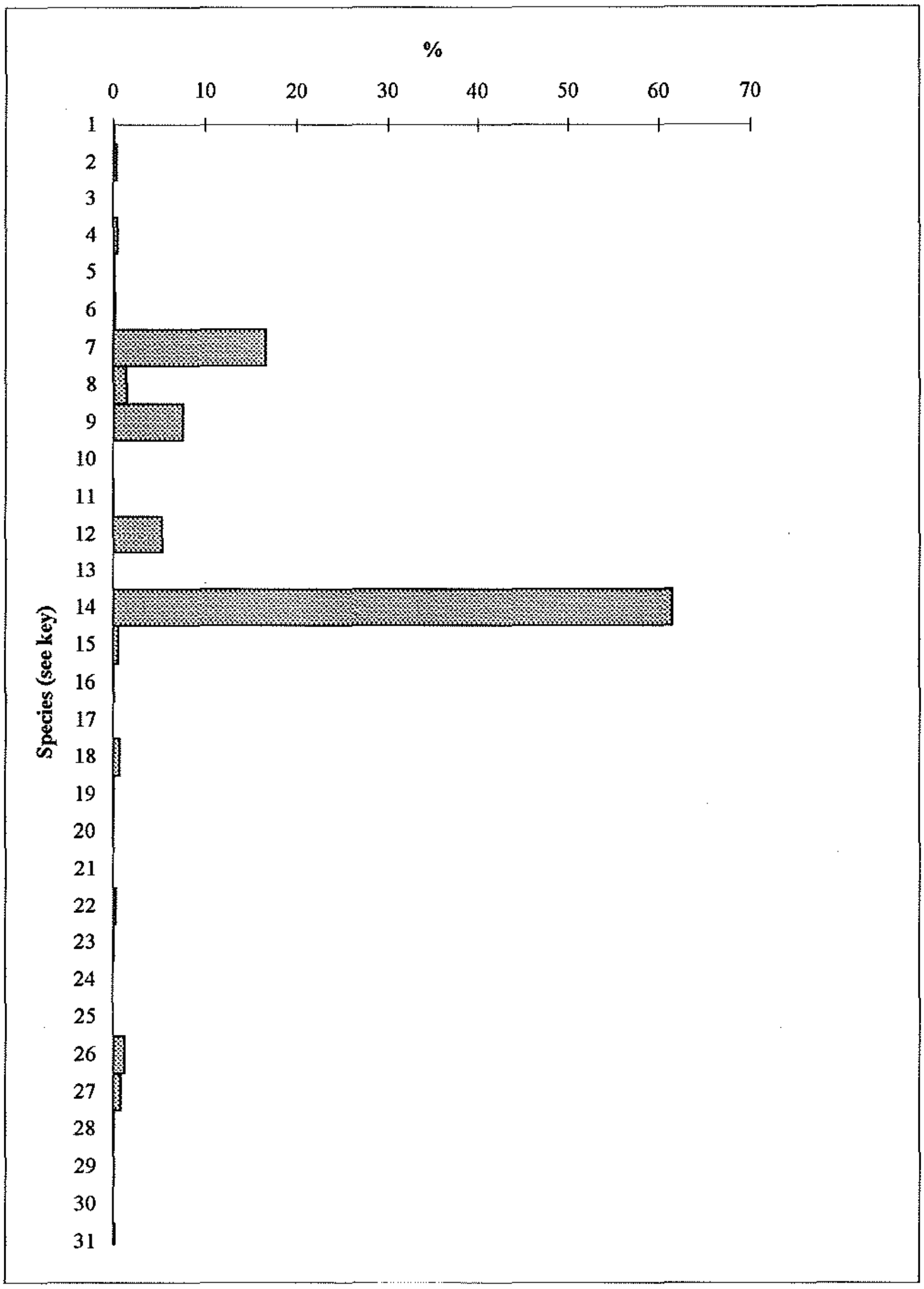
Figure 5: Fish bone from samples, relative proportion of species



Key

1	spurdog	11	saithe	21	gilt head
2	ray	12	cod	22	wrasse
3	sturgeon	13	haddock	23	ballan wrasse
4	herring	14	hake	24	mullet
5	salmon	15	ling	25	mackerel
6	eel	16	scad	26	gurnard
7	conger eel	17	bass	27	grey gurnard
8	cod fishes	18	sea breams	28	flatfish
9	whiting	19	couch's sea bream	29	turbot
10	pollack	20	red sea bream	30	plaice
				31	halibut

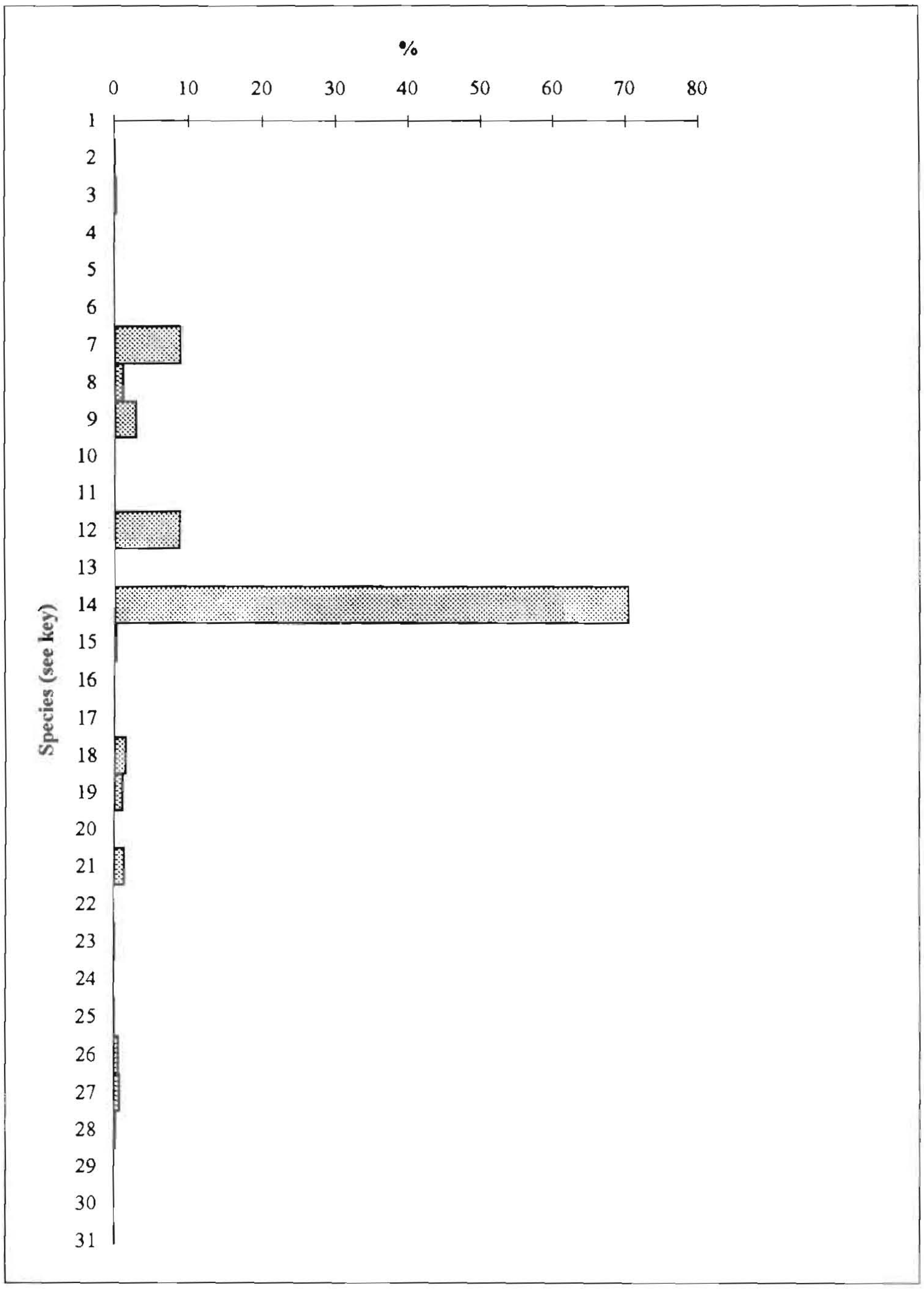
Figure 6: Period 6, relative proportion of species



Key

1 spurdog	11 saithe	21 gilt head
2 ray	12 cod	22 wrasse
3 sturgeon	13 haddock	23 ballan wrasse
4 herring	14 hake	24 mullet
5 salmon	15 ling	25 mackerel
6 eel	16 scad	26 gurnard
7 conger eel	17 bass	27 grey gurnard
8 cod fishes	18 sea breams	28 flatfish
9 whiting	19 couch's sea bream	29 turbot
10 pollack	20 red sea bream	30 plaice
		31 halibut

Figure 7: Period 8, relative proportion of species



Key

1 spurdog	11 saithe	21 gilt head
2 ray	12 cod	22 wrasse
3 sturgeon	13 haddock	23 ballan wrasse
4 herring	14 hake	24 mullet
5 salmon	15 ling	25 mackerel
6 eel	16 scad	26 gurnard
7 conger eel	17 bass	27 grey gurnard
8 cod fishes	18 sea breams	28 flatfish
9 whiting	19 couch's sea bream	29 turbot
10 pollack	20 red sea bream	30 plaice
		31 halibut

Figure 8 : Frequency graph showing the predicted lengths of the hake from Launceston Castle from the greatest height of the premaxilla

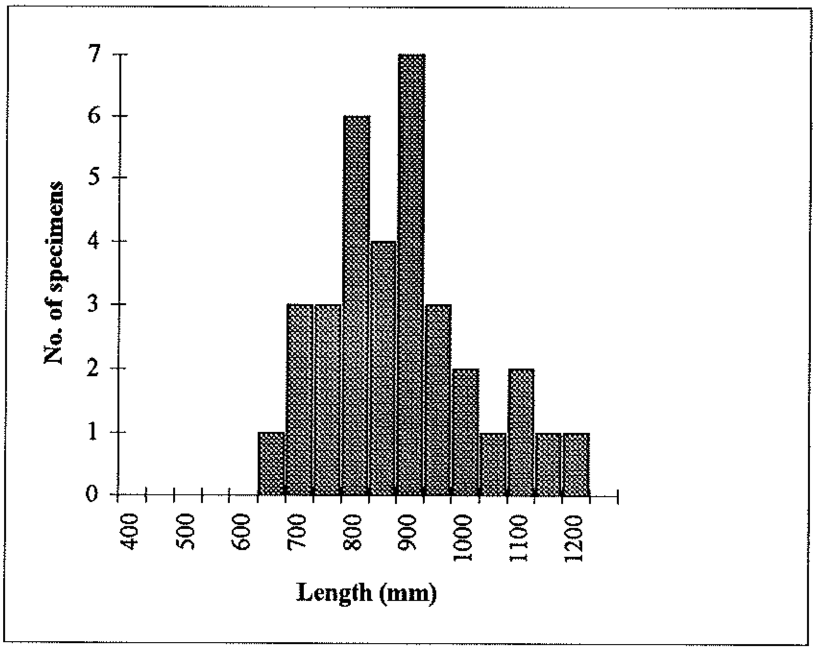


Figure 9 : Frequency graph showing the predicted lengths of the hake from Launceston Castle from M4 of the premaxilla

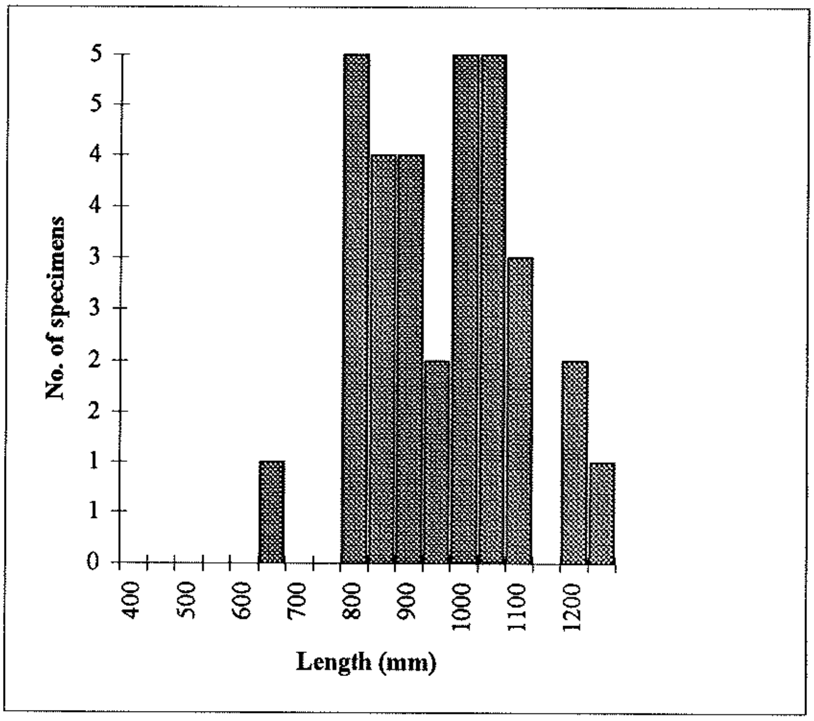


Figure 10 : Frequency graph showing the predicted lengths of the hake from Launceston Castle from M5 of the dentary

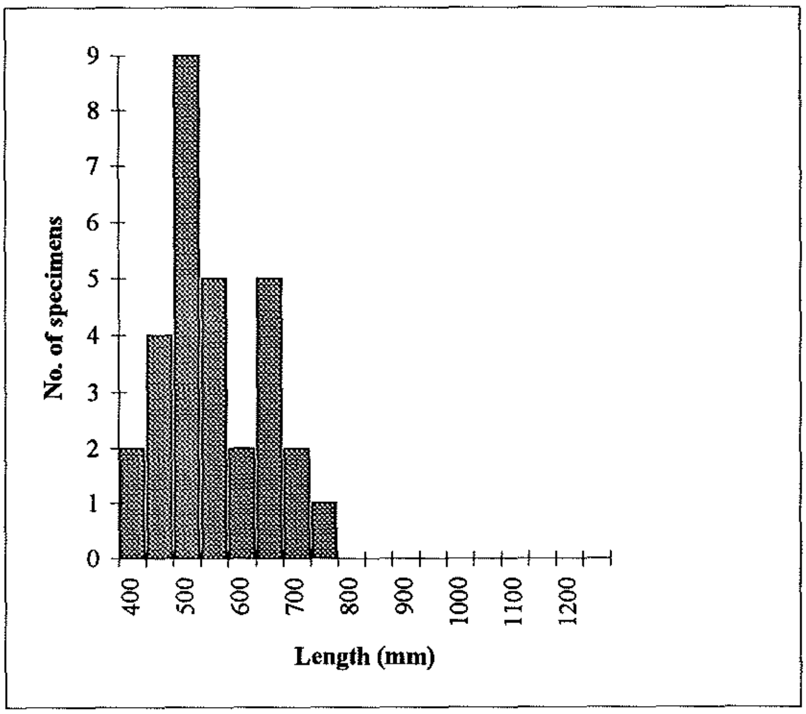


Figure 11 : Frequency graph showing the predicted lengths of the hake from Launceston Castle from the greatest breadth of the articular

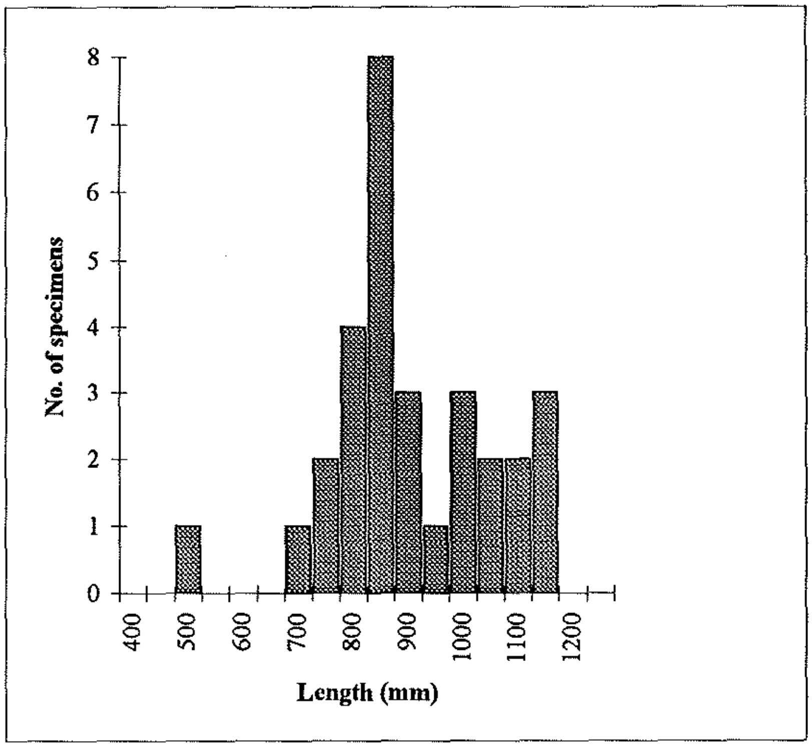


Figure 12 : Hake precaudal vertebrae: greatest height (GH)/ greatest breadth (GB) period 6

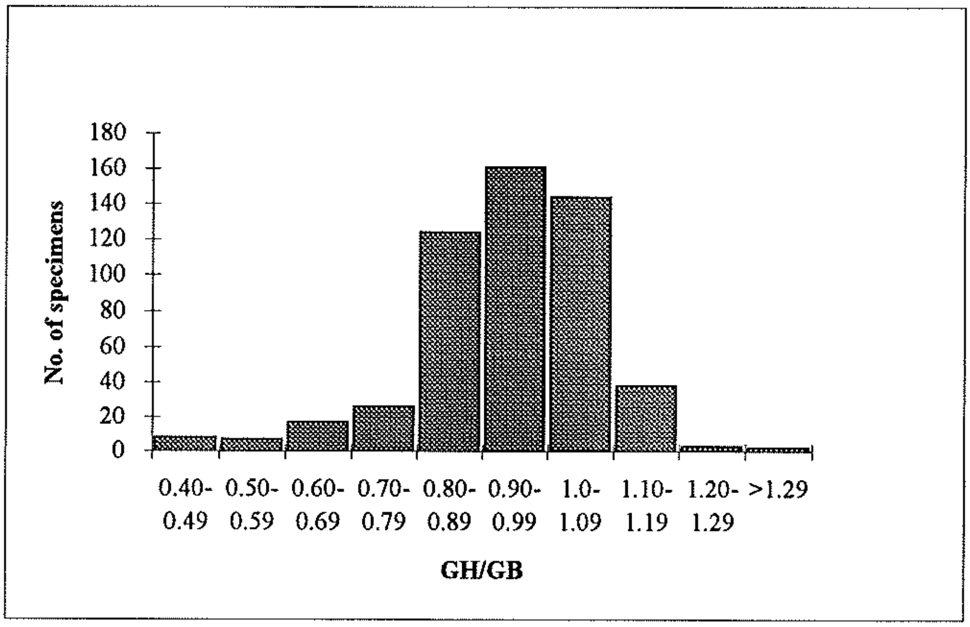


Figure 13 : Hake precaudal vertebrae: greatest height (GH)/ greatest breadth (GB) period 8

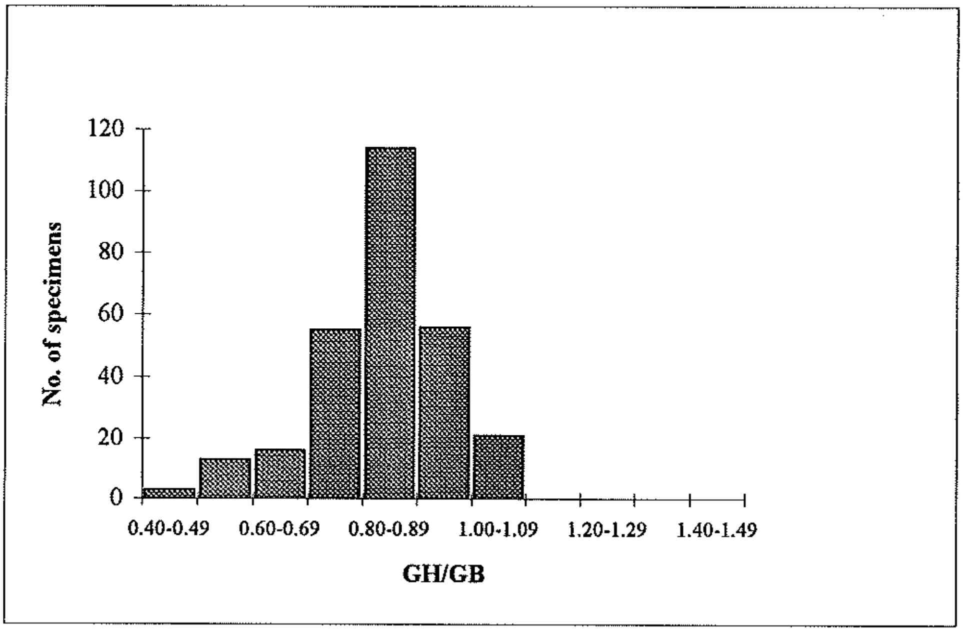


Figure 14: Modern hake precaudal vertebrae: greatest height (GH)/greatest breadth (GB)
Total length=630mm

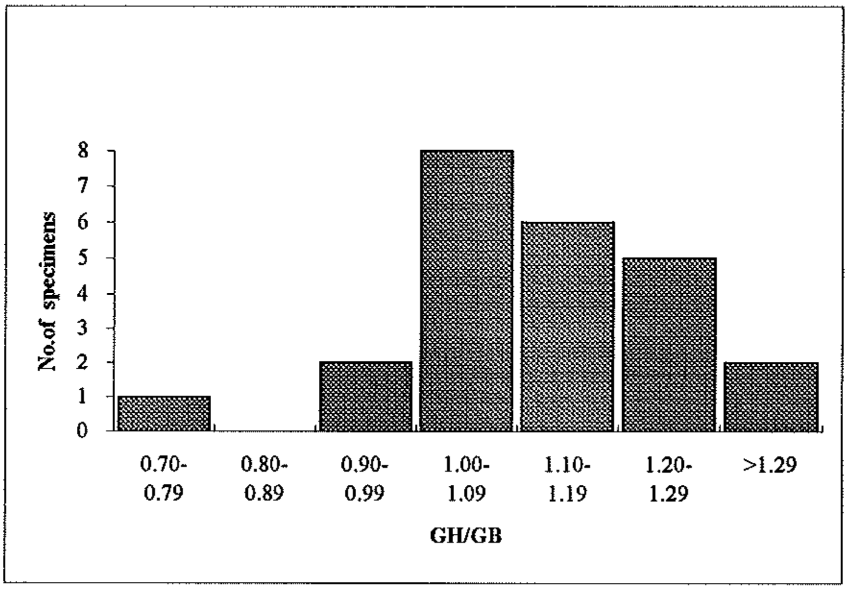


Figure 15: Modern hake precaudal vertebrae: greatest height (GH)/greatest breadth (GB)
Total length=420mm

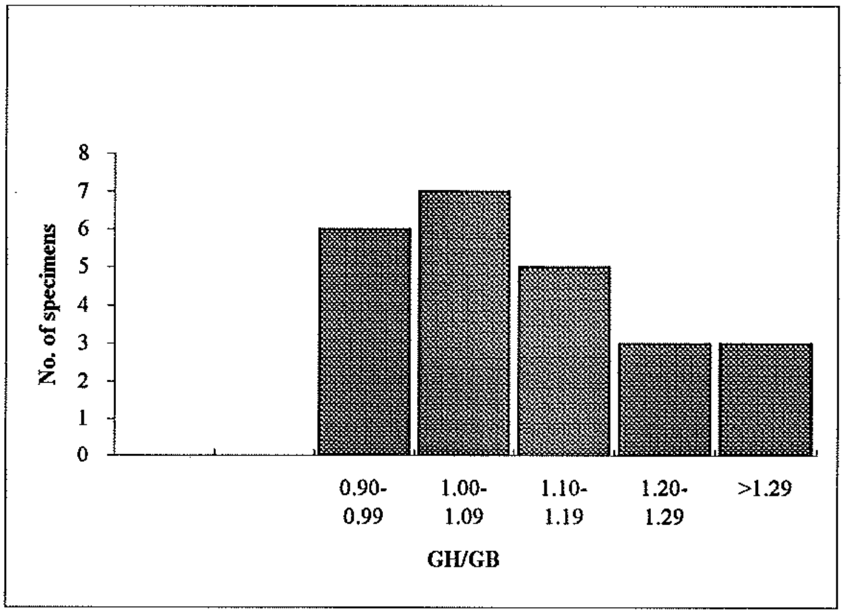


Figure 16: Modern hake precaudal vertebrae: greatest height (GH)/greatest breadth (GB)
Total length=749 mm

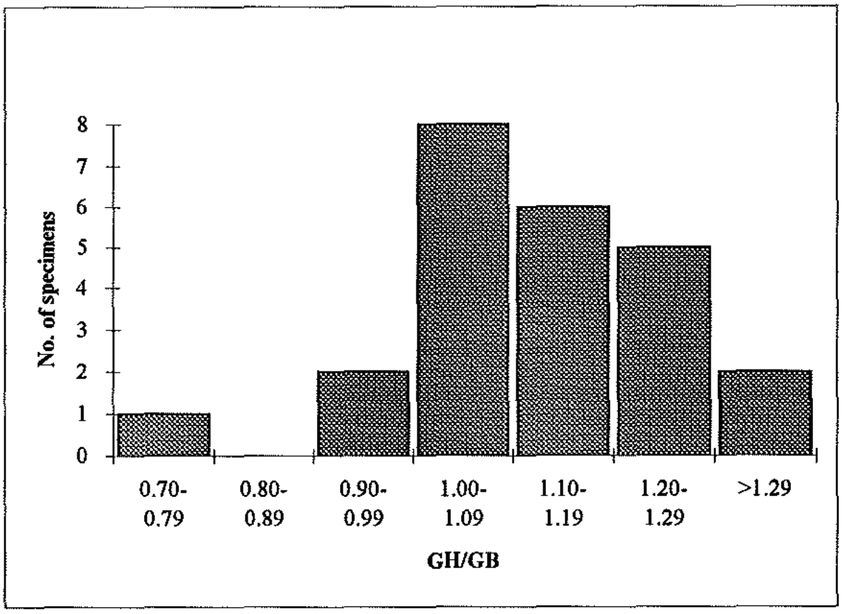


Figure 17: Modern hake precaudal vertebrae: greatest height (GH)/greatest breadth (GB)
Total length=430 mm