**Supplementary materials**

Holocene deglaciation drove rapid genetic diversification of Atlantic walrus.

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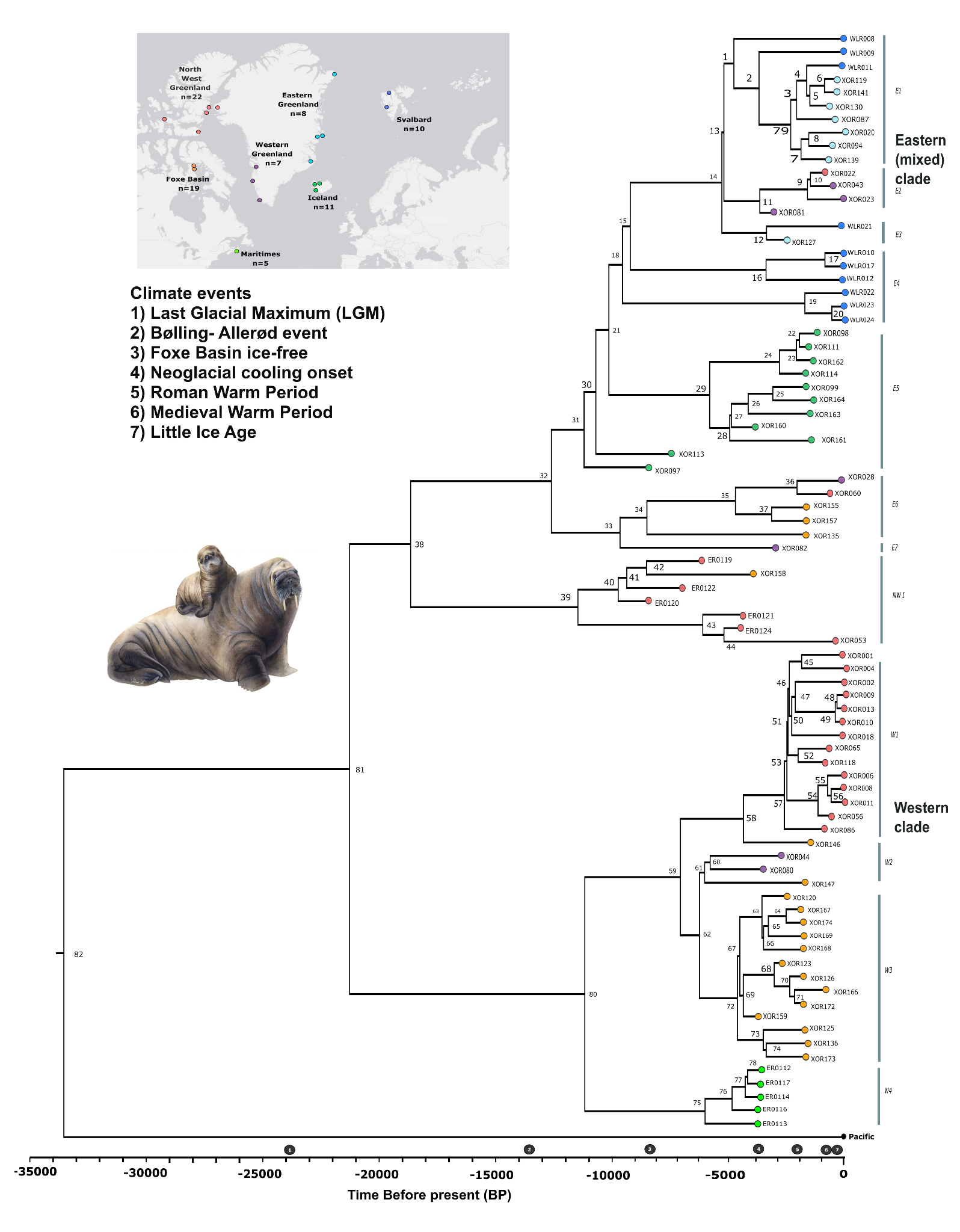
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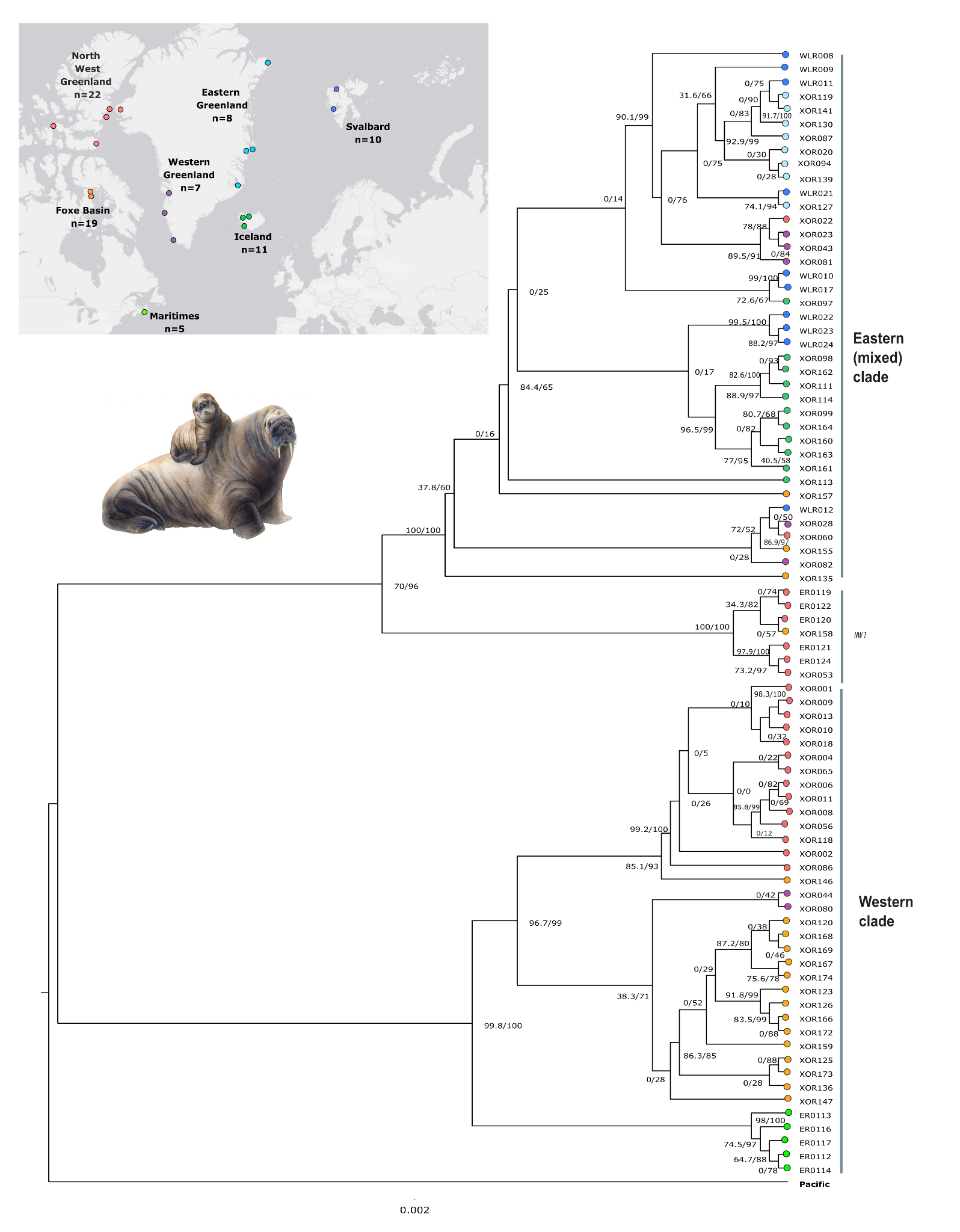
[Morten Tange Olsen](mailto:morten.olsen@sund.ku.dk): [morten.olsen@sund.ku.dk](mailto:morten.olsen@sund.ku.dk)

This PDF file includes:

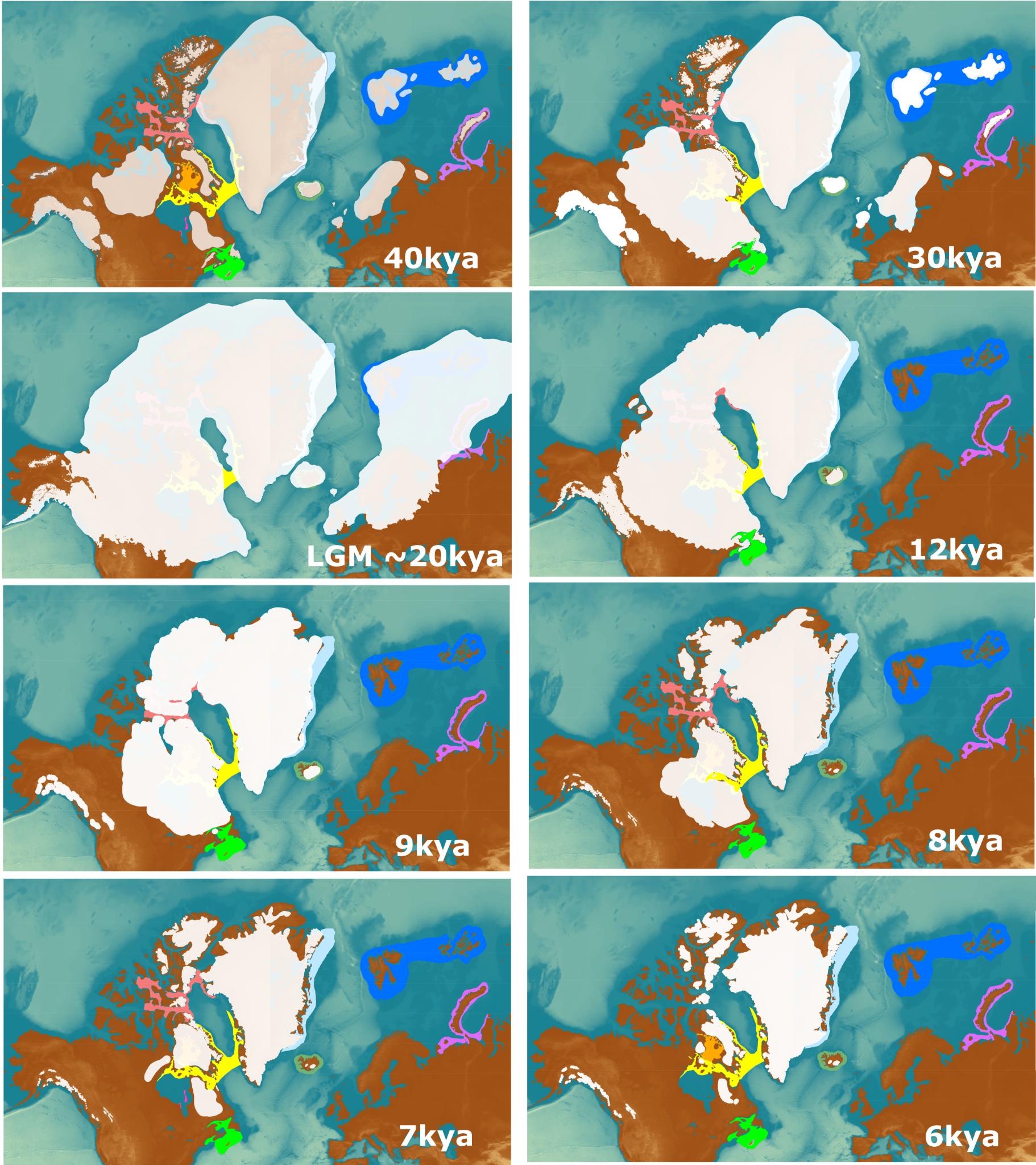
1. **Figure S1.** Relaxed exponential clock Bayesian phylogeny identical to Figure 1 in the main text, but providing node numbers for easier interpretation of each nodes’ posterior, age and 95% HPD, as provided in Supplementary Table S3.
2. **Figure S2.** Maximum likelihood phylogeny obtained from IQTree.
3. **Figure S3**. Changing ice coverage across the North Atlantic over the last 30 000 years and delineation of current Atlantic walrus (*Odobenus rosmarus rosmarus*) subpopulations.
4. **Table S1**. Information for each sample used for this study.
5. **Table S2.** Posterior, likelihood and prior statistics for the Bayesian phylogeny using a relaxed exponential clock model (Figure 1 and Supplementary Figure S1).
6. **Table S3.** Posteriors, age (kya) and 95% HPD for each node in the Bayesian phylogeny using a relaxed exponential clock (Figure 1 and Supplementary Figure S1).
7. **Table S4.** Posterior, likelihood and prior statistics using strict clock model for Bayesian phylogeny.
8. **Table S5.** Genetic differentiation among North Atlantic walrus populations.
9. **Table S6.** Sample size and measures of genetic diversity for each walrus population.



**Supplementary Figure S1:** Bayesian phylogeny using a relaxed exponential clock model. Tips are number-coded to aid interpretation of posterior parameter estimates provided in Supplementary Table S3.

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**Supplementary Figure. S2:** Maximum likelihood phylogeny with mitogenomes with at least 95% breadth of coverage (n=82) and with Pacific walrus as output obtained from IQtree to support the topology presented in the Bayesian phylogeny (Figure 1).



**Supplementary Figure S3**. **Changing ice coverage across the North Atlantic over the last 30 000 years.** A time series adapted from [(Dyke et al. 2003)](https://paperpile.com/c/Uebhb1/7YA1), [(Hughes et al. 2016)](https://paperpile.com/c/Uebhb1/9waE) and [(Batchelor et al. 2019)](https://paperpile.com/c/Uebhb1/K6pY). Ages are labelled in the bottom right-hand corner of each of the six maps. Ice sheets are shown in white. The distribution of contemporary walruses is shown as shaded areas in colours reflecting contemporary population structure based on [(Born et al. 1995; Andersen et al. 2009; Andersen et al. 2014; Dietz et al. 2014; McLeod et al. 2014)](https://paperpile.com/c/wzh7NS/C6XR+1Hsg+U2hE+WoIC+6pc6). Basemap was adapted and obtained from ETOPO1 Arc-Minute Global Relief Model available at: <https://www.ngdc.noaa.gov/mgg/global/>

**Supplementary Table S1. Information about the samples included in this study**. Out of 187 initially screened specimens, only 82 specimens with mitogenomes with at least 95% breadth of coverage were included. Institution where the sample was found, geographic locality, age. Sample dates are historical, archaeological or indicate the midpoint of a calibrated radiocarbon probability date distribution of the sample, or dated terrestrial mammal remains from the same context. Only one sample had neither radiocarbon or cultural dating, this was removed from the analysis. Walruses from North Baffin Bay, Jones Sound and Penny Strait-Lancaster Sound were grouped together under 'North West Greenland’, as the current stock designation for modern Atlantic walruses is still debated in this region (e.g., Heide-Jørgensen et al. 2017).

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|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Sample\_ID** | **Storage** | **Skeletal element** | **Ontogenetic age** | **Age (cal BP) years before 1950** | **Year collected** | **Locality** | **Geographic region based upon extant stocks** | **Endogenous percentage** | **Mitochondrial depth of coverage** | **Museum ID** | **Source** |
| **WLR008** | University Museum, University of Bergen | Petrous bone | Unknown | 100 | Unknown | Moffen | Svalbard | Na | 36.65 | in reference | Star et al. 2018 |
| **WLR009** | University Museum, University of Bergen | Petrous bone | Unknown | 100 | Unknown | Russekeila | Svalbard | Na | 16.88 | in reference | Star et al. 2018 |
| **WLR010** | University Museum, University of Bergen | Petrous bone | Unknown | 100 | Unknown | Moffen | Svalbard | Na | 55.76 | in reference | Star et al. 2018 |
| **WLR011** | University Museum, University of Bergen | Petrous bone | Unknown | 100 | Unknown | Moffen | Svalbard | Na | 6.88 | in reference | Star et al. 2018 |
| **WLR012** | University Museum, University of Bergen | Petrous bone | Unknown | 100 | Unknown | Moffen | Svalbard | Na | 28.58 | in reference | Star et al. 2018 |
| **WLR017** | University Museum, University of Bergen | Petrous bone | Unknown | 100 | Unknown | Moffen | Svalbard | Na | 107.9 | in reference | Star et al. 2018 |
| **WLR021** | University Museum, University of Bergen | Petrous bone | Unknown | 100 | Unknown | Moffen | Svalbard | Na | 71.3 | in reference | Star et al. 2018 |
| **WLR022** | University Museum, University of Bergen | Petrous bone | Unknown | 100 | Unknown | Moffen | Svalbard | Na | 78.73 | in reference | Star et al. 2018 |
| **WLR023** | University Museum, University of Bergen | Petrous bone | Unknown | 100 | Unknown | Moffen | Svalbard | Na | 69.59 | in reference | Star et al. 2018 |
| **WLR024** | University Museum, University of Bergen | Petrous bone | Unknown | 100 | Unknown | Moffen | Svalbard | Na | 41.28 | in reference | Star et al. 2018 |
| **XOR001** | Natural History Museum of Denmark | Skull | Unknown | 50 | 2016 | SW Coast Appat (Saunders Island) | North West Greenland | 24.4 | 8.80 | - | Keighley et al. 2019 |
| **XOR002** | Natural History Museum of Denmark | Skull | Unknown | 50 | 2016 | SW Coast Appat (Saunders Island) | North West Greenland | 11.3 | 17.80 | - | Keighley et al. 2019 |
| **XOR004** | Natural History Museum of Denmark | Tooth | Unknown | 50 | 2016 | SW Coast Appat (Saunders Island) | North West Greenland | 26.5 | 78.20 | - | Keighley et al. 2019 |
| **XOR006** | Natural History Museum of Denmark | Tooth | Adult | 12 | 1938 | Thule | North West Greenland | 41.5 | 36.47 | M1269 | This paper |
| **XOR008** | Natural History Museum of Denmark | Tusk | Adult | 12 | 1938 | Thule | North West Greenland | 46.4 | 156.99 | M1269 | This paper |
| **XOR009** | Natural History Museum of Denmark | Mandible | Unknown | 35 | 1915 | Thule | North West Greenland | 2.3 | 52.71 | 403 | This paper |
| **XOR010** | Natural History Museum of Denmark | Skull | Unknown | 35 | 1915 | Thule | North West Greenland | 19.4 | 34.87 | 403 | This paper |
| **XOR011** | Natural History Museum of Denmark | Skull | Adult | 12 | 1938 | Thule | North West Greenland | 0.6 | 1.56 | M1269 | This paper |
| **XOR013** | Natural History Museum of Denmark | Skull | Unknown | 35 | 1915 | Thule | North West Greenland | 27.4 | 158.11 | 403 | This paper |
| **XOR018** | Natural History Museum of Denmark | Mandible | Unknown | 50 | 2016 | SW Coast Appat (Saunders Island) | North West Greenland | 26.5 | 78.20 | - | Keighley et al. 2019 |
| **XOR020** | Natural History Museum of Denmark | Mandible | Unknown | 26 | 1924 | Scoresby Sound | Eastern Greenland | 10.8 | 70.20 | - | Keighley et al. 2019 |
| **XOR022** | Natural History Museum of Denmark | Tooth | Unknown | 820 | 1997 | Qeqertaaraq, Hatherton Bay, Inglefield Land | North West Greenland | 4.6 | 56.36 | ZMK 73/1997 | This paper |
| **XOR023** | Natural History Museum of Denmark | Mandible | Unknown | 24 | 1926 | Jakobshavn | Western Greenland | 23 | 17.00 | - | Keighley et al. 2019 |
| **XOR028** | Natural History Museum of Denmark | Tusk | Unknown | 38 | 1915 | Sjæret Saitok, off Disko | Western Greenland | 0.4 | 5.43 | 385 | This paper |
| **XOR043** | Natural History Museum of Denmark | Tooth | Unknown | 475 | 1989 | Isuamiut | Western Greenland | 27.3 | 16.66 | ZMK 135/1989 | This paper |
| **XOR044** | Natural History Museum of Denmark | Tusk | Unknown | 2630 | 1978 | Sermersooq | Western Greenland | 62.5 | 125.00 | ZMK 3/1978 | This paper |
| **XOR053** | Canadian Museum of History | Limb | Unknown | 475 | Unknown | Bathurst Island | North West Greenland | 5.8 | 25.60 | - | Keighley et al. 2019 |
| **XOR056** | Canadian Museum of History | Tooth | Unknown | 580 | 1974 | Porden Point Brook | North West Greenland | 63.3 | 28.95 | TEAL6598 | This paper |
| **XOR060** | Canadian Museum of History | Limb | Unknown | 630 | 1978-1980 | Skraeling Island | North West Greenland | 31 | 26.40 | - | Keighley et al. 2019 |
| **XOR065** | Canadian Museum of History | Skull | Unknown | 630 | Unknown | Skraeling Island | North West Greenland | 10.5 | 4.14 | TEAL-7549 | This paper |
| **XOR080** | Natural History Museum of Denmark | Tusk | Adult | 3543 | 1992 | Nipisat I, Sisimiut | Western Greenland | 1.3 | 18.23 | ZMK136/1989 | This paper |
| **XOR081** | Natural History Museum of Denmark | Tooth | Adult | 3135 | 1993 | Nipisat I, Sisimiut | Western Greenland | 4.7 | 29.20 | - | Keighley et al. 2019 |
| **XOR082** | Natural History Museum of Denmark | Tusk | Juvenile | 3010 | 1992 | Nipisat I,  Sisimiut | Western Greenland | 2 | 89.17 | ZMK 136/1989 | This paper |
| **XOR086** | Natural History Museum of Denmark | Mandible | Unknown | 820 | 1997 | Qeqertaaraq, Hatherton Bay, Inglefield Land | North West Greenland | 3.9 | 5.69 | ZMK 73/1997 | This paper |
| **XOR087** | Natural History Museum of Denmark | Fragmentary | Unknown | 384 | 2008 | Walrus Island, south of Sabine Ø | Eastern  Greenland | 3.9 | 6.32 | ZMK 65/2008 | This paper |
| **XOR094** | Natural History Museum of Denmark | Fragmentary | Unknown | 475 | 2007 | Clavering Ø | Eastern  Greenland | 9.5 | 24.80 | - | Keighley et al. 2019 |
| **XOR097** | Institude of Natural History, Iceland | Tusk | Unknown | 8529 | 1989 | Iceland | Iceland | 2 | 5.30 | MOR#16 | This paper |
| **XOR098** | Institude of Natural History, Iceland | Tusk + Skull | Adult | 1231 | 1955 | Iceland | Iceland | 23.5 | 128.09 | MOR#11 | This paper |
| **XOR099** | Private ownserhip, stored Bjarnarfoss | Tusk + Skull | Unknown | 1642 | Pre 1990 | Iceland | Iceland | 2.1 | 5.90 | - | Keighley et al. 2019 |
| **XOR111** | Institude of Natural History, Iceland | Tusk | Unknown | 1573 | 1894 | Iceland | Iceland | 1.7 | 12.62 | MOR#18 | This paper |
| **XOR113** | Institude of Natural History, Iceland | Tusk | Unknown | 7367 | 1910 | Iceland | Iceland | 7.5 | 109.60 | - | Keighley et al. 2019 |
| **XOR114** | Institude of Natural History, Iceland | Tusk | Unknown | 1649 | 1907 | Iceland | Iceland | 4.7 | 5.40 | MOR#26 | This paper |
| **XOR118** | Natural History Museum of Denmark | Tooth | Unknown | 775 | 1996 | Qeqertaaraq, Hatherton Bay, Inglefield Land | North West Greenland | 22.1 | 32.50 | Keighley et al. 2019 | Keighley et al. 2019 |
| **XOR119** | Natural History Museum of Denmark | Tusk | Unknown | 475 | 2008 | Clavering Ø | Eastern Greenland | 0.9 | 7.29 | ZMK 63/2008 | This paper |
| **XOR120** | Nunavut Department of Culture and Heritage, Canadian Museum of Nature | Tusk | Unknown | 2510 | 2015 | Foxe Basin | Foxe Basin | 2.2 | 9.80 | - | Keighley et al. 2019 |
| **XOR123** | Nunavut Department of Culture and Heritage, Canadian Museum of Nature | Tooth | Unknown | 2630 | 2015 | Foxe Basin | Foxe Basin | 3.8 | 32.20 | - | Keighley et al. 2019 |
| **XOR125** | Nunavut Department of Culture and Heritage, Canadian Museum of Nature | Tooth | Unknown | 1695 | 2015 | Foxe Basin | Foxe Basin | 7.3 | 20.30 | - | Keighley et al. 2019 |
| **XOR126** | Nunavut Department of Culture and Heritage, Canadian Museum of Nature | Tusk | Unknown | 1690 | 2015 | Foxe Basin | Foxe Basin | 0.1 | 16.30 | - | Keighley et al. 2019 |
| **XOR127** | Natural History Museum of Denmark | Tusk | Unknown | 2610 | 1993 | Holm Land | Eastern Greenland | 1.4 | 32.49 | ZMK 54/1993 | This paper |
| **XOR130** | Natural History Museum of Denmark | Tusk | Unknown | 820 | 1993 | Amdrup Land | Eastern Greenland | 5 | 48.44 | ZMK 50/1993 | This paper |
| **XOR135** | Natural History Museum of Denmark | Mandible | Unknown | 1575 | 1954 | Alarniq, Foxe Basin | Foxe Basin | 23.9 | 57.50 | - | Keighley et al. 2019 |
| **XOR136** | Natural History Museum of Denmark | Tooth | Unknown | 1575 | 1954 | Alarniq, Foxe Basin | Foxe Basin | 37.9 | 13.90 | - | Keighley et al. 2019 |
| **XOR139** | Natural History Museum of Denmark | Tusk | Unknown | 820 | 1993 | Amdrup Land | Eastern Greenland | 0.7 | 36.35 | ZMK 50/1993 | This paper |
| **XOR141** | Natural History Museum of Denmark | Baculum | Unknown | 475 | 2007 | Clavering Ø | Eastern Greenland | 22.9 | 28.89 | ZMK 119/2007 | This paper |
| **XOR146** | Natural History Museum of Denmark | Mandible | Unknown | 1575 | 1954 | Alarniq, Foxe Basin | Foxe Basin | 7.6 | 13.90 | - | Keighley et al. 2019 |
| **XOR147** | Natural History Museum of Denmark | Mandible | Unknown | 1575 | 1954 | Alarniq, Foxe Basin | Foxe Basin | 8.8 | 43.30 | - | Keighley et al. 2019 |
| **XOR155** | Natural History Museum of Denmark | Tooth | Unknown | 1575 | 1954 | Alarniq, Foxe Basin | Foxe Basin | 26.3 | 9.17 | ZMK 123a/1955 | This paper |
| **XOR157** | Natural History Museum of Denmark | Tusk | Unknown | 1575 | 1954 | Alarniq, Foxe Basin | Foxe Basin | 2.3 | 49.70 | - | Keighley et al. 2019 |
| **XOR158** | Natural History Museum of Denmark | Tooth | Unknown | 3850 | 1957 | Kaleruserk, Igloolik Ø | Foxe Basin | 10.1 | 13.20 | - | Keighley et al. 2019 |
| **XOR159** | Natural History Museum of Denmark | Tooth | Unknown | 3850 | 1957 | Kaleruserk, Igloolik Ø | Foxe Basin | 31.2 | 13.50 | - | Keighley et al. 2019 |
| **XOR160** | Institute of Natural History, Iceland | Tusk | Unknown | 3755 | 1986 | Iceland | Iceland | Na | 200.1 | MOR#22 | This paper |
| **XOR161** | Institute of Natural History, Iceland | Tusk | Unknown | 1373 | 1978 | Iceland | Iceland | Na | 131.0 | MOR#17 | This paper |
| **XOR162** | Institute of Natural History, Iceland | Tusk + Skull | Unknown | 1336 | 1952 | Iceland | Iceland | 2.3 | 15.50 | MOR#23 | This paper |
| **XOR163** | Institute of Natural History, Iceland | Tusk | Unknown | 1431 | 1954 | Iceland | Iceland | 3.7 | 2.40 | MOR#14 | This paper |
| **XOR164** | Private ownership, stored Bjarnarfoss | Tusk + Skull | Unknown | 1306 | 1990 | Iceland | Iceland | 27.5 | 113.50 | - | Keighley et al. 2019 |
| **XOR166** | Nunavut Department of Culture and Heritage, Canadian Museum of Nature | Tooth | Unknown | 950 | 2015 | Foxe Basin | Foxe Basin | 4.4 | 15.69 | NhHd-9:264 | This paper |
| **XOR167** | Nunavut Department of Culture and Heritage, Canadian Museum of Nature | Tusk | Unknown | 1900 | 2015 | Foxe Basin | Foxe Basin | 27.9 | 30.03 | NhHd-3:1454 | This paper |
| **XOR168** | Nunavut Department of Culture and Heritage, Canadian Museum of Nature | Tooth | Unknown | 1833 | 2017 | Foxe Basin | Foxe Basin | 7.4 | 6.49 | NhHd-1:DNA1 | This paper |
| **XOR169** | Nunavut Department of Culture and Heritage, Canadian Museum of Nature | Tooth | Unknown | 1833 | 2017 | Foxe Basin | Foxe Basin | 1.2 | 25.55 | NhHd-1:DNA2 | This paper |
| **XOR172** | Nunavut Department of Culture and Heritage, Canadian Museum of Nature | Tooth | Unknown | 1702 | 2017 | Foxe Basin | Foxe Basin | 26.4 | 31.48 | NhHe-11:DNA5 | This paper |
| **XOR173** | Nunavut Department of Culture and Heritage, Canadian Museum of Nature | Tooth | Unknown | 1702 | 2017 | Foxe Basin | Foxe Basin | 39.6 | 46.31 | NhHe-11:DNA6 | This paper |
| **XOR174** | Nunavut Department of Culture and Heritage, Canadian Museum of Nature | Tooth | Unknown | 1716 | 2017 | Foxe Basin | Foxe Basin | 14.3 | 27.77 | NhHe-11:DNA7 | This paper |
| **ER0112** | Fossil Vertebrae Collection, Canadian Museum of Nature | maxilla | Unknown | 3659 | Unknown | Sable Island | Maritimes | Na | 52.527 | CMNFV 35797 | This paper |
| **ER0113** | Fossil Vertebrae Collection, Canadian Museum of Nature | Temporal | Unknown | 3659 | Unknown | Sable Island | Maritimes | Na | 13.39 | CMNFV 43818 | This paper |
| **ER0114** | Fossil Vertebrae Collection, Canadian Museum of Nature | maxilla | Unknown | 3659 | Unknown | Sable Island | Maritimes | Na | 80.506 | CMNFV 43819 | This paper |
| **ER0116** | Fossil Vertebrae Collection, Canadian Museum of Nature | maxilla | Unknown | 3659 | Unknown | Sable Island | Maritimes | Na | 43.459 | CMNFV 43821 | This paper |
| **ER0117** | Fossil Vertebrae Collection, Canadian Museum of Nature | mandible | Unknown | 3659 | Unknown | Sable Island | Maritimes | Na | 99.4 | CMNFV 43825 | This paper |
| **ER0119** | Fossil Vertebrae Collection, Canadian Museum of Nature | Tusk | Unknown | 6200 | 1999 | North West Baffin Island | North West Greenland | Na | 346.64 | CMNFV 48389- S3093 | This paper |
| **ER0120** | Fossil Vertebrae Collection, Canadian Museum of Nature | Tusk | Unknown | 8640 | 1999 | North West Baffin Island | North West Greenland | Na | 627.46 | CMNFV 48390 - S3092 | This paper |
| **ER0121** | Fossil Vertebrae Collection, Canadian Museum of Nature | mandible | Unknown | 4730 | Unknown | North West Baffin Island | North West Greenland | Na | 33.488 | CMNFV 55070,TO-4985 | This paper |
| **ER0122** | Fossil Vertebrae Collection, Canadian Museum of Nature | Tusk | Unknown | 7050 | Unknown | Devon Island | North West Greenland | Na | 10.67 | CMNFV 55135, S-3527 | This paper |
| **ER0124** | Fossil Vertebrae Collection, Canadian Museum of Nature | maxilla | Unknown | 4500 | Unknown | Devon Island | North West Greenland | Na | 77.556 | CMNFV 56803- 94DCA 001 | This paper |

**Supplementary Table S2.** The posterior, likelihood and prior statistics for the Bayesian phylogeny using a relaxed exponential clock model (Figure 1).

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **This study** | **Relaxed clock model** | | | | | | | | |
| **Summary statistic** | **mean** | **stderr of mean** | **stdev** | **variance** | **median** | **value range** | **95% HPD interval** | **auto-correlation time (ACT)** | **effective sample size (ESS)** |
| **Posterior** | -23500.7325 | 0.7154 | 18.3868 | 338.0736 | -23500.0729 | [-23579.3011, -23426.836] | [-23537.1702, -23465.1813] | 1.09E+05 | 660.6 |
| **Likelihood** | -22528.2472 | 0.2404 | 9.4389 | 89.0927 | -22527.8548 | [-22574.9133, -22492.8169] | [-22546.1997, -22509.4037] | 46703.9997 | 1541.6 |
| **Prior** | -972.4853 | 0.8626 | 17.8768 | 319.5794 | -971.9939 | [-1057.6703, -905.6171] | [-1007.5426, -937.7287] | 1.68E+05 | 429.5 |
| **Tree height** | 33535.9031 | 927.6382 | 15006.0852 | 2.25E+08 | 29696.9243 | [12283.8567, 1.7605E5] | [14068.1022, 62022.561] | 2.75E+05 | 261.7 |
| **Coalescent exponential** | -921.8897 | 0.8553 | 17.4015 | 302.8129 | -921.4646 | [-1006.0882, -858.1903] | [-955.9305, -887.8113] | 1.74E+05 | 413.9 |
| **ePopSize** | 39153.0021 | 613.4827 | 13175.9362 | 1.74E+08 | 36797.3067 | [10041.1302, 1.5776E5] | [18605.3443, 66196.4991] | 1.56E+05 | 461.3 |
| **UcedMean (rate)** | 1.49E-07 | 1.19E-09 | 2.90E-08 | 8.39E-16 | 1.47E-07 | [6.1139E-8, 3.1883E-7] | [9.576E-8, 2.0719E-7] | 1.22E+05 | 589.5 |
| **Growth rate** | 6.21E-05 | 2.28E-06 | 4.43E-05 | 1.97E-09 | 5.75E-05 | [-0.0001, 2.7266E-4] | [-0, 1.5152E-4] | 1.91E+05 | 377 |

**Supplementary Table S3.** Posterior values, age (kya) and 95% HPD for each node in the Bayesian phylogeny using a relaxed exponential clock model, as illustrated in Figure 1 and according to node numbers provided in Supplementary Figure S1.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Node #** | **Posterior value** | **Node age (kya)** | **95% HPD** | **Node #** | **Posterior value** | **Node age (kya)** | **95% HPD** |
| 1 | 0.24 | -4771.9 | [2488.32,7404.59] | 22 | 0.38 | -1960.29 | [1573,2689.99] |
| 2 | 0.78 | -3695.28 | [1763.32,6163.97] | 23 | **1** | **-2086.42** | **[1573.19,2893.55]** |
| 3 | 0.41 | -2078.06 | [1067.52,3313.88] | 24 | **1** | **-2818.02** | **[1677.87,4384.61]** |
| 4 | 0.74 | -1643.88 | [877.62,2525.68] | 25 | 0.71 | -3103.57 | [1895.53,4553.89] |
| 5 | 0.35 | -1510.82 | [820.36,2339.2] | 26 | 0.61 | -4159.78 | [2434.57,6064.13] |
| 6 | **1** | **-881.64** | **[500.31,1388.14]** | 27 | 0.17 | -4883.09 | [3851.1,6313.11] |
| 7 | 0.41 | -1892.38 | [881.64,3078.01] | 28 | **0.98** | **-4948.62** | **[3878.01,6438.26]** |
| 8 | 0.41 | -1558.99 | [496.51,2834.42] | 29 | **1** | -5814.52 | [3878.01,6438.26] |
| 9 | **1** | **-1612.72** | **[820.01,2857.48]** | 30 | 0.3 | -10700.31 | [7775.61,13841.16] |
| 10 | 0.23 | -1484.02 | [820.01,2720] | 31 | 0.53 | -11203.75 | [9136.63,14074.96] |
| 11 | **1** | **-3658.28** | **[3138.72,4510.84]** | 32 | **1** | **-12608.06** | **[9422.29,16863.34]** |
| 12 | **0.99** | **-3371.34** | **[2644.74,4448.86]** | 33 | 0.27 | -9662.24 | [3147.55,16312.64] |
| 13 | 0.13 | -5201.33 | [3494.57,7471.13] | 34 | 0.17 | -8506.57 | [2376.92,15979.77] |
| 14 | **1** | **-5287.41** | **[3551.29,7568.53]** | 35 | 0.33 | -4705.71 | [1800.93,11179.65] |
| 15 | 0.1 | -9221.56 | [4367.09,13681.61] | 36 | **1** | **-2060.86** | **[807.78,3653.82]** |
| 16 | **0.94** | **-3392.24** | **[799.29,10391.51]** | 37 | 0.6 | -3155.61 | [1593.55,6176.79] |
| 17 | **1** | **-862.9** | [158.78,1880.82] | 38 | **0.9** | **-18651.67** | **[12162.04,26782.63]** |
| 18 | 0.19 | -9549.31 | [4536.4,13794.26] | 39 | **1** | **-11470.06** | [8480.36,15255.76] |
| 19 | **1** | **-1725.36** | [416.64,3570.08] | 40 | **0.95** | **-9740.91** | [8480.06,11807.23] |
| 20 | 1 | -567.22 | [107.23,1322.78] | 41 | 0.42 | -9368.91 | [7439.32,11674.77] |
| 21 | 0.22 | -10139.09 | [5771.31,14010.12] | 42 | 0.48 | -8524.24 | [6223.42,10990.67] |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| **Node #** | **Posterior value** | **Node age (kya)** | **95% HPD** | **Node #** | **Posterior value** | **Node age (kya)** | **95% HPD** |
| 43 | **1** | **-6108.21** | **[4602.25,8336.46]** | 65 | 0.29 | -3292.19 | [2276.54,4323.96] |
| 44 | **0.92** | **-5199.2** | **[4501.91,6524.62]** | 66 | 0.22 | -3499.5 | [2596.76,4497.44] |
| 45 | 0.14 | -1865.62 | [364.65,3317.96] | 67 | 0.16 | -4519.47 | [3850,5644.24] |
| 46 | 0.01 | -2392.19 | [1216.51,3773.23] | 68 | **1** | **-3039.28** | [2630.02,3745.23] |
| 47 | 0.06 | -2134.42 | [842.77,3551.71] | 69 | 0.17 | -4369.38 | [3850,5365.35] |
| 48 | 0.33 | -345.4 | [35.01,908.64] | 70 | **1** | **-2377.41** | [1798.48,2997.86] |
| 49 | **1** | **-420.87** | **[40.47,1005.37]** | 71 | 0.54 | -2163.45 | [1702.01,2801.65] |
| 50 | 0.02 | -2288.6 | [1042.08,3670.86] | 72 | **1** | **-4621.73** | [3850,5831.63] |
| 51 | 0.06 | -2455.62 | [1335.69,3809.63] | 73 | **0.71** | **-3514.09** | [2130.11,5151.32] |
| 52 | 0.1 | -2016.1 | [866.84,3307.46] | 74 | 0.23 | -3386.82 | [1934.76,5080.37] |
| 53 | 0.24 | -2495.14 | [1394.84,3849.11] | 75 | **1** | **-6007.06** | [4151.79,8475.93] |
| 54 | **1** | **-1159.8** | **[633.39,1847.41]** | 76 | **0.99** | **-4848.46** | [3863.58,6254.38] |
| 55 | 0.7 | -752.84 | [22.17,1601.08] | 77 | **0.93** | **-4285.54** | [3717.62,5164.23] |
| 56 | 0.32 | -598.77 | [12.01,1482.67] | 78 | 0.3 | -4184.72 | [3666.06,4981.07] |
| 57 | **1** | **-2606.72** | **[1498.47,3983.57]** | 79 | **1** | **-2332.98** | **[1272.05,3580.72]** |
| 58 | **1** | **-4365.2** | **[2220.19,6967.99]** | 80 | **1** | **-11171.77** | **[6244.69,17620.3]** |
| 59 | **1** | **-7066.25** | **[4509.38,10255.98]** | 81 | **1** | **-21269.83** | **[12919.33,32028.36]** |
| 60 | 0.23 | -5792.23 | [3736.93,8363.07] | 82 | **1** | **-33535.9** | **[14068.1,62022.56]** |
| 61 | 0.25 | -6028.39 | [3942.47,8681.59] |  | | | |
| 62 | 0.66 | -6249.36 | [4284.78,8785.49] |  | | | |
| 63 | **0.98** | **-3569.13** | **[2720.43,4504.34]** |  | | | |
| 64 | **0.98** | **-2531.81** | **[1943.75,3281.22]** |  | | | |

**Supplementary Table S4.** The posterior, likelihood and prior statistics for strict clock Bayesian phylogenies based on our 82 walrus mitogenomes, but using the original settings by Star et al. 2018 and Andersen et al. 2017.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Strict clock** | **Andersen et al. (2017)** | | | | | | **Star et al. (2018)** | | | | | |
| **Summary statistic** | **Posterior** | **Likelihood** | **Prior** | **TreeHeight** | **Yule Model** | **Birth rate** | **Posterior** | **Likelihood** | **Prior** | **TreeHeight** | **Yule Model** | **Birth rate** |
| **mean** | -24161.4023 | **-23186.1809** | -975.2213 | 7.95E+05 | -968.6985 | 2.48E-05 | -24194.1847 | **-23227.1688** | -967.0159 | 6.97E+05 | -960.5881 | 2.68E-05 |
| **stderr**  **of mean** | 1.5278 | 0.1059 | 1.5103 | 26559.5783 | 1.5109 | 3.58E-07 | 3.2396 | 0.1772 | 3.2322 | 52611.6051 | 3.2327 | 8.19E-07 |
| **stdev** | 56.6092 | 7.7255 | 55.3454 | 1.03E+06 | 55.3488 | 1.43E-05 | 53.3996 | 7.2682 | 52.5105 | 9.11E+05 | 52.5094 | 1.45E-05 |
| **variance** | 3204.6015 | 59.6834 | 3063.1129 | 1.05E+12 | 3063.4925 | 2.03E-10 | 2851.5153 | 52.8264 | 2757.354 | 8.30E+11 | 2757.235 | 2.10E-10 |
| **median** | -24152.9526 | -23185.7646 | -966.543 | 5.31E+05 | -960.009 | 2.26E-05 | -24186.1154 | -23226.677 | -958.9155 | 4.75E+05 | -952.5378 | 2.48E-05 |
| **value\_range** | [-24523.0467, -24027.0084] | [-23228.1403, -23158.7606] | [-1332.6283, -843.1146] | [98361.9045, 5.076E7] | [-1326.048, -835.4459] | [2.3349E-7, 1.066E-4] | [-24488.741, -24072.7445] | [-23261.4277, -23205.3739] | [-1259.366, -859.0494] | [1.2091E5, 2.0104E7] | [-1253.9741, -852.4613] | [7.2775E-7, 9.2559E-5] |
| **95% HPD interval** | [-24276.8971, -24064.1805] | [-23201.5585, -23171.4403] | [-1090.3682, -883.512] | [1.2564E5, 2.164E6] | [-1083.7084, -876.9286] | [1.5726E-6, 5.1616E-5] | [-24298.2223, -24104.7348] | [-23241.3001, -23212.629] | [-1067.6974, -879.1333] | [1.4238E5, 1.6964E6] | [-1062.0244, -873.5199] | [2.0255E-6, 5.4624E-5] |

**Supplementary Table S5. Genetic differentiation among North Atlantic walrus populations**. Values below the diagonal line are the net number of nucleotide substitution per site between populations (Nei’s *d*A). Values above the diagonal are *F*ST. Asterisks present p-values from 1000 permutations. \*: p>0.5, \*\*: 0.01 < p < = 0.05, \*\*\*: 0.001 < p < =0.01, \*\*\*\*: p <= 0.001,

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Svalbard** | **Northwestern Greenland** | **Western Greenland** | **Eastern Greenland** | **Foxe Basin** | **Iceland** | **Sable Island** |
| **Svalbard** |  | 0.02653\*\* | 0.01164\* | 0.06329\*\* | 0.01668\*\* | 0.0110\* | 0.14074\*\*\*\* |
| **Northwestern Greenland** | 0.00213 |  | 0.01033\* | 0.06452\*\*\*\* | 0.02108\*\* | 0.01594\* | 0.13409\*\* |
| **Western Greenland** | 0.00025 | 0.00093 |  | 0.05477\* | 0.00641\* | 0.0000\* | 0.13774\*\* |
| **Eastern Greenland** | 0.00027 | 0.00245 | 0.00047 |  | 0.05487\*\* | 0.05125\*\* | 0.19214\*\* |
| **Foxe Basin** | 0.00191 | 0.00043 | 0.00068 | 0.00223 |  | 0.00609\* | 0.12495\*\*\*\* |
| **Iceland** | 0.00030 | 0.00226 | 0.00045 | 0.00061 | 0.00206 |  | 0.12655\*\* |
| **Sable Island** | 0.00311 | 0.00126 | 0.00182 | 0.00339 | 0.00109 | 0.00324 |  |

**Supplementary Table S6. Sample size and measures of genetic diversity for each walrus population.** Groupings have been made according to fine and broad scale geographic region, as well as phylogenetic affinity to either ‘eastern’ clade, ‘western’ clade or ‘northwestern clade’. Therefore, a single walrus may be included in multiple groupings (e.g. all, North Western Greenland and ‘western’ clade).

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Sample number** | **Number of haplotypes** | **Nucleotide diversity (Pi)** | **Standard deviation** | **Theta per sequence** | **Gene diversity** | **Standard deviation** | **Fu's Fs statistic** | **Tajima D** | | **Biallelic sites Fu and Li's D stat** | **Biallelic sites F stat** |
| **All** | 82 | 69 | 0.00275 | 0.00009 | 62.879 | 0.995 | 0.003 | -22.924 | -1.51088 | P > 0.10 | -4.5083 | -3.71459 |
| **Sable Island** | 5 | 3 | 0.00016 | 0.00007 | 2.4 | 0.7 | 0.218 | 0.804 | -0.56199 | P > 0.10 | -0.56199 | -0.56199 |
| **East Greenland** | 8 | 7 | 0.00038 | 0.0001 | 7.328 | 0.964 | 0.077 | -1.859 | -1.57336 | 0.10 > P > 0.05 | -1.62975 | -1.6398 |
| **Iceland** | 11 | 11 | 0.00085 | 0.0002 | 17.754 | 1 | 0.039 | -3.683 | -1.60967 | 0.10 > P > 0.05 | -1.87965 | -1.86707 |
| **Svalbard** | 10 | 10 | 0.00135 | 0.00013 | 24.037 | 1 | 0.045 | -1.939 | -1.13761 | P > 0.10 | -1.22845 | -1.24714 |
| **West Greenland** | 7 | 7 | 0.00219 | 0.00055 | 30.612 | 1 | 0.076 | 0.079 | -0.11641 | P > 0.10 | 0.17551 | 0.11089 |
| **Northwest Greenland** | 22 | 17 | 0.00239 | 0.00032 | 32.919 | 0.97 | 0.024 | 0.437 | -0.11506 | P > 0.10 | -0.34327 | -0.29322 |
| **Foxe Basin** | 18 | 16 | 0.00155 | 0.00039 | 29.074 | 0.987 | 0.023 | -2.266 | -1.18997 | P > 0.10 | -1.43289 | -1.44663 |
| **Eastern clade (mixed)** | 46 | 41 | 0.00177 | 0.00021 | 48.237 | 0.994 | 0.006 | -14.794 | -1.86548 | P < 0.05\* | -3.26754 | -3.07784 |
| **Western clade** | 36 | 28 | 0.00109 | 0.00008 | 23.874 | 0.983 | 0.011 | -7.782 | -1.47948 | P > 0.10 | -3.01805 | -2.74682 |
| **Northwestern clade** | 7 | 6 | 0.00061 | 0.00011 | 8.571 | 0.952 | 0.096 | -0.14 | -0.06252 | P > 0.10 | -0.32567 | -0.26898 |