ELECTRONIC SUPPLEMENTAL TEXT

**Radiocarbon dating methodology**. A sample of ~1 cm3 of bone was cut from a whale rib for radiocarbon dating at the Keck Carbon Cycle AMS Facility in the Department of Earth System Science at the University of California, Irvine. An aliquot of 200mg of crushed bone was decalcified overnight in 1N HCl, gelatinized

overnight at 60°C and pH 2, and ultrafiltered to select a high molecular weight fraction (>30 kiloDaltons). The lyophilized collagen was combusted in vacuo in quartz at 900°C with CuO, graphitized by Fe-catalyzed hydrogen reduction, and 14C was measured by AMS.

Radiocarbon concentrations are shown as fractions of the modern standard (F14C) and conventional radiocarbon ages (Reimer et al., 2004). Sample preparation backgrounds have been subtracted based on measurements of 14C-free whale and mammoth bone, and the results have been corrected for isotopic fractionation using d13C values measured online with the AMS spectrometer. The d13C and d15N values shown here were measured separately on aliquots of ultrafiltered collagen to a precision of <0.1‰ and <0.2‰, respectively, using a Fisons NA1500NC elemental analyzer/Finnigan Delta Plus isotope ratio mass spectrometer.

**Institutional Abbreviations and Specimens.** The following institutional abbreviations and specimens were used for morphometric analysis, following Pyenson and Sponberg (2011) and Noakes et al. (2013) for gray whales. See Table S3 for data.

*Institutional Abbreviations.* **LACM**, Natural History Museum of Los Angeles County, Los Angeles, California, U. S. A.; **LML-GOGA**, Long Marine Laboratory, University of California, Santa Cruz, California, U. S. A.; **USNM**, National Museum of Natural History, Smithsonian Institution, Washington, D. C., U. S. A.; **UWBM**, Burke Museum of Natural History and Culture, Seattle. WA. U.S.A.

*Specimens measured*. LACM 54540, 54547, 72551, 84190, 84202, 84260, 85979, 85980, 86047, LML-GOGA-1982, USNM 364976, 364969, 364970, 364979, 364974, UWBM 442001.

Table S1. Radiocarbon Age Calculations

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **UCIAMS #** | **F14C** | **±** | **14C age** | **±** | **Calibrated age** | **Yield\*** | **d15N** | **d13C** | **%N** | **%C** | **C/N\*\*** |
|  |  |  | **(BP)** |  | **range (2 sigma)** | **(%)** | **(‰)** | **(‰)** |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |
| 243284 | 0.8443 | 0.0014 | 1360 | 15 | 655 - 1004 | 8.8 | 14.8 | -14.1 | 15.8 | 43.9 | 3.2 |

\* Ultrafiltered collagen wt/bone wt

\*\*Atoms C/atoms N

Table S2: Descriptions and intensity of butchery marks

|  |  |
| --- | --- |
| **Element** | **Butchery mark intensity and descriptions** |
| Skull | Moderate right exoccipital |
| Mandible (left) | Minimal distal and medial |
| Mandible (right) | Minimal (only proximal ventral) |
| Pre-maxilla (right) | Extensive at distal end and medial |
| Scapula (left) | Moderate (on coracoid) |
| Scapula (right) | Extensive |
| Humerus (right) | Moderate |
| Ulna (left) | Moderate at distal end |
| Ulna (right) | Moderate |
| Radius (left) | Moderate |
| Rib 4 (right) | Single mark |
| Rib 5 (right) | Minimal |
| Rib 6 (right) | Minimal |
| Rib 7 (right) | Moderate |
| Rib 9 (right) | Minimal |
| Rib 10 (right) | Minimal |

Table S3. All measurements in cm. Linear regression:

y = 49.87x - 276.06, R² = 0.895.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Specimens** | **Family** | **Genus** | **species** | **OCB** | **BIZYG** | **CBL** | **TL** |
| LACM 54540 | Eschrichtiidae | *Eschrichtius* | *robustus* | 18.1 | 52.6 | 96.3 | 460 |
| LACM 72551 | Eschrichtiidae | *Eschrichtius* | *robustus* | 26.5 | 101 | 222 | 1100 |
| LACM 84190 | Eschrichtiidae | *Eschrichtius* | *robustus* | 24.4 | 90.2 | 218 | 932 |
| LACM 84202 | Eschrichtiidae | *Eschrichtius* | *robustus* | 32.6 | 117 | 257 | 1180 |
| LACM 84260 | Eschrichtiidae | *Eschrichtius* | *robustus* | 28.8 | 120 | 246 | 1198 |
| LACM 85979 | Eschrichtiidae | *Eschrichtius* | *robustus* | 29.6 | 109 | 255 | 1150 |
| LACM 85980 | Eschrichtiidae | *Eschrichtius* | *robustus* | 26.9 | 100 | 235 | 1090 |
| LACM 86047 | Eschrichtiidae | *Eschrichtius* | *robustus* | 27.1 | 116 | 250 | 1170 |
| LACM 54547 | Eschrichtiidae | *Eschrichtius* | *robustus* | 14.3 | 43.3 | 86.3 | 460 |
| LML-GOGA | Eschrichtiidae | *Eschrichtius* | *robustus* | 30.7 | 121.5 | 280 | 1226 |
| USNM 364976 | Eschrichtiidae | *Eschrichtius* | *robustus* | 31.2 | 120 | 265 | 1260 |
| USNM 364969 | Eschrichtiidae | *Eschrichtius* | *robustus* | 31 | 125.7 | 267 | 1341 |
| USNM 364970 | Eschrichtiidae | *Eschrichtius* | *robustus* | 26.5 | 109.2 | 257 | 1181 |
| USNM 364979 | Eschrichtiidae | *Eschrichtius* | *robustus* | 26.2 | 97 | 207 | 1054 |
| USNM 364974 | Eschrichtiidae | *Eschrichtius* | *robustus* | 26.7 | 102.5 | 218 | 1085 |
| UWBM 442001 | Eschrichtiidae | *Eschrichtius* | *robustus* | 30.6 | 114.7 | 253.2 | 1200 |

Table S4: List of all documented North Atlantic gray whale specimens.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Anatomical element** | **Specimen number/s** | **Age (BP)** | **Collection Date & Locality** | **Original reference** | **Age reference** |
| 1 | Partial skeleton | Royal Cornwall M.; loan from Royal Geo. Soc. Cornwall. TRURI: Loan.350.8 | 1329 ± 195 | 1829, Cornwall, UK | Flower (1872) | Bryant (1995) |
| 2 | Partial skeleton | UPSZTY 2302, Lilljeborg (1861) | 4,395 ± 155 | 1859, Graso, Sweden | Lilljeborg (1861) | Persson (1986) |
| 3 | Vertebra | Torquay Museum |  | 1861, Babbacombe Bay, UK | Gray (1864), Pengelly (1865) | -- |
| 4 | Vertebra | Torquay Museum | 340 ± 260 | 1865, Babbacombe Bay, UK | Pengelly (1865), Gray (1866) | Bryant, 1995 |
| 5 | Partial skull | NML 13130 | 8330 ± 85 | 1879, Ijmuiden, Netherlands | Van Deinse and Junge (1937) | Bryant, 1995 |
| 6 | Partial skull | NML 630 | 1730 ± 50 | 1916 Ijmuiden, Netherlands | Van Deinse and Junge (1937) | Bryant, 1995 |
| 7 | Partial skeleton (skull) | NML 20350 | 4195 ± 45 | 1935, Wieringermeer-Polder, Netherlands | Denise and Junge (1937) | Bryant, 1995 |
| 8 | -- | -- | 2,024 ± 110 | 1978 Oostduinkerke-Koksijde,Belgium | Asselberg (1981) | Pers.comm w/ WMA DeSmet (in Bryant, 1995) |
| 9 | Left mandible | USNM 187448 | 455 ± 90 | 1850’s Toms River, New jersey | Mead and Mitchell (1984) | Mead and Mitchell (1984) |
| 10 | Partial skeleton | USNM 23260 | 865 ± 165 | 1959 Myrtle Beach, South Carolina | Mead and Mitchell (1984) | Mead and Mitchell (1984) |
| 11 | Partial skull | USNM 187449 | 10,140 ± 125 | 1969 Chesapeake Bay, Virginia | Mead and Mitchell (1984) | Mead and Mitchell (1984) |
| 12 | Left mandible | USNM 244465 | 865 ± 50 | 1970’s Nags Head North Carolina | Mead and Mitchell (1984) | Mead and Mitchell (1984) |
| 13 | Squamosal | USNM 244308 | 2,415 ± 90 | 1976 Corolla, North Carolina | Mead and Mitchell (1984) | Mead and Mitchell (1984) |
| 14 | Jaw | USNM 244307 | 275 ± 35 | 1977 Southampton, New York | Mead and Mitchell (1984) | Mead and Mitchell (1984) |
| 15 | Partial skull | USNM 299838 | -- | 1977 Corolla, North Carolina | Mead and Mitchell (1984) | -- |
| 16 | Squamosal | USNM 256749 | -- | 1978 Rehobeth, Delaware | Mead and Mitchell (1984) | -- |
| 17 | Partial skull | Hampton Mariners Museum, NC | 1,190 ± 245 | 1979 Cape Lookout North Carolina | Mead and Mitchell (1984) | Mead and Mitchell (1984) |
| 18 | Left mandible | GMNH 27372 | ~41,030 | 2008 JY reef | Noakes (2013) | Noakes (2013) |
| 19 | Left mandible | GMNH 27375 | ~48,340 | 2010 JY reef | Noakes (2013) | Noakes (2013) |
| 20 | Mandible juvenile | NMR 999100001877 | 1150-1270 | 2001  North Sea, Netherlands | Alter (2015) | Alter (2015) |
| 21 | -- | -- | 1350-1500 | -- North Sea, Netherlands | Alter (2015) | Alter (2015) |
| 22 | Mandible juvenile | NMR999100001783 | 1350-1500 | 1997 North Sea, Netherlands | Alter (2015) | Alter (2015) |
| 23 | Cervical vertebra | NMR999100001780 | 2650-2730 | 2003 North Sea, Netherlands | Alter (2015) | Alter (2015) |
| 24 | Vertebra | -- | >48,000 | -- North Sea, Netherlands | Alter (2015) | Alter (2015) |
| 25 | Large vertebra | NMR999100001938 | >48,000 | 2005 North Sea, Netherlands | Alter (2015) | Alter (2015) |
| 26 | Half atlas juvenile | NMR999100001781 | 42,500-43,300 | 2003 North Sea, Netherlands | Alter (2015) | Alter (2015) |
| 27 | Skull | NMR9990-0082 | 4950-5250 | -- North Sea, Netherlands | Alter (2015) | Alter (2015) |
| 28 | Skull | Barbant CollNr42002 | 3830-3960 | 1954 North Sea, Netherlands | Alter (2015) | Alter (2015) |
| 29 | Thoracic vertebra juvenile | NMR99910001790 | 960-1120 | 1994 North Sea, Netherlands | Alter (2015) | Alter (2015) |
| 30 | Lumbar vertebra | NMR999100001785 | 4230-4420 | 1995 North Sea, Netherlands | Alter (2015) | Alter (2015) |
| 31 | Axis | NMR999100001788 | >48,000 | 1996 North Sea, Netherlands | Alter (2015) | Alter (2015) |
| 32 | Axis | NMR999100001789 | 1820-1950 | 2005 North Sea, Netherlands | Alter (2015) | Alter (2015) |
| 33 | Caudal vertebra | NMR999100001786 | >50,000 | 2005 North Sea, Netherlands | Alter (2015) | Alter (2015) |
| 34 | Lumbar vertebra | NMR999100001791 | 3480-3630 | 2005 North Sea, Netherlands | Alter (2015) | Alter (2015) |
| 35 | Radius | NMR999100001784 | 10,000-10,180 | 2005 North Sea, Netherlands | Alter (2015) | Alter (2015) |
| 36 | Thoracic vertebra | NMR999100002102 | 5280-5430 | 2005 North Sea, Netherlands | Alter (2015) | Alter (2015) |
| 37 | Ulna | NMR999100001999 | 6620-6700 | 2005 North Sea, Netherlands | Alter (2015) | Alter (2015) |
| 38 | -- | Vol1, CollVonk/Texel | 5320-5470 | -- North Sea, Netherlands | Alter (2015) | Alter (2015) |
| 39 | -- | Vol2, CollVonk/Texel | 3470-3620 | -- North Sea, Netherlands | Alter (2015) | Alter (2015) |
| 40 | Ulna | NMR999100001998 | 40,200-41,400 | -- North Sea, Netherlands | Alter (2015) | Alter (2015) |
| 41 | Mandible | NMR999100001994 | 1680-1800 | -- North Sea, Netherlands | Alter (2015) | Alter (2015) |
| 42 | Thoracic vertebra | NMR999100001996 | 42,400-43,600 | -- North Sea, Netherlands | Alter (2015) | Alter (2015) |
| 43 | Mandible | NMR999100003115 | 3930-4070 | 2007 North Sea, Netherlands | Alter (2015) | Alter (2015) |
| 44 | -- | -- | 4020-4270 | -- North Sea, Netherlands | Alter (2015) | Alter (2015) |
| 45 | Skull,  calf | UF 69000 | 1500-2150 | 1983 Jupiter Island, Florida | Garrison (2019) | Garrison (2019) |
| 46 | Skull, juvenile | UF 99000 | 1570-2220 | 1970s Jacksonville Beach, Florida | Garrison (2019) | Garrison (2019) |
| 47 | Dentary | GMNH 4032 | 36,000 | 2006 South Atlantic bight, Georgia | Noakes et al., (2009), Garrison (2019) | Garrison (2019) |
| 48 | Dentary | GMNH 4024 | 41,490-42,070 | 2006 South Atlantic bight, Georgia | Garrison (2019) | Garrison (2019) |
| 49 | Dentary | GMNH 4281 | 40,230-41,550 | 2006 South Atlantic bight, Georgia | Garrison (2019) | Garrison (2019) |
| 50 | Dentary | GMNH 4215 | 38,350-39140 | 2006 South Atlantic bight, Georgia | Garrison (2019) | Garrison (2019) |
| 51 | Dentary | GMNH 4214 | 36,240-37,460 | 2006 South Atlantic bight, Georgia | Garrison (2019) | Garrison (2019) |
| 52 | Dentary | GMNH 7742a | 48,550-50,000 | 2006 South Atlantic bight, Georgia | Garrison (2019) | Garrison (2019) |
| 53 | Rib | NMS.Z.1935.50.34C | 1000-1200 | 1935, Jarlshof, Shetland, Scotland | Curle (1935a,b) | Kitchener (2021) |
| 54 | Thoracic vertebra | NMS.X.HAS 3210 | 1200-2800 | <1956, Jarlshof, Shetland, Scotland | Van den Hurk and McGrath (2021) | Kitchener (2021) |
| 55 | Rib | NMS.Z.1940.11.34 | 1500 - 2200 | 1940, Aikerness Broch, Orkney | Richardson (1948) | Kitchener (2021) |
| 56 | Fragment | Finds #5549 (context 1223) in Kitchener, 2021 | 1600-1900 | 1978-1982, Howe, Orkney | Ballin-Smith (1994) | Kitchener (2021) |
| 57 | Caudal vertebra | Finds #4688 in Kitchener, 2021 | 1550-1750 | 2018, The Cairns, Orkney | Carruthers (2018) | Kitchener (2021) |
| 58 | Cervical vertebra | Str.fn. 301 | 1750-1930 | 1997, Kringlevagen, Norway | Hufthammer (2018) | Hufthammer (2018) |
| 59 | Partial vertebra | WH815 in Rodrigues, 2018 | 1600-1770 | 2001, Algeciras, Spain | Rodrigues (2018) | Rodrigues (2018) |
| 60 | Whole scapula | WH810 in Rodrigues, 2018 | 2400-2200 (est.) | 1996, Asturias, Spain | Rodrigues (2018) | Rodrigues (2018) |
| 61 | Bone fragment | WH820 in Rodrigues, 2018 | 1950-1775 | 2012, Tetouan, Morocco | Rodrigues (2018) | Rodrigues (2018) |
| 62 | Cervical vertebra | 26C-122; WH609 in van den Hurk, 2022 | 800-2100 | --, Hallum, Friesland | Van den Hurk (2022) | -- |
| 63 | Bone fragment | 1915-VI.1; WH606 in van den Hurk, 2022 | 800-2600 | --, Rottum, Friesland | Van den Hurk (2022) | -- |
| 64 | Cranial fragment | Find no. 29173 in van den Hurk, 2022 | 1000-1150 | --, Domburg, Zeeland | Van den Hurk (2022) | -- |
| 65 | Multiple fragments | 75.17; WH634 in van den Hurk, 2022 | 1000-1250 | --, Den Burg, North Holland | Van den Hurk (2022) | -- |
| 66 | Tympanic bulla | Find no.1266 in van den Hurk, 2022 | 1600-1800 | --, Wijster, Drenthe | Van den Hurk (2022) | -- |
| 67 | Skull, appendicular, axial elements (42 total) | USNM PAL 706596 | 1. - 999 | ~1970s, Onslow Beach, North Carolina, USA | This paper | This paper |

**Supplemental References**

Ballin-Smith, B. 1994. Howe: Four millennia of Orkney prehistory excavations, 1978-1982. *Monograph of the Society of Antiquaries of Scotland* 9, Edinburgh.

Carruthers, M. 2018. The Cairns. Windwick Bay. Excavation. *Discovery and Excavation Scotland* 20, 137-138.

Curle, A. 1935a. An account of the excavation of a dwelling of the Viking period at Jarlshof, Sumburgh, Shetland, carried out on behalf of HM Office of Works. *Proceedings of the Society of Antiquaries of Scotland* 69, 265-321.

Curle, A.O. 1935b. The excavations at Jarlshof, Sumburgh, Shetland. *The Antiquaries Journal* 15(1), 26-29.

Hufthammer, A.K., Arntsen, L., Kitchener, A.C. and Buckley, M., 2018. Grey whale (Eschrichtius robustus) in Norwegian waters 2000 years ago. *Palaeogeography, Palaeoclimatology, Palaeoecology*, *495*, pp.42-47.

Kitchener, A.C., Szabo, V.E., Buckley, M., van den Hurk, Y., Mainland, I., Carruthers, M., MacKay, C. & Frasier, B.A. 2021. First records of grey whale, Eschrichtius robustus, from Scotland. *Mammal. Communications.* 7, 17-28.

Reimer P.J., Brown, T.A., Reimer R., 2004. Discussion: Reporting and Calibration of Post-Bomb 14C Data. Radiocarbon 46(3):1299-1304

Richardson, J.S. 1948. The Broch of Gurness: Aikerness, West Mainland, Orkney. H.M. Stationery Office, Edinburgh

van den Hurk, Y. & McGrath, K. 2021. Whaling in Iron Age to Post-Medieval Scotland: A zooarchaeological and biomolecular study of cetacean remains from selected sites in Caithness, the Orkney Islands and the Shetland Islands. *Proceedings of the Society of Antiquaries of Scotland* 150, 451-474.

van den Hurk, Y., Spindler, L., McGrath, K. and Speller, C. 2022. Medieval Whalers in the Netherlands and flanders: zooarchaeological analysis of medieval cetacean remains. *Env. Archaeol.* 27(3), 243-257.