Fish bone from the Scotland's First Settlers test pitting programme

Rachel L. Parks

1. Introduction

Fish bone was recovered from 29 of the test-pitted sites, 11 of which are dated (the test-pitted material from Sand is not included here). Aside from work conducted in the Western Isles (Cerón-Carrasco 2002 and references within, 1998, Wheeler 1981) there is relatively little (published) fish bone evidence from the west coast of Scotland, compared to northern Scotland (for example Barrett *et al* 1999). This body of data therefore makes an important contribution to archaeo-ichthyological evidence from the area.

2. Recovery and Methodology

Recovery methods followed those outlined in Finlayson *et al* 1999:11. With the exception of SFS171 all samples were wet sieved to 1mm and the 2mm and 4mm fractions retained. Due to its remote location, a 50% sample of excavated material from SFS171 was dry sieved at the site using a 300m sieve (Hardy and Wickham-Jones 2000:18).

Analysis was conducted at the *fishlab*, Centre for Human Palaeoecology, University of York. Following the York system recording protocol (Harland *et al* 2003), 18 diagnostic elements (QC1 elements) are identified and fully recorded. This includes characteristics such as bone surface texture, element completeness, bone modification and estimated fish size. Vertebrae (QC2 elements) are identified to family or species level where possible. In addition, gadidae vertebrae are identified to 8 groups according to their place along the vertebral column (as defined in Barrett 1997). Special elements such as otoliths (QC4 elements) are recorded in a similar way to the QC1 elements. All other elements are recorded as QC0, this includes both non-diagnostic and truly unidentifiable bones. All bone fragments are counted and weighed.

Where possible fish bone measurements follow those used in the York system and references therein (Harland *et al* 2003). For some Labridae specimens it was necessary to use alternative measurements; these are defined in appendix i. Metric data is provided in appendix ii. The latin names for taxa mentioned in the text are listed in appendix iii.

3. Results

Assemblages which remain undated, and sites with fewer than 100 identified specimens (QC1, QC2 and QC4 elements) are not discussed in detail. SFS 49 is also not included in detail as the context information is poor. The number and weight of identified specimens from all sites are provided in tables 1 and 2. The estimated size of common gadid species is provided in table 3. A general trend across all sites and periods is the presence of saithe, pollack and cod as the dominant taxa. The majority of these are from small (151-300mm) and medium (301-500mm) sized fish. Larger gadids, typically associated with deep sea fishing are largely absent (SFS 22 is a notable exception as discussed below). In addition to the cod family fishes, herring and species belonging to the wrasse family are also common at many of the sites. Sites SFS 8, 89a, 20, 2, 41, 66 and 22 are discussed in more detail below.

3.1 SFS 8 Loch a Sguirr

Ten trenches were excavated at Loch a Sguirr, four of which, (trenches 1, 2, 3 and 10) produced fish bone (Finlayson *et al* 1999, 17). Trench 1 was excavated at the back of a small shelter within the main rockshelter, from which 343 diagnostic (QC1, QC2, and QC4) fish bones were identified (table 4). From trench 3, near the mouth of the small shelter, 132 diagnostic elements were recorded. From trench 2, in the centre of the cave, only 1

unidentifiable fish bone was recovered. The stratigraphy of the fish bone from trench 10, excavated at the back of the main rockshelter is problematic. The excavators describe this as a deposit that is probably associated with animal disturbance towards the back of the cave (Finlayson *et al* 1999, 17). Based on a qualitative assessment the fish bone is a mix of very small fragments with some larger elements of mostly wrasse and *Pollachius.* The material is very similar to modern otter spraint supplied by the International Otter Survival Fund from Broadford, Isle of Skye, and some of the fragments have concretion consistent with spraint (Nicholson 2000). For this reason no analysis of the material from trench 10 was undertaken.

To date, there are few substantial fish bone assemblages from the Mesolithic in Scotland. The fish bone evidence from the Oronsay shell middens (Mellars and Wilkinson 1980) and from Sand (Parks and Barrett this volume) suggests that the fishery in this period along the west coast was inshore based. This assumption, however, is based on only a handful of sites, and the fish bone from Loch A Sguirr (SFS8) is potentially an additional dataset. Three radiocarbon dates were obtained from trench 1; from spit 2 (6230-6000BC), spit 3 (6640-6250BC) and spit 6 (170-50AD). However, most of the diagnostic fish bones from trench 1 were recovered from spits 4 and 5 which are not dated. Many of the spits in test pit 1 are comprised of thin lenses, and the later date from spit 6 suggests that the deposits have been subject to disturbance. The fish bone from all spits from trench 1 is combined in the following analysis. Similarly, the fish bone from trench 3 is treated as one context.

The surface texture of the QC1 elements from trenches 1 and 3 was excellent to fair, and the majority of elements were over 20% complete (tables 5 and 6). Just over 20% of the fish bones from trench 1 were burnt, the majority charred black rather than calcined. From trench 3, only 16 fish bones were burnt, 15 of which were charred (table 7). The dominant taxa from both test pits were saithe or pollack and ballan wrasse (table 4). Wrasse are associated with a rocky shore and are shallow water fish (Whitehead *et al* 1986, 919). Based on the QC1 elements, the saithe and pollack from the site are mostly small (151-300mm) and medium (301-500mm) sized fish (table 3). The habitat of these taxa varies with age (and therefore length); small fish such as those from Loch a Sguirr are consistent with the littoral zone (Wheeler 1969, 272-273). The presence of young saithe and pollack, and the wrasse, therefore suggests the primary method of fishing used at the site was inshore based.

3.2 SFS 89a Coire Sgamhadail 1

The assemblage from Coire Sgamhadail 1, dated to 2250-1950 calBC and 2290-1880 calBC, is small (211 identified bones). Two test pits were excavated, but only context 8914 from test pit 1, near the mouth of the cave, contained more than 10 identifiable fragments of fish bone (table 8). This context was a layer of well preserved limpet shells (Hardy and Wickham-Jones 2000:41). Preservation of the fish bone (table 5) is also good (based on QC1 elements) and excellent (based on QC4 elements). QC1 element completeness is variable, but most are over 20% complete and the majority of otoliths (QC4) are over 80% complete (table 6). A small number (21) of specimens from context 8914 were charred black (table 7).

From this context, 932 bones were recovered, 20% of which were identified, including 34 QC1 elements and 83 vertebrae (table 8). There are too few identified specimens to allow a detailed discussion of element distribution, however, there are some interesting features with regards to species representation. The usual suite of species that might be expected, such as saithe, pollack and cod are underrepresented. The 75 otoliths from the context are surprising, given the small number of QC1 and QC2 elements. Specimens identified to saithe or pollack or to cod, saithe or pollack are only represented by otoliths, these include specimens from fish of an estimated total length of 801-1000mm. The majority of the otoliths are from small growing gadid species, identified to either Norway pout, bib or poor cod. In addition, taxa such as the corkwing wrasse, herring, and species belonging to the sea scorpion family are also represented by QC1 and QC2 elements.

3.3 SFS 20 Toscaig 2

Two test pits were excavated in this cave; test pit 1 (dated to the Middle Iron Age, see **xxxx this volume**) was located 2m from the mouth of the cave and test pit 2, 3m from the cave mouth (Hardy and Wickham-Jones 2000:26). A total of 3063 fish bones were recovered from the site, bone was recovered from 9 contexts from test pit 1 and 5 contexts from test pit 2 (table 9). In test pit 2 the contexts are largely mixed due to the slopewash described by the excavators (Hardy and Wickham-Jones 2000, 26). Because of the uncertainty surrounding the integrity of the contexts all the material from test pit 2 is treated as one deposit.

The number of identified diagnostic elements from each context in test pit 1 is small, if the material from the interface between contexts is excluded (table 9), and interpretation limited. From context 2014, 74 diagnostic elements were recorded. Gadids, species belonging to the wrasse family and plaice family were all represented in nominal amounts. The remaining contexts also have too few diagnostic elements to merit detailed discussion; table 9 shows the taxa and elements recorded. As a whole, however, the material from test pit 1 (in contrast to test pit 2) included very few saithe and pollack elements. The surface texture and element completeness of QC1 elements from test pit 1 is variable, and few bones were burnt (tables 5, 6 and 7).

Thirty-one of the fish bones from test pit 2 were burnt, all but one of the burnt specimens being charred rather than calcined white. Two hundred and forty-four diagnostic (QC1, QC2 and QC4) elements were recovered in total. The completeness of the QC1 elements was variable, and ranged from less than 20% to greater than 80% (table 6). The surface texture of the same QC1 elements was generally good (table 5). Saithe and pollack were the dominant species from test pit 2. Other taxa included species belonging to the wrasse family and cod. Most of the identified specimens are vertebra, with a smaller number of cranial and appendicular elements represented (table 9).

3.4 SFS 2 Crowlin 1

Three trenches were excavated at Crowlin 1. Fish bones were recovered from contexts 106, 108 and 110 from trench 1, at the back of the cave, and context 303 from trench 3. Of these only context 106 is dated, to 1400-1480AD (**XXXX this volume elephant)**. Based on surface texture, the preservation of the QC1 elements from all contexts was generally good (table 5). Element completeness was variable, but in context 106 most elements were over 20% complete (table 6). Thirty-two specimens from context 106 were burnt (table 7). The majority of diagnostic elements came from context 106, a shallow organic layer, and a smaller number (mostly vertebrae) from context 303 (table 10). From context 106, 310 elements were identified (61 QC1, 248 QC2 and 1 QC4). Nine QC1 elements, 70 QC2 elements and 1 QC4 element were recorded from context 303. Nominal amounts of fish bone were recorded from the other contexts.

From both contexts 106 and 303 the most common taxa was saithe or pollack; other species recorded in small amounts include herring and cod (table 10). Context 106 has a large enough assemblage to discuss the representation of *Pollachius* elements. There is a bias towards caudal vertebrae over abdominal vertebrae but caudal vertebrae are more abundant in the skeleton (Barrett 1995, 455). Turning to the QC1 elements from context 106, cleithra, and scapulae are missing. Rather than this being the result of the removal of the appendicular elements, this is more likely to be the result of a preservation bias, as the more robust supracleithrum is present. Other less robust elements such as the opercular are also missing.

3.5 SFS 41 Toscaig 9

Two test pits were excavated, test pit 1 inside the rock shelter and test pit 2 in front of it. Fish bone was recovered from 3 of the 4 contexts in test pit 1, and 2 of the 5 contexts in test pit 2. The largest assemblage of 405 diagnostic elements (45 QC1, 360 QC2) came from context

4112 (dated to 1460-1640AD, 1480-1650AD and 1380-1450AD) in test pit 1 and is discussed in more detail.

The majority of the QC1 elements from context 4112 had a good surface texture and were between 21-60% complete (tables 5 and 6). One hundred and sixty of the 1033 specimens were burnt, 48 of which were calcined white and 112 charred black (table 7). The most abundant taxa were saithe and pollack. Cod and species belonging to the wrasse family were also common, and other nominal taxa were recorded (table 11). Table 3 shows that many of the *Pollachius* specimens were from small (150–300mm) and medium (301-500mm) sized fish. Larger fish, indicative of deep sea fishing, are represented by 4 large (501-800mm) saithe specimens, 3 cod specimens from fish between 801-1000mm and one saithe element from a fish over 1 m long.

In terms of assessing whether fish processing took place at the site the element distribution pattern from context 4112 is interesting due to the lack of cleithra and supracleithra from the most abundant taxa (illus 1). There is good archaeological evidence from northern Scotland for the production of dried fish from the Viking Age and later based on butchery evidence and element distribution (Barrett *et al* 1999, Barrett 1997). The cleithrum and supracleithrum, along with caudal vertebra were typically left in the fish during processing (and then removed from the site), and cranial elements and abdominal vertebrae discarded (Barrett *et al* 1999, 37). In addition to the element representation this type of processing leaves a distinct pattern of cut marks (Barrett 1997).

If such processing had occurred at Toscaig 9, and processed fish were removed from the site, the lack of cleithra and supracleithra (and scapulae) should be accompanied by an under representation of caudal vertebrae, and cut marks (Barrett 1997). Considering again only the *Pollachius* specimens, posterior caudal vertebrae (caudal vertebra2) are less abundant than the more anterior vertebrae (table 11). It is unlikely that this element distribution pattern is the result of a preservation bias. The supracleithrum is a robust element and although the cleithum is less so, other less robust elements such as the hyomandibular and palatine are represented. Based on the element representation it is likely that the processing of fish took place at the site, however, the lack of butchery marks makes this interpretation inconclusive.

3.6 SFS 66 Ard Clais Salacher 2

One test pit was excavated and fish bones were recovered from all 4 contexts, however, only from context 6614, a shell midden layer dated to the mid 15th- mid 17th centuries, was a large enough assemblage recovered to warrant further discussion. From this context, preservation, indicated by surface texture was good, and element completeness was variable (tables 5 and 6). The number of burnt specimens (41) was minimal, the majority of which were charred (table 7).

The predominant taxa from context 6614 were, in order of abundance, saithe or pollack and cod. Species belonging to the wrasse family, other gadids not identifiable to species and nominal amounts of other taxa were also recovered. The full range of QC1 elements of the main taxa appear to be represented, with the exception of the scapula which is a fragile element (table 12). There appears to be no evidence for specialised processing activity. Specimens of the main taxa are from a range of sizes (table 3), including fish less than 150mm in estimated length, medium sized (301-500mm) fish, and some specimens from pollack over a metre long. The medium and small sized gadids could have been taken from near the shore, either with traps or nets, or by line. The few large pollack specimens may represent deeper water fishing, or, given their limited number, incidental catches.

3.7 SFS 22 Crowlin 3

Fish bones were recovered from contexts 3002, a dark humified layer dated to **XXXX elephant**, and 3003, a layer interpreted as animal fat during excavation, in test pit 1, which was situated at the rear of the cave (Hardy and Wickham-Jones 2000, 23). From both

contexts the surface texture of the QC1 elements was generally good, and element completeness variable (tables 5 and 6). Less than 5% of the bones in context 3002 were burnt whilst just over 15% of the bones from context 3003 were burnt. In both cases the majority were charred black rather than calcined white (table 7).

From context 3003, 1201 diagnostic elements were recorded (128 QC1, 978 QC2 and 45 QC4). 785 diagnostic elements were recovered from context 3002: 73 QC1 elements, 709 vertebrae and 3 QC1 elements (table 13). The dominant taxa from both contexts are saithe and pollack, ling and conger eel. Illustration 2 shows the QC1 element distribution pattern of the main gadid taxa for contexts 3002 and 3003. For both contexts the pattern seems to be largely the result of differential element survival, rather than fish processing at the cave. Robust and easily identifiable elements such as the quadrate and dentary are abundant, whilst less robust elements such as the scapula and cleithrum are under represented. Similarly, the vertebrae representation pattern is not consistent with one produced by processing.

In contrast to many of the Scotland's First Settlers test pitted sites there is evidence for deep water fishing at Crowlin 3. Specimens from conger eel, ling and cod over 1 metre long were recovered, and the majority of specimens were from fish of 301-500mm and above (table 14).

4. Summary

Although many of the assemblages are undated and have fewer than 100 identified specimens (QC1, QC2 and QC4 elements combined), some general comments can still be made. The majority of the assemblages are dominated by gadids, typically saithe and pollack. The abundance of pollack compared to assemblages from northern Scotland is surprising, and this may be due to this species being more abundant on the west coast.

The dates of the test pitted sites range from the Mesolithic to the post-Medieval. The fish assemblage from the trench with Mesolithic dates at Loch a Sguirr (SFS8) is interesting. The number of specimens from the two dated spits is small, but, if the contexts are combined the fish assemblage is similar to the pattern of inshore fishing for saithe at Oronsay, and *Pollachius* and wrasse at Sand. However, it is likely that the deposits have been disturbed given the later date from a lower context.

A common trend in the area seems to be towards inshore fishing of local species; the majority of the assemblages across all periods were dominated by immature saithe and pollack. At the Bronze Age site of Coire Sgamhadail 1 (SFS89a), however, these species were relatively underrepresented, and other shore based fish (small gadids and species belonging to the wrasse family) were most common. The fish bones from Toscaig 2 (SFS20) accord well with the pattern of inshore fishing of saithe and pollack from the Western Isles in the Iron Age (Cerón-Carrasco 2002,170). This pattern is replicated at the later sites of Ard Clais Salacher 2, dated to c.1450-1640 AD, and at Crowlin 1 (SFS 2), also post-Medieval in date. A notable exception to this is Crowlin 3 (SFS 22), as large sized fish including conger eel and ling were caught. Deep water fishing is also likely to have taken place at Toscaig 9 (SFS 41) in the post-Medieval period. It is also conceivable that fish processing occurred at the site.

Bibliography

Barrett, J.H. 1997. Fish trade in Norse Orkney and Caithness: a zooarchaeological approach. *Antiquity* 71, 616-638.

Barrett, J.H. 1995. '"Few know an earl in fishing-clothes." Fish middens and the economy of the Viking Age and Late Norse earldoms of Orkney and Caithness, northern Scotland'. Unpublished PhD thesis. University of Glasgow.

Barrett, J.H., Nicholson, R.A. and Cerón-Carrasco, R. 1999. 'Archaeo-ichthyological evidence for long-term socioeconomic trends in Northern Scotland: 3500 BC to AD 1500'. *Journal of Archaeological Science* 26, 353-388.

Cerón-Carrasco, R. 2002. 'Of fish and men, De iasg agus dhaoine: Aspects of the utilisation of marine resources as recovered from selected Hebridean archaeological sites'. Unpublished PhD thesis. University of Edinburgh.

Cerón-Carrasco, R. 1998. 'Fishing: Evidence for seasonality and processing of fish for perservation in the Northern Isles of Scotland during the Iron Age and Norse times', *Environmental Archaeology* 3, 73-80.

Finlayson, Hardy and Wickham-Jones, 1999. *Scotland's First Settlers 1999.* Data Structure Report. Centre for Field Archaeology, University of Edinburgh. Unpublished.

Hardy, K and Wickham-Jones, C.R. 2000. Scotland's First Settlers. Data Structure Report. Centre for Field Archaeology, University of Edinburgh. Unpublished.

Harland, J. F., J. H. Barrett, J. Carrott, K. Dobney, and D. Jaques. 2003. The York System: An integrated zooarchaeological database for research and teaching. *Internet Archaeology* 13: http://intarch.ac.uk/journal/issue13/harland_index.html.

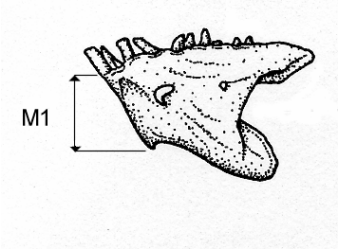
Mellars, P. A. and Wilkinson, M.R.1980. Fish Otoliths as Indicators of Seasonality in Prehistoric Shell Middens: the Evidence from Oronsay (Inner Hebrides). *Proceedings of the Prehistoric Society* 46, 19-44.

Wheeler, A. 1981. Report on the fish bones from the Monastic midden. In Reece, R. *Excavations in Iona 1964 to 1974*. Institute of Archaeology Occasional Publication no.5. London, Institute of Archaeology. p47-48.

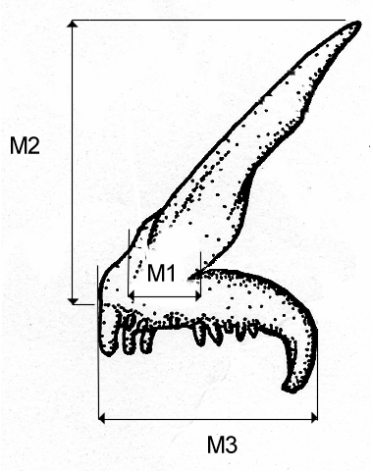
Wheeler, A. 1969. *The Fishes of the British Isles and North-West Europe*. Macmillan, London.

Whitehead, P. J. P., M. L. Bauchot, J. C. Hureau, J. Nielsen, and E. Tortonese. Editors. 1986. *Fishes of the North-eastern Atlantic and the Mediterranean Volume 3*. Paris: United Nations Educational, Scientific and Cultural Organization.

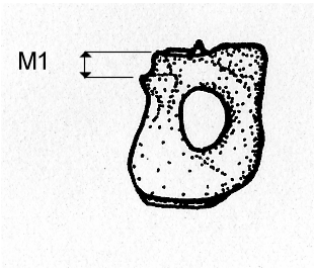
appendix i. Labrid dentary, premaxilla and scapula measurements, the left lateral view is shown. Drawings by Sven Schroeder based on *Labrus bergylta*. All other measurements used for labrids follow those defined in the York protocol.



dentary measurement



premaxilla measurements



scapula measurement

appendix ii. Fish QC1 and QC4 measurements taken (SFS8, 89a, 20, 2, 41, 66 and 22)

taxon	element	site	provenance	bone id	M1	M2	M3
conger eel							
	basioccipital	SFS22	3002	SFS22-8749	9.93	12.77	
	basioccipital	SFS22	3002	SFS22-9005	9.08	11.98	
	quadrate	SFS22	3002	SFS22-10963	10.58		
	quadrate	SFS22	3002	SFS22-10964	9.68		
	quadrate	SFS22	3002	SFS22-8690	8.37		
	quadrate	SFS22	3003	SFS22-8817	7.81		
three-bearded rockling							
	premaxilla	SFS20	2012/13	SFS20-10124	1.34		3.2
saithe							
	basioccipital	SFS2	106	SFS02-9813	2.31	2.91	
	basioccipital	SFS22	3002	SFS22-8743	3.3	3.75	
	basioccipital	SFS22	3002	SFS22-8791	2.65	3.45	
	basioccipital	SFS22	3003	SFS22-8984	1.88	2.21	
	basioccipital	SFS22	3003	SFS22-8985	2.4	3.16	
	basioccipital	SFS66	6614	SFS66-9427	1.75	2.01	
	dentary	SFS2	106	SFS02-11655		2.42	
	dentary	SFS2	106	SFS02-9795		2.48	
	dentary	SFS2	106	SFS02-9796		2.5	
	dentary	SFS20	TP2	SFS20-10873		3.12	
	dentary	SFS22	3002	SFS22-8753	2.71		2.86
	dentary	SFS22	3002	SFS22-8755	3.76	3.41	
	dentary	SFS22	3002	SFS22-9024	2.83	2.98	
	dentary	SFS22	3002	SFS22-9057		2.5	
	dentary	SFS22	3002	SFS22-9098		1.71	
	dentary	SFS22	3002	SFS22-9099		1.92	
	dentary	SFS22	3002	SFS22-9194	1.99	1.69	
	dentary	SFS22	3002	SFS22-9195	1.2	1.23	
	dentary	SFS22	3002	SFS22-9196	1.94	1.49	
	dentary	SFS41	TP1	SFS41-10257	2.4	2.8	
	dentary	SFS41	TP1	SFS41-10425		2.28	
	dentary	SFS66	6614	SFS66-9347	3.2	3.28	
	dentary	SFS66	6614	SFS66-9433		2.5	
	dentary	SFS66	6614	SFS66-9434	2.55	2.34	
	premaxilla	SFS2	303	SFS02-9683	3.95		5.54
	premaxilla	SFS2	106	SFS02-9809	2.31		3.3
	premaxilla	SFS20	2021/22	SFS20-11038	4.23		6.32
	premaxilla	SFS22	3003	SFS22-8994	2.71		3.56
	premaxilla	SFS22	3002	SFS22-9092	3.31		4.19
	premaxilla	SFS22	3002	SFS22-9093	3.24		4.17
	premaxilla	SFS22	3002	SFS22-9094	2.56		
	premaxilla	SFS41	2015	SFS41-10423	3.81		5.61
	premaxilla	SFS66	6614	SFS66-9430	3.29		4.83
	premaxilla	SFS8	trench1/spit4	SFS8-14284	2.29		
	premaxilla	SFS8	trench3/spit3	SFS8-14422	2.89		
	quadrate	SFS2	303	SFS02-9682	4.94		
	quadrate	SFS2	106	SFS02-9801	3.39		
	quadrate	SFS2	106	SFS02-9803	3.89		
	quadrate	SFS20	2021/22	SFS20-10868	4.61		
	quadrate	SFS20	2021/22	SFS20-10885	4.01		
	quadrate	SFS22	3002	SFS22-8710	4.47		
	quadrate	SFS22	3002	SFS22-8711	4.73		
	quadrate	SFS22	3002	SFS22-8712	3.92		
	quadrate	SFS22	3002	SFS22-8758	3.29		

taxon	element	site	provenance	bone id	M1	M2	M3
	quadrate	SFS22	3002	SFS22-8793	2.76		
	quadrate	SFS22	3003	SFS22-8816	4.11		
	quadrate	SFS22	3003	SFS22-8819	3.83		
	quadrate	SFS22	3003	SFS22-8989	2.52		
	quadrate	SFS22	3002	SFS22-9058	3.42		
	quadrate	SFS22	3002	SFS22-9090	3.23		
	quadrate	SFS41	4112	SFS41-10260	2.81		
	quadrate	SFS66	6614	SFS66-9339	3.74		
	quadrate	SFS66	6614	SFS66-9340	2.85		
	quadrate	SFS66	6614	SFS66-9396	3.65		
	quadrate	SFS66	6614	SFS66-9397	2.25		
	quadrate	SFS66	6614	SFS66-9398	1.99		
	quadrate	SFS66	6614	SFS66-9399	2.37		
	quadrate	SFS8	trench1/spit4	SFS8-14226	4.27		
	quadrate	SFS8	trench1/spit4	SFS8-14372	3.72		
pollack							
	basioccipital	SFS22	3002	SFS22-9136	3.76	5.18	
	basioccipital	SFS41	4112	SFS41-10265	3.19	4.41	
	basioccipital	SFS41	4112	SFS41-10388	2.03	2.43	
	basioccipital	SFS66	6614	SFS66-9348	3.96	5.91	
	dentary	SFS22	3002	SFS22-9023	3.69		
	dentary	SFS66	6614	SFS66-9332		5.35	
	premaxilla	SFS2	106	SFS02-9808	2.95		3.08
	premaxilla	SFS22	3003	SFS22-10747	4.91		5.65
	premaxilla	SFS22	3002	SFS22-8698	5.24		6.38
	premaxilla	SFS89a	8921	SFS89a-11376	11.8		13.07
	premaxilla	SFS2	106	SFS02-9802	2.28		
	premaxilla	SFS22	3003	SFS22-8818	5.53		
	premaxilla	SFS22	3003	SFS22-8988	3.99		
saithe or pollack							
	basioccipital	SFS20	2021/22	SFS20-11048	4.33	5.77	
	basioccipital	SFS22	3002	SFS22-8744	4.43	5.11	
	basioccipital	SFS22	3002	SFS22-8745	3.1	3.64	
	basioccipital	SFS22	3002	SFS22-8746	3.62	4.24	
	basioccipital	SFS22	3002	SFS22-8747	4.18	5.24	
	basioccipital	SFS22	3002	SFS22-9059	3.38		
	basioccipital	SFS41	4112	SFS41-10380	3.45	4.37	
	basioccipital	SFS41	4112	SFS41-10426	2.83	3.55	
	basioccipital	SFS41	4112	SFS41-10430	2.65	3.1	
	basioccipital	SFS8	trench1/spit4	SFS8-14227	3.39	4.94	
	dentary	SFS2	106	SFS02-9797		3.22	
	dentary	SFS22	3002	SFS22-8764		3.66	
	dentary	SFS22	3002	SFS22-9096		1.56	
	dentary	SFS22	3002	SFS22-9097		1.91	
	dentary	SFS22	3002	SFS22-9108		1.71	
	dentary	SFS66	6612	SFS66-10934	2.23		
	dentary	SFS66	6614	SFS66-9435		3.7	
	dentary	SFS66	6612	SFS66-9507	2.35	2.28	
	dentary	SFS66	6612	SFS66-9518	2.86	3.52	
	dentary	SFS8	trench1/spit5	SFS8-14368		2.78	
	otolith	SFS2	106	SFS02-9778	8.46	3.23	
	otolith	SFS20	2021/22	SFS20-11443		3.55	
	otolith	SFS20	2002	SFS20-11445		3.93	
	otolith	SFS20	2022-24	SFS20-11447		3.85	
	otolith	SFS20	2021/22	SFS20-11452		3.39	
	otolith	SFS20	2021/22	SFS20-11455	7.32	2.66	
	otolith	SFS20	2024	SFS20-11462	6.8	2.73	

taxon	element	site	provenance	bone id	M1	M2	M3
	otolith	SFS22	3003	SFS22-11472	10.75	3.98	
	otolith	SFS22	3003	SFS22-11475	13.79	5.55	
	otolith	SFS22	3002	SFS22-11476	12.99	4.49	
	otolith	SFS22	3002	SFS22-11477	10.07	4.26	
	otolith	SFS22	3002	SFS22-11479		3.08	
	otolith	SFS22	3003	SFS22-11480	8	3.43	
	otolith	SFS22	3003	SFS22-11481	8.83	3.52	
	otolith	SFS22	3002	SFS22-11485		3.5	
	otolith	SFS22	3002	SFS22-11486	7.89	3.11	
	otolith	SFS22	3002	SFS22-11487	7.32	2.96	
	otolith	SFS22	3002	SFS22-11488	7.75	2.89	
	otolith	SFS22	3002	SFS22-11489		3.08	
	otolith	SFS22	3002	SFS22-11491		4.17	
	otolith	SFS66	6614	SFS66-11464		4.42	
	otolith	SFS66	6614	SFS66-11466		3.12	
	otolith	SFS89a	8914	SFS89a-11501		4.53	
	otolith	SFS89a	8914	SFS89a-11534		2.63	
	otolith	SFS89a	8914	SFS89a-11535		2.97	
	otolith	SFS89a	8914	SFS89a-11537		3.35	
	otolith	SFS89a	8914	SFS89a-11543		2.42	
	otolith	SFS89a	8914	SFS89a-11571		3.92	
	otolith	SFS89a	8914	SFS89a-11572	2.77		
	otolith	SFS89a	8914	SFS89a-11573	2.94		
	otolith	SFS89a	8914	SFS89a-11574		2.53	
	premaxilla	SFS41	4112	SFS41-10222	4.86		6.21
	premaxilla	SFS41	4112	SFS41-10512	4.28		
	quadrate	SFS2	106	SFS02-9804	3.44		
	quadrate	SFS20	2021/22	SFS20-11083	3.43		
	quadrate	SFS22	3002	SFS22-9091	3.26		
	quadrate	SFS8	trench3/spit3	SFS8-14451	2.93		
cod							
	dentary	SFS2	106	SFS02-9745	2.38	2.61	
	otolith	SFS20	2012/13	SFS20-11453	14.51	7.02	
	otolith	SFS20	2012/13	SFS20-11454		6.49	
	otolith	SFS22	3002	SFS22-11473	18.15	10.06	
	otolith	SFS22	3002	SFS22-11482	19.41	10.32	
	otolith	SFS22	3002	SFS22-11483		10.22	
	otolith	SFS41	4111	SFS41-9884	17.93	10.05	
	otolith	SFS41	4111	SFS41-9885	18.76	9.44	
	otolith	SFS66	6612	SFS66-11467	11.76	6.13	
	quadrate	SFS22	3002	SFS22-8709	5.29		
	quadrate	SFS66	6614	SFS66-9337	4.5		
	quadrate	SFS66	6614	SFS66-9338	4.48		
cod, saithe or pollack							
	basioccipital	SFS66	6614	SFS66-9428	3.12	3.78	
	dentary	SFS22	3003	SFS22-8845		1.63	
	dentary	SFS22	3003	SFS22-8846		1.38	
	otolith	SFS89a	8914	SFS89a-11536		2.54	
	otolith	SFS89a	8914	SFS89a-11576		2.6	
	quadrate	SFS2	106	SFS02-9806	4.06		
ling							
	basioccipital	SFS22	3002	SFS22-9119	10.06	13.4	
	basioccipital	SFS22	3002	SFS22-9120	11.41	13.75	
	basioccipital	SFS22	3002	SFS22-9121	13.96	19.8	
	dentary	SFS22	3003	SFS22-10743	6.87	5.99	
	quadrate	SFS22	3002	SFS22-8708	7.32		

taxon	element	site	provenance	bone id	M1	M2	M3
haddock							
	basioccipital	SFS66	6614	SFS66-9429	3.05	3.3	
Norway pout							
	otolith	SFS89a	8914	SFS89a-11503	5.24	2.43	
bib							
	quadrate	SFS89a	8914	SFS89a-9612	1.72		
poor cod							
	otolith	SFS20	2015	SFS20-11442	6.16	2.96	
	otolith	SFS20	2012/13	SFS20-11456	5.64	2.95	
	otolith	SFS20	2014	SFS20-11457	7.71	3.77	
	otolith	SFS20	2014	SFS20-11458	7.07	3.4	
	otolith	SFS20	2014	SFS20-11459	7.1	3.66	
	otolith	SFS8	trench3/spit3	SFS8-14482		3.85	
	otolith	SFS89a	8914	SFS89a-11505	6.6	3.12	
	otolith	SFS89a	8914	SFS89a-11509	7.29	3.45	
	otolith	SFS89a	8914	SFS89a-11510	6.91	3.46	
	otolith	SFS89a	8914	SFS89a-11511	7.12	3.43	
	otolith	SFS89a	8914	SFS89a-11513	7.84	3.89	
	otolith	SFS89a	8914	SFS89a-11517	5.98	2.76	
	otolith	SFS89a	8914	SFS89a-11520	6.05	2.9	
	otolith	SFS89a	8914	SFS89a-11525	7.24	3.58	
	otolith	SFS89a	8914	SFS89a-11526	6.83	3.21	
	otolith	SFS89a	8914	SFS89a-11527	8.64	3.99	
	otolith	SFS89a	8914	SFS89a-11528	7.85	3.89	
	otolith	SFS89a	8914	SFS89a-11529	7.66	3.75	
	otolith	SFS89a	8914	SFS89a-11545	7.52	3.58	
	otolith	SFS89a	8914	SFS89a-11546		3.56	
	otolith	SFS89a	8914	SFS89a-11547		3.43	
	otolith	SFS89a	8914	SFS89a-11548		3.68	
	otolith	SFS89a	8914	SFS89a-11549	6.28	3.09	
	otolith	SFS89a	8914	SFS89a-11550	6.37	3.14	
	otolith	SFS89a	8914	SFS89a-11563	5.48	2.67	
Norway Pout, bib or poor cod							
	otolith	SFS20	2015/16	SFS20-11450	7.82	4.19	
	otolith	SFS89a	8914	SFS89a-11502		4.67	
	otolith	SFS89a	8914	SFS89a-11504	6.47	2.92	
	otolith	SFS89a	8914	SFS89a-11508	7.42	3.36	
	otolith	SFS89a	8914	SFS89a-11512	6.93	3.25	
	otolith	SFS89a	8914	SFS89a-11514	7.78	3.38	
	otolith	SFS89a	8914	SFS89a-11515	6.39	3.22	
	otolith	SFS89a	8914	SFS89a-11516		3.36	
	otolith	SFS89a	8914	SFS89a-11518	5.71	2.82	
	otolith	SFS89a	8914	SFS89a-11519	6.22	2.72	
	otolith	SFS89a	8914	SFS89a-11521	6	2.94	
	otolith	SFS89a	8914	SFS89a-11522	5.89	2.91	
	otolith	SFS89a	8914	SFS89a-11523	6.27	3.13	
	otolith	SFS89a	8914	SFS89a-11524		3.13	
	otolith	SFS89a	8914	SFS89a-11530		3.09	
	otolith	SFS89a	8914	SFS89a-11532	7.03	3.17	
	otolith	SFS89a	8914	SFS89a-11533	5.07	2.32	
	otolith	SFS89a	8914	SFS89a-11551		3.12	
	otolith	SFS89a	8914	SFS89a-11552	7.72	3.7	
	otolith	SFS89a	8914	SFS89a-11553	6.71	3.22	

taxon	element	site	provenance	bone id	M1	M2	M3
	otolith	SFS89a	8914	SFS89a-11554	7.14	3.45	
	otolith	SFS89a	8914	SFS89a-11555	6.94	3.26	
	otolith	SFS89a	8914	SFS89a-11556		3.27	
	otolith	SFS89a	8914	SFS89a-11557	7.22	3.27	
	otolith	SFS89a	8914	SFS89a-11558	6.13	2.93	
	otolith	SFS89a	8914	SFS89a-11559	6.44	3.05	
	otolith	SFS89a	8914	SFS89a-11560	6.55	2.98	
	otolith	SFS89a	8914	SFS89a-11561	6.19	3.24	
	otolith	SFS89a	8914	SFS89a-11562	5.72	2.73	
	otolith	SFS89a	8914	SFS89a-11564	6.08	3.15	
	otolith	SFS89a	8914	SFS89a-11567		2.59	
	otolith	SFS89a	8914	SFS89a-11568	5.05	2.42	
cod family							
	basioccipital	SFS2	106	SFS02-9815	1.36	1.78	
	basioccipital	SFS20	2013	SFS20-10137	4.6	6.13	
	basioccipital	SFS22	3002	SFS22-8748	5	7.26	
	basioccipital	SFS89a	8914	SFS89a-9610	1.82	2.31	
	dentary	SFS20	2013/14	SFS20-11768		1.61	
	dentary	SFS22	3002	SFS22-8756		3.29	
	dentary	SFS89a	8914	SFS89a-9595		3.79	
	dentary	SFS89a	8914	SFS89a-9613		1.56	
	otolith	SFS89a	8914	SFS89a-11531		3.51	
	premaxilla	SFS2	106	SFS02-9811	1.47		2.23
	premaxilla	SFS66	6614	SFS66-9432	3.21		
	quadrate	SFS20	2014	SFS20-10192	4.36		
	quadrate	SFS89a	8914	SFS89a-9615	3.1		
hake							
	premaxilla	SFS89a	8914	SFS89a-11386	12.58		10.07
Atlantic horse mackerel							
	otolith	SFS22	3002	SFS22-11484	8.92	4.31	
goldsinny							
	premaxilla	SFS20	2022-24	SFS20-11097	2.41	8.22	5.95
ballan wrasse							
	articular	SFS41	4112	SFS41-10494	3.21		
	basioccipital	SFS8	trench1/spit5	SFS8-14340	4.85	5.1	
	dentary	SFS20	2014/15	SFS20-10989	2.91		
	premaxilla	SFS20	2015	SFS20-10980	2.69	9.21	
	premaxilla	SFS8	trench1/spit4	SFS8-14183	6.16		
	premaxilla	SFS8	trench1/spit5	SFS8-14336	7.25		
	quadrate	SFS20	2012/13	SFS20-10101	7.36		
	quadrate	SFS41	4113	SFS41-10474	5.15		
	quadrate	SFS8	trench1/spit4	SFS8-14197	3.97		
	quadrate	SFS8	trench1/spit4	SFS8-14250	3.5		
	quadrate	SFS8	trench1/spit4	SFS8-14287	2.82		
	quadrate	SFS8	trench1/spit5	SFS8-14371	4.02		
	quadrate	SFS8	trench3/spit2	SFS8-14457	4.22		
	scapula	SFS8	trench3/spit3	SFS8-14418	2.07		
cuckoo wrasse							
	quadrate	SFS41	4111/12	SFS41-10204	3.36		
ballan or cuckoo wrasse							
	quadrate	SFS8	trench1/spit4	SFS8-14289	2.68		
	quadrate	SFS8	trench1/spit4	SFS8-14290	3.52		

taxon	element	site	provenance	bone id	M1	M2	M3
	quadrate	SFS8	trench1/spit4	SFS8-14291	2.48		
	scapula	SFS8	trench1/spit4	SFS8-14234	1.91		
	scapula	SFS8	trench1/spit4	SFS8-14235	1.91		
	scapula	SFS8	trench1/spit4	SFS8-14236	1.64		
	scapula	SFS8	trench1/spit4	SFS8-14237	1.92		
	scapula	SFS8	trench1/spit4	SFS8-14239	1.52		
	scapula	SFS8	trench1/spit4	SFS8-14240	1.33		
	scapula	SFS8	trench3/spit3	SFS8-14420	1.62		
wrasse family							
	basioccipital	SFS8	trench1/spit 4	SFS8-14200	2.93	3.26	
	basioccipital	SFS8	trench1/spit4	SFS8-14247	3.26	3.62	
	premaxilla	SFS20	2006	SFS20-11143	1.65		5.06
	premaxilla	SFS89a	8913	SFS89a-9573	1.51		
	quadrate	SFS20	2013/14	SFS20-10148	4.41		
	quadrate	SFS20	2006	SFS20-11142	2.17		
	quadrate	SFS8	trench3/spit3	SFS8-14402	5.31		
	scapula	SFS20	2025	SFS20-11126	1.6		
	scapula	SFS22	3002	SFS22-8788	2.12		
	scapula	SFS8	trench1/spit4	SFS8-14202	1.5		

appendix iii. Latin names for taxa mentioned in the text

common name	latin name
black mouthed dogfish	*Galeus melastomus*
dogfish families	Scyliorhinidae/Squalidae
spurdog	*Squalus acanthias*
ray family	Rajidae
elasmobranch	elasmobranch
eel	*Anguilla anguilla*
conger eel	*Conger conger*
herring	*Clupea harengus*
salmon family	Salmonidae
three-bearded rockling	*Gaidropsarus vulgaris*
rockling sp.	*Ciliata/Gaidropsarus*
saithe	*Pollachius virens*
pollack	*Pollachius pollachius*
saithe or pollack	*Pollachius*
cod	*Gadus morhua*
cod, saithe or pollack	*Gadus/Pollachius*
haddock	*Melanogrammus aeglefinus*
haddock?	*Melanogrammus aeglefinus?*
whiting	*Merlangius merlangus*
ling	*Molva molva*
Norway pout	*Trisopterus esmarki*
bib	*Trisopterus luscus*
poor cod	*Trisopterus minutus*
Norway pout/bib/poor cod	*Trisopterus*
cod family	Gadidae
hake	*Merluccius merluccius*
angler	*Lophius piscatorius*
grey gurnard	*Eutrigla gurnardus*
gurnard family	Triglidae
bull rout	*Myoxocephalus scorpius*
sea scorpion family	Scorpaenidae
Atlantic horse mackerel	*Trachurus trachurus*
sea bream family	Sparidae
corkwing wrasse	*Symphodus (Crenilabrus) melops*
goldsinny	*Ctenolabrus rupestris*
corkwing wrasse or goldsinny	*Symphodus (Crenilabrus) melops/Ctenolabrus rupestris*
ballan wrasse	*Labrus bergylta*
cuckoo wrasse	*Labrus bimaculatus*
ballan or cuckoo wrasse	*Labrus bergylta/Labrus bimaculatus*
wrasse family	Labridae
eelpout	*Zoarces viviparus*
butterfish	*Pholis gunnellus*
wolf-fish	*Anarhichas lupus*
sandeel family	Ammodytidae
dragonet	*Callionymus lyra*
dragonet family	Callionymidae
goby family	Gobiidae
Atlantic mackerel	*Scomber scombrus*
turbot family	Bothidae
plaice	*Pleuronectes platessa*
plaice family	Pleuronectidae
sole family	Soleidae
flatfish order	Pleuronectiformes