**Multiproxy analysis of permafrost preserved faeces provides an unprecedented insight into the diets and habitats of extinct and extant megafauna**

Marcel Polling, Anneke T.M. ter Schure, Bas van Geel, Tom van Bokhoven, Sanne Boessenkool, Glen MacKay, Bram W. Langeveld, María Ariza, Hans van der Plicht, Albert V. Protopopov, Alexei Tikhonov, Hugo de Boer, Barbara Gravendeel

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## S1. Sample information

**Table S1.** Detailed information on age and location of the five woolly mammoth (*Mammuthus primigenius*), steppe bison (*Bison priscus*), horse (Yukon: *Equus lambei* and Oyogas Yar: *Equus* cf. *lenensis*) and northern mountain caribou (*Rangifer tarandus caribou*). Modern and extant caribou samples were collected from cores in ice patches (Galloway et al., 2012).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Species** | **Name** | **Reference** | **Calibrated**  **14C age calBP** | **Lab. No. for radiocarbon dating** | **Coordinates** |
| Caribou | Selwyn A (KfTe-1 surface) | Galloway et al. (2012) | 0 | modern | 62°58’12.4”N  129°27’42.2”W |
| Caribou | Selwyn B (KfTe-1-C2-1) | Galloway et al. (2012) | 1,545 - 1,415 | Beta-240104 faeces | 62°58’12.4”N  129°27’42.2”W |
| Caribou | Selwyn C (KfTe-1-C1-3) | Galloway et al. (2012) | 2,995 - 2,880 | Beta-240102 faeces | 62°58’12.4”N  129°27’42.2”W |
| Horse | Oyogas Yar | Boeskorov et al. (2014); Gravendeel et al. (2014) | 5,445 - 5,310 | GrA-54020 bone | 72°40’49.42”N  142°50’38.33”E |
| Bison | Yakutian bison | Boeskorov et al. (2014); van Geel et al. (2014) | 10,580 - 10,425  10,570 - 10,415 | GrA-53290 bone  GrA-53292 hair | 72°17’30”N  140°54’05”E |
| Woolly mammoth | Cape Blossom | van Geel et al. (2011) | 14,790 - 14,085 | AA-77015 faeces | 66°44’0’’N  162°29’0’’W |
| Woolly mammoth | Yukagir | van Geel et al. (2008) | 22,765 - 22,445 | GrA-24288 hair | 71°52’9.88”N  140°34’8.73”E |
| Woolly mammoth | Adycha | This study | 25,765 - 25,360 | GrA-67394 faeces | 67°57’3.44’’N  135°25’52.39’’E |
| Horse | Yukon Horse | Harington and Eggleston-Stott (1996) | 31,225 - 30,560 | Beta-67407 bone | 64°00’N  139°10’W |
| Woolly mammoth | Abyland | This study | 32,995 - 32,215 | GrA-67393 faeces | 68°13’1.92’’N  146°51’1.88’’E |
| Woolly mammoth | Maly Lyakhovsky | This study | 33,165 - 32,260  33,640 - 33,110 | GrA-60021 hair  GrA-60044 bone | 74°39’36”N  141°59’14”E |

## S2. Abyland and Adycha sample identity confirmation

The identity of the Adycha faecal sample was confirmed using specifically designed primers, while for Abyland a previously published primer pair was used (Table S2; Barnes et al., 2007). Subsamples (volume ca. 1 ml) were ground in a Retsch CryoMill at -196°C in a dedicated ancient DNA lab. DNA was extracted using silica-based extraction protocol of Rohland and Hofreiter (2007). DNA amplifications were carried out on a Bio-Rad C1000 Touch in 30 µl final volumes. They consisted of 17.8 µl nuclease-free ultrapure water, 6 µl 5X Phire Green reaction buffer, 1.5 µl of each primer, 0.6 µl of dNTPs, 0.6 µl Phire Hot Start II DNA Polymerase and 2 µl DNA sample template. During the PCR a 30 s activation step at 98°C was followed by 40 cycles of 5 sec at 98°C, 5 sec annealing at 55°C and 10 sec at 72°C. The PCR ended with a final extension step at 72°C for 1 min. The products were checked using gel electrophoresis using EtBr staining. The obtained amplicons were Sanger sequenced by BaseClear B.V. (Leiden, The Netherlands) on an ABI3730XL sequencer (Life Technologies). Resulting sequences were matched against reference data in NCBI GenBank using BLAST.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Target taxon | DNA Marker | Primer Name | Primer sequence 5’-3’ | Amplicon length (bp) | Reference |
| *M. primigenius* (Adycha) | COI | - mam\_COI\_5771\_F  - mam\_COI\_5892\_R | TTTTTCACTTCACCTTGCAGGAGTATC  TGGACCATACAAATAAGGGTATGTGATA | 67 | This publication |
| *M. primigenius* (Abyland) | mitochondrial control region | - mam\_15528F  - mam\_15656R | TAGACCATACCATGTATAATCG  GAGCTTTAATGTGCTATGTAAG | 127 | Barnes et al. (2007) |

**Table S2.** Overview of the PCR primers used in this study to identify the identity of the producer of the Abyland and Adycha faeces.

Resulting sequences

* Adycha: 5’-CTCTATTTTAAGTGCAATTAATTTTATCACTACCATCATTAACATAAAACCTCCAGCTATGTCTCAA-3’ (too short to submit to ENA)
* Abyland: 5’-TGCATCACATTATTTACCCCATGCTTATAAGCAAGTACTGTTTAATCAATGTGTCAAGTCATATTCGTGTAGATTCACAAGTCATGTTTCAGCTCATGGATATTATTCACCTACGATAAACCATAGT-3’ (ERA3966948)

## S3. Primer selection

Overview of primers used in this study to amplify plants (*trn*L, nrITS1, nrITS2) and fungi (nrITS2 region).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Target Taxon | DNA Marker | Primer Name | Primer sequence 5’-3’ | Annealing  T (°) | Amplicon length (bp) | Reference |
| Plants | ITS1 | ITS-p5 (F)  ITS-u2 (R) | CCTTATCAYTTAGAGGAAGGAG  GCGTTCAAAGAYTCGATGRTTC | 58 | ~300-400 | Cheng et al. (2016)  Cheng et al. (2016) |
|  | ITS2 | ITS-p3 (F)  ITS4 (R) | YGACTCTCGGCAACGGATA  TCCTCCGCTTATTGATATGC | 55 | ~350-400 | Cheng et al. (2016)  White et al. (1990) |
|  | *trnL* | *trn*L-g (F)  *trn*L-h (R) | GGGCAATCCTGAGCCAA  CCATTGAGTCTCTGCACCTATC | 60 | ~8 – 143 | Taberlet et al. (2006)  Taberlet et al. (2006) |
| Fungi | ITS2 | fITS7 (F)  ITS4 (R) | GTGARTCATCGAATCTTTG  TCCTCCGCTTATTGATATGC | 56 | ~200-300 | Ihrmark et al. (2012)  White et al. (1990) |

**Table S3.** Overview of primers used in current study

## S4. Manually removed taxa

Taxon identifications that still remained in the dataset after all filtering steps. These were manually removed from the dataset before further analysis.

***trn*L manually removed**

* likely food contaminants: Musaceae including *Musa* (banana), *Oryza sativa* (rice), *Capsicum* (pepper), *Glycine max* (L.) Merr. (soy), *Zingiber officinale* Roscoe(ginger), *Humulus lupulus* (hops), Laurales, Juglandaceae
* contaminants of unknown origin: Convolvulaceae incl. *Convolvulus*, *Ipomoea* (not in Arctic)

**nrITS1 manually removed**

* likely food contaminants: *Allium cepa* L.(onion), *Lagenaria siceraria* (Molina) Standl.(calabash)
* non-native species *Celtis tetrandra* Roxb.and *Pteroceltis tatarinowii* Maxim.(native Chinese and South-East Asian tree species)

**nrITS2 manually removed:**

* likely food contaminants: *Lagenaria siceraria* (Molina) Standl.(calabash)*, Spanicia turkestanica* Iljin(spinach)
* contaminants of unknown origin*: Urtica dioica* L. (Selwyn caribou C)
* non-native species: *Celtis biondii* Pamp.(native South-East Asian tree species), *Chamaecyparis obtusa* (Siebold & Zucc.) Endl. and *Cryptomeria japonica* (Thunb. ex L.f.) D.Don (native to Japan and Taiwan)

## S5. *trn*L and nrITS filtering steps

**Table S5.1** Number of total reads and unique sequences for plant nrITS remaining after each filtering step. Raw reads for nrITS run = 16,734,333. All paired-end reads were merged using PEAR, resulting in 16,421,333 assembled reads.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | **nrITS1** | | **nrITS2** | |
| **Filtering steps** | **Program/**  **command** | **Total reads** | **Unique sequences** | **Total reads** | **Unique sequences** |
| Assignment to samples | Cutadapt | 4,888,459 |  | 4,307,952 |  |
| Removal of sequences with quality <20 and length <150 bp | PRINSEQ | 4,854,574 |  | 4,305,913 |  |
| Dereplication, sorting by size and clustering into OTUs (removing singletons and chimeras) | VSEARCH, unoise3 (USEARCH) |  | 657 |  | 1805 |
| Removal of sequences with ≤80% match & <80% cover | R | 4,086,417 | 484 | 3,790,860 | 1531 |
| Removal of sequences with maximum abundance in negative controls | R | 3,872,930 | 464 | 3,710,741 | 1511 |
| Setting abundance of reads below filtering threshold of 0.3% (nrITS2) or 0.35% (nrITS1 and fungal nrITS2) to 0 for each replicate to account for leaking | R | 3,810,820 |  | 3,762,751 |  |
| Removal of algae, fungi and merging identical identifications | R | 2,170,250 | 79 | 2,201,842 | 83 |
| Manual removal of contaminations | R | 2,138,759 | 73 | 2,177,482 | 71 |

**Table S5.2** Number of total reads and unique sequences for *trn*L remaining after each filtering step in OBITools and R.

|  |  |  |  |
| --- | --- | --- | --- |
| **Filtering steps** | **Program/**  **command** | **Total reads** | **Unique sequences** |
| Raw reads |  | 24,767,590 |  |
| Pairwise alignment | *illuminapairedend*, score-min = 40 | 20,385,514 |  |
| Assignment to samples | *ngsfilter* | 20,283,841 |  |
| Merged identical reads | *obiuniq* & *obiannotate* |  | 497,296 |
| Removal of reads with count <10 & < 10 bp length | *obigrep* | 19,655,209 | 15,780 |
| Identification & removal of PCR/sequencing errors | *obiclean* & R | 17,985,094 | 3,736 |
| Removal of sequences with ≤99% match & <100% cover | R | 13,473,872 | 264 |
| Removal of sequences with maximum abundance in negative controls | R | 12,255,382 | 225 |
| Reduction of reads below filtering threshold of 1.0% of total reads for each replicate to account for leaking | R | 11,985,611 |  |
| Manual removal of contaminations | R | 11,715,436 | 212 |
|  |  |  |  |

## S6. Pollen, DNA and macrofossil results of all samples

Pollen spectra, plant macrofossil data and DNA metabarcoding results of the eleven studied faecal samples. Observations in pollen spectra denoted with a + were made after finishing the counting procedure. Fungal spores are expressed as percentages calculated on the total pollen sum. Abundance categories in macrofossil data are as follows: + = rare/present, ++ = frequent/common and +++ = abundant to dominant. For DNA metabarcoding, any reads below a relative read abundance of 0.1% are shown as + (present).

### Table S6.1 Selwyn caribou A (modern) – surface material KfTe-1 Ice Patch

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Family/order** | **Taxon** | **Pollen**  **(%)** | **Macro\*** | ***trn*L**  **(%)** | **nrITS1**  **(%)** | **nrITS2**  **(%)** | **Caribou Diet (Denryter et al., 2017)** |
| **Phanerogams** |  |  |  |  |  |  | **A = Avoided**  **N = Neutral**  **S= Selected**  **U = Unknown** |
| Apiaceae | tribe Oenantheae |  |  | 0.1 |  |  | U |
|  | tribe Selineae |  |  | + |  |  | U |
| Asteraceae | indet. |  |  | + |  |  | U |
|  | *Artemisia* sp. | 10.0 |  |  |  |  | N |
|  | *Artemisia norvegica* subsp. *saxatilis* H.M.Hall & Clem. |  |  |  | + | + | N |
|  | subfamily Asteroideae (Tubuliflorae) | 5.0 |  | + |  |  | U |
| Betulaceae | *Alnus* sp. | + |  |  |  |  |  |
|  | *Betula* sp. | 16.0 | ++ | 89.1 | 80.9 | 78.5 | S |
| Boraginaceae | *Mertensia paniculata* (Aiton) G.Don |  |  | + |  | + | N |
| Campanulaceae | *Campanula* sp. |  |  | + |  |  |  |
| Caprifoliaceae | *Valeriana* sp. |  |  | + |  |  | A |
| Crassulaceae | *Rhodiola integrifolia* Raf. |  |  | 0.2 | + | + | U |
| Cyperaceae | indet. | 1.0 |  |  |  |  | A |
|  | *Carex microchaeta* Holm |  |  | + |  |  | A |
|  | *Carex podocarpa* R.Br. |  |  |  | + |  | A |
| Ericaceae | indet. | 5.0 |  |  |  |  | U |
|  | *Arctostaphylos uva-ursi* (L.) Spreng. |  |  | + |  |  | N |
|  | *Arctous alpina* (L.) Nied. |  |  | + |  | + | N |
|  | *Arctous alpina/rubra* |  |  | 0.4 |  |  | N |
|  | *Arctous rubra* (Rehder & E.H.Wilson) Nakai |  |  |  | + |  | N |
|  | *Cassiope tetragona* (L.) D.Don |  |  | + | + |  | U |
|  | *Empetrum nigrum* L. |  |  | + | 0.1 | 0.4 | S |
|  | *Erica* sp. |  |  | + |  |  | U |
|  | *Pyrola* sp. |  |  | + |  |  | N |
|  | *Pyrola grandiflora* Radius |  |  | 0.2 |  |  | A |
|  | *Pyrola asarifolia* Michx. |  |  |  | + | + | A |
|  | *Vaccinium* sp. |  |  |  |  | + | U |
|  | *Vaccinium uliginosum* L. |  |  | 0.4 | 0.5 | 1.2 | S |
|  | *Vaccinium vitis-idaea* L. |  |  | + | + | 0.1 | A |
| Fabaceae | *Astragalus* sp. |  |  | + | + |  | N |
| Family indet. |  | 2.0 |  |  |  |  |  |
| Liliaceae | *Gagea serotina* (L.) Ker Gawl. |  |  | + |  |  | U |
| Lycopodiaceae | *Lycopodium* sp. | 8.0 |  |  |  |  | A |
|  | subfamily Lycopodioideae |  |  | + |  |  | A |
| Menyanthaceae | *Menyanthes trifoliata* L. |  |  | + |  | + | U |
| Onagraceae | *Chamaenerion angustifolium* (L.) Scop. |  |  | + | + | + | N |
|  | *Epilobium palustre* L. |  |  |  |  | + | N |
| Ophioglossaceae | *Botrychium* sp. | 2.0 |  |  |  |  | A |
| Orobanchaceae | *Pedicularis capitata* Adams |  |  | + |  |  | A |
|  | *Pedicularis sudetica* Willd. |  |  | + |  |  | A |
| Pinaceae | indet. | 2.0 |  |  |  |  | A |
|  | *Abies* sp. | 5.0 |  |  |  |  | A |
|  | *Picea* sp. | 15.0 |  |  |  |  | A |
|  | *Pinus* sp. | 10.0 |  |  |  |  | A |
|  | *Pinus* subsect. *Contortae* |  |  | + |  |  | A |
| Plantaginaceae | *Veronica* sp. |  |  | + |  |  | U |
|  | *Veronica wormskjoldii* Roem. & Schult. |  |  | + |  |  | U |
| Poaceae | indet. | + | + |  |  |  | U |
|  | *Arctophila fulva* (Trin.) Andersson |  |  |  |  | + | U |
|  | *Alopecurus magellanicus* Lam. |  |  |  |  | + | U |
|  | *Calamagrostis* sp. |  |  |  |  | + | A |
|  | *Deschampsia cespitosa* (L.) P.Beauv. |  |  |  |  | + | U |
|  | *Festuca altaica* Trin. |  |  | 0.1 | + |  | N |
|  | *Poa glauca* Vahl |  |  |  | + |  | N |
| Polemoniaceae | *Polemonium* sp. | 1.0 |  |  |  |  | N |
| Polygonaceae | *Bistorta vivipara* (L.) Delarbre |  |  | + | + |  | N |
|  | *Oxyria digyna* (L.) Hill |  |  | + |  |  | N |
| Primulaceae | *Primula frigida* (Cham. & Schltdl.) A.R.Mast & Reveal |  |  | + |  |  | U |
| Pteridophyta | indet. | 4.0 |  |  |  |  | A |
| Ranunculaceae | indet. | + |  |  |  |  |  |
|  | *Anemone* sp. |  |  | + |  |  | U |
|  | *Anemonastrum narcissiflorum* (L.) Holub |  |  | 0.1 |  | + | U |
|  | *Anemone patens* L. |  |  |  |  | 0.1 | U |
|  | *Anemone richardsonii* Hook. |  |  | + |  |  | U |
|  | *Caltha palustris* L. |  |  |  |  | + | A |
| Rosaceae | indet. | 2.0 |  |  |  |  | U |
|  | *Comarum palustre* L. |  |  | 0.1 |  |  | U |
|  | *Dryas* sp. |  |  | 0.1 |  |  | N |
|  | *Dryas octopetala* L. |  |  |  | 0.2 | 0.3 | N |
|  | *Geum* sp. |  |  | 0.6 |  | + | N |
|  | *Geum aleppicum* Jacq. |  |  |  | + |  | N |
|  | subfamily Rosoidea |  |  | + |  |  | U |
|  | *Rubus arcticus* L. |  |  |  |  | + | A |
|  | *Spiraea stevenii* (C.K.Schneid.) Rydb. |  |  | + |  |  | U |
| Salicaceae | indet. |  |  | 8.2 |  |  | S |
|  | *Populus* sp. | + |  |  |  |  | S |
|  | *Salix* sp. | 12.0 | + |  | 16.4 | 15.7 | S |
| Saxifragaceae | *Micranthes* sp. |  |  | + |  |  | A |
|  | *Saxifraga* (sect. *Mesogyne*) |  |  | + |  |  | A |
| Violaceae | *Viola epipsila*var. *repens* (W.Becker) R.J.Little |  |  | + |  |  | A |
| **Cryptogams** |  |  |  |  |  |  |  |
| **Bryophyta** |  |  |  |  |  |  |  |
| Amblystegiaceae | *Drepanocladus/Sanionia* sp. |  | + |  |  |  | A |
|  | *Sanionia uncinata* Loeske |  |  | + | + |  | A |
| Anastrophyllaceae | *Barbilophozia barbata* (Schmidel ex Schreb.) Loeske |  |  |  |  | + | A |
| Aulacomniaceae | *Aulacomnium palustre* (Hedw.) Schwägr. |  |  |  | + | + | A |
| Brachytheciaceae | *Tomentypnum nitens* Loeske |  |  |  |  | + | A |
| Bryaceae | *Bryum* sp. |  | + | + |  |  | A |
|  | *Ptychostomum pallescens* (Schleich. ex Schwägr.) J.R.Spence |  |  |  |  | + | A |
| Dicranaceae | indet. |  |  | + | + |  | A |
|  | *Dicranum* sp. |  | + |  | + |  | A |
|  | *Dicranum fuscescens* Sm. |  |  |  | 1.2 | 0.2 | A |
| Grimmiaceae | *Bucklandiella* sp. |  |  |  | + |  | A |
|  | *Niphotrichum* sp. |  |  |  |  | + | A |
| Hylocomiaceae | *Hylocomiastrum pyrenaicum* Fleisch. |  |  |  |  | + | A |
|  | *Hylocomium splendens* (Hedw.) Schimp. |  |  |  | + | + | A |
|  | *Pleurozium schreberi* Mitten |  | + | + | 0.3 | 0.1 | A |
| Hypnales | indet. |  |  | + |  |  | A |
| Mniaceae | indet. |  |  |  |  | + | A |
| Polytrichaceae | indet. |  |  | + |  |  | A |
|  | *Polytrichastrum alpinum* (Hedw.) G.L. Sm. |  |  |  |  | 0.3 | A |
|  | *Polytrichum juniperinum* Hedw. |  |  |  |  | 0.1 | A |
|  | *Polytrichum piliferum* Hedw. |  |  |  | + | 1.4 | A |
|  | *Polytrichum* cf. *strictum* Menzies ex Bridel |  | ++ |  |  | + | A |
|  | *Polytrichum commune* var. *commune* Hedw. |  | ++ |  |  | 1.2 | A |
| Pottiaceae | indet. |  |  |  | + |  | A |
| Scapaniaceae | *Douinia ovata* (Dicks.) H.Buch |  |  |  |  | + | A |
| Sphagnaceae | *Sphagnum* cf. *magellanicum* Brid. |  | + |  |  |  | A |
| Takakiaceae | indet. |  |  |  | + |  | A |
| **Lichen** |  |  |  |  |  |  |  |
| Cladoniaceae | *Cladonia* cf. *rangiferina* (L.) Weber ex F.H.Wigg. |  | + |  |  |  | S |

\* insufficient material was present for detailed macro analysis

### Table S6.2 Selwyn caribou B (±1.5kyr) – core 2, 189-191cm, KfTe-1 Ice Patch

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Family/order** | **Taxon** | **Pollen**  **(%)** | **Macro** | ***trn*L**  **(%)** | **nrITS1**  **(%)** | **nrITS2**  **(%)** | **Caribou Diet**  **(Denryter et al., 2017)** |
| **Phanerogams** |  |  |  |  |  |  | **A = Avoided**  **N = Neutral**  **S = Selected**  **U = Unknown** |
| Asteraceae | indet. |  |  | + |  |  | U |
|  | *Antennaria* sp. |  | 0.5 |  |  |  | A |
|  | *Artemisia* sp. | 40.0 | 0.2 |  |  |  | N |
|  | *Artemisia norvegica* subsp. *saxatilis* H.M.Hall & Clem. |  |  |  | 0.3 |  | N |
|  | subfamily Asteroideae (Tubuliflorae) | 10.0 |  |  |  |  | U |
| Betulaceae | *Betula* sp. |  | 2.3 | 8.5 | 18.9 | 10.9 | S |
| Caryophyllaceae | *Stellaria* sp. |  | 0.3 |  |  | + | A |
| Cyperaceae | *Carex* sp. |  | 7.7 | 0.1 |  |  | A |
|  | *Carex aquatilis* Wahlenb. *0.3 A* |  |  |  | 0.3 |  | A |
|  | *Carex* subgenus *Euthyceras* |  | 0.3 |  |  |  | U |
|  | *Carex lachenalii* Schkuhr |  |  | + |  |  | A |
|  | *Carex nigra*subsp.*juncea* (Fries) Soó |  |  |  | 0.4 |  | A |
|  | *Eriophorum* sp. |  | 2.3 |  |  |  | N |
| Elaeagnaceae | *Shepherdia canadensis* Nutt. | 1.0 |  |  |  |  | N |
| Equisetaceae | *Equisetum* sp. |  | 1.8 |  |  |  | N |
| Ericaceae | *Arctous alpina/rubra* |  |  | 0.1 |  |  | N |
|  | *Pyrola* sp. |  |  | + |  |  | N |
|  | *Pyrola grandiflora* Radius |  |  | + |  |  | A |
|  | *Vaccinium* sp. |  |  |  |  | + | U |
|  | *Vaccinium uliginosum* L. |  |  | + |  |  | S |
|  | *Vaccinium vitis-idaea* L. |  |  |  | 1.1 | 1.1 | A |
| Fabaceae | *Astragalus* sp. |  |  | + |  |  | N |
|  | *Hedysarum* sp. |  | 0.9 |  |  |  | N |
| Family indet | indet. | 20.0 |  |  |  |  | U |
| Juncaceae | *Juncus* sp. |  | 2.5 | 0.2 |  |  | N |
|  | *Juncus alpinoarticulatus* Chaix |  |  | 0.1 |  |  | N |
|  | *Juncus effusus* L. |  |  |  | 2.9 |  | N |
|  | *Juncus oxymeris* Engelm. |  |  |  | 0.4 |  | N |
|  | *Luzula* sp. |  |  | + |  |  | A |
| Juncaginaceae | *Triglochin palustris* L. |  |  |  | 1.3 |  | U |
| Liliaceae | *Gagea serotina* (L.) Ker Gawl. |  |  | + |  |  | U |
| Lycopodiaceae | *Lycopodium* sp. |  | 1.1 |  |  |  | A |
| Orobanchaceae | *Pedicularis* sp. |  |  | + |  |  | A |
|  | *Pedicularis sudetica* Willd. |  |  | 0.1 |  | 1.0 | A |
| Pinaceae | indet. | 5.0 |  |  |  |  | A |
|  | *Abies* sp. | 5.0 |  |  |  |  | A |
|  | *Picea* sp. | 6.0 |  |  |  |  | A |
|  | *Pinus* sp. | 8.0 |  |  |  |  | A |
| Poaceae | indet. |  | 0.9 |  |  |  | U |
|  | *Arctagrostis* sp. |  | 1.9 |  |  |  | U |
|  | *Arctagrostis latifolia* Griseb. |  |  |  |  | + | U |
|  | *Calamagrostis* sp. |  | 0.9 |  |  |  | A |
|  | *Festuca* sp |  | 1.8 |  |  |  | N |
|  | *Hierochloe* sp. |  | 1.4 |  |  |  | N |
|  | *Poa* sp. |  | 9.1 |  |  |  | N |
|  | *Poa arctica* R.Br. |  |  |  |  | + | N |
| Plantaginaceae | *Veronica* sp. |  |  | + |  |  | U |
| Polygonaceae | *Bistorta vivipara* (L.) Delarbre |  |  | + |  |  | N |
|  | *Rumex* sp. |  | 0.9 |  |  |  | N |
| Pteridophyta | indet. | 5.0 |  |  |  |  | A |
| Ranunculaceae | indet. | + |  |  |  |  | U |
|  | *Anemone* sp. |  |  | + |  |  | U |
|  | *Anemonastrum narcissiflorum* (L.) Holub |  |  | 0.4 | 5.1 | 2.4 | U |
|  | *Ranunculus trichophyllus* Chaix |  |  |  | 0.2 |  | A |
| Rosaceae | *Comarum palustre* L. |  |  |  | + |  | U |
|  | *Dryas* sp. |  | 2.5 |  |  |  | N |
|  | *Geum* sp. |  |  | 6.3 |  | 1.7 | N |
|  | *Geum aleppicum* Jacq. |  |  |  | 1.0 |  | N |
|  | subfamily Rosoideae |  |  | + |  |  | U |
| Salicaceae | *Salix* sp. |  | 9.1 | 84.1 | 67.1 | 78.5 | S |
|  | *Salix alaxensis* (Andersson ex DC.) Coville |  |  |  |  | 0.2 | S |
| Saxifragaceae | *Saxifraga* sp. |  | 0.2 |  |  |  | A |
| Selaginellaceae | *Selaginella* sp. |  | 0.9 |  |  |  | U |
| Taxaceae | *Taxus canadensis* Marshall |  |  |  |  | 1.2 | U |
| Unknown forb |  |  | 1.4 |  |  |  | U |
| **Cryptogams** |  |  |  |  |  |  |  |
| **Brypophyta** |  |  |  |  |  |  | A |
| Anastrophyllaceae | *Barbilophozia barbata* (Schmidel ex Schreb.) Loeske |  |  |  |  | 0.4 | A |
| Aulacomniaceae | *Aulacomnium* sp. |  | 5.6 |  |  |  | A |
| Dicranaceae | indet. |  |  | + |  |  | A |
|  | *Dicranum*-type |  | 15.3 |  |  |  | A |
|  | *Dicranum fuscescens* Sm. |  |  |  | 0.5 |  | A |
|  | *Dicranum scoparium* Hedw. |  |  |  | 0.8 |  | A |
| Hylocomiaceae | *Hylocomium splendens* (Hedw.) Schimp. |  |  |  | + | 1.2 | A |
|  | *Pleurozium schreberi* Mitten |  |  | + | + | 0.1 | A |
| Hypnales | indet. |  |  | + |  |  | A |
| Mniaceae | *Pohlia* sp. |  |  | + |  |  | A |
|  | *Pohlia nutans* (Hedw.) H. Lindb. |  |  |  |  | 0.5 | A |
| Polytrichaceae | indet. |  |  | + |  |  | A |
|  | *Polytrichum* sp. |  | 2.6 |  |  |  | A |
|  | *Polytrichum piliferum* Hedw. |  |  |  |  | 0.8 | A |
| Pottiaceae | indet. |  |  |  | + |  | A |
| Sphagnaceae | *Sphagnum* sp. |  | 2.5 |  |  |  | U |
| **Lichen** |  |  |  |  |  |  |  |
| Cladoniaceae | *Cladonia* sp. |  | 7.2 |  |  |  | S |
| Parmeliaceae | *Alectoria* sp. |  | 4.6 |  |  |  | S |
|  | subfamily Parmelioideae (*Cetraria*/*Dactylina* sp.) |  | 7.6 |  |  |  | N |
| Peltigeraceae | *Peltigera* sp. |  | 1.4 |  |  |  | A |
| Stereocaulaceae | *Stereocaulon* sp. |  | 0.9 |  |  |  | A |
| Unknown lichen |  |  | 0.2 |  |  |  | U |

### Table S6.3 Selwyn caribou C (±2.7kyr) – core 1, 254-256cm, KfTe-1 Ice Patch

N.B. nrITS1 and nrITS2 did not produce any results.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Family/order** | **Taxon** | **Pollen**  **(%)** | **Macro** | ***trn*L**  **(%)** | **Caribou Diet (Denryter et al., 2017)** |
|  |  |  |  |  | **A = Avoided**  **N = Neutral**  **S= Selected**  **U = Unknown** |
| Amaranthaceae | *Blitum nuttallianum* Schult. |  |  | + | U |
| Apiaceae | subfamily Apioideae |  |  | 2.4 | U |
|  | *Cymopterus sessiliflorus* (W.L.Theob. & C.C.Tseng) R.L.Hartm. |  |  | + | U |
| Asteraceae | tribe Anthemideae |  |  | 31.9 | U |
|  | subfamily Asteroideae (Tubuliflorae) | 10.0 |  |  | U |
|  | *Artemisia* sp. | 15.0 |  |  | N |
|  | *Artemisia gmelinii* Web. ex Stechm. |  |  | 0.1 | N |
| Betulaceae | *Betula* sp. | 3.0 | 1.1 | 7.0 | S |
| Boraginaceae | *Mertensia paniculata* (Aiton) G.Don |  |  | 1.7 | N |
| Caryophyllaceae | *Stellaria* sp. |  | 0.7 |  | A |
| Cyperaceae | indet. | 1.0 |  |  | A |
|  | *Carex* sp. |  | 4 |  | A |
|  | *Eriophorum* sp. |  | 0.4 |  | N |
| Elaeagnaceae | *Shepherdia canadensis* Nutt. | 3.0 |  |  | N |
| Ericaceae | indet. | 2.0 |  |  | U |
|  | *Cassiope* sp. |  | 0.4 |  | A |
|  | *Empetrum* sp. |  | 1.1 |  | S |
| Indet. |  | 27.0 |  |  | U |
| Juncaceae | *Juncus* sp. |  | 0.5 |  | N |
| Lycopodiaceae | *Lycopodium* sp. | 1.0 | 0.2 |  | A |
| Onagraceae | *Chamaenerion angustifolium* (L.) Scop. |  |  | 2.5 | N |
| Pinaceae | indet. | 5.0 |  |  | A |
|  | *Picea* sp. | 20.0 |  |  | A |
|  | *Abies* sp. | 2.0 |  |  | A |
| Poaceae | indet. | 5.0 | 1.1 |  | U |
|  | *Arctagrostis* sp. |  | 2.2 |  | U |
|  | *Calamagrostis* sp. |  | 0.4 |  | A |
|  | *Festuca* sp. |  | 1.1 |  | N |
|  | *Hierochloe* sp. |  | 0.4 |  | N |
|  | *Poa* sp. |  | 2.7 |  | N |
| Polemoniaceae | *Polemonium* sp. | + |  |  | N |
| Polygonaceae | *Bistorta vivipara* (L.) Delarbre |  |  | 0.6 | N |
|  | *Oxyria digyna* (L.) Hill |  |  | + | N |
| Pteridophyta | indet. | 5.0 |  |  |  |
| Ranunculaceae | *Anemonastrum narcissiflorum* (L.) Holub |  |  | 0.4 | U |
|  | *Ranunculus nivalis* L. |  |  | 3.6 | U |
|  | *Ranunculus pygmaeus* Wahlenb. |  |  | 2.5 | U |
| Rosaceae | *Dryas* sp. |  | 4.6 |  | N |
|  | subfamily Rosoideae |  |  | 0.5 | U |
|  | *Sibbaldia procumbens* L. |  |  | 25.5 | N |
| Salicaceae | *Salix* sp. | + | 6 | 20.4 | S |
| Saxifragaceae | *Micranthes* sp. |  |  | 0.7 | A |
|  | *Micranthes nelsoniana* (D.Don) Small |  |  | 0.2 | A |
|  | *Saxifraga* sp. |  | 0.9 |  | A |
| Selaginellaceae | *Selaginella* sp. |  | 1.1 |  | U |
| **Cryptogams** |  |  |  |  |  |
| **Brypophyta** |  |  |  |  |  |
| Aulacomniaceae | *Aulacomnium* sp. |  | 6.7 |  | A |
| Dicranaceae | *Dicranum*-type |  | 13.3 |  | A |
| Mniaceae | *Pohlia* sp. |  |  | + | A |
| Polytrichaceae | *Polytrichum* sp. |  | 2.7 |  | A |
| Sphagnaceae | *Sphagnum* sp. |  | 4 |  | A |
| **Lichen** |  |  |  |  |  |
| Cladoniaceae | *Cladonia* sp. |  | 24.6 |  | S |
| Parmeliaceae | *Alectoria* sp. |  | 10.2 |  | S |
|  | Subfamily Parmelioideae *(Cetraria/Dactylina sp.)* |  | 5.3 |  | S |
| Peltigeraceae | *Peltigera* sp. |  | 2.9 |  | A |
| Stereocaulaceae | *Stereocaulon* sp. |  | 0.5 |  | A |

### Table S6.4 Oyogos Yar horse (±5.4kyr)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Family/order** | **Taxon** | **Pollen**  **(%)** | **Macro** | ***trn*L**  **(%)** | **nrITS1**  **(%)** | **nrITS2**  **(%)** |
| **Phanerogams** |  |  |  |  |  |  |
| Apiaceae | indet. | 0.1 |  |  |  |  |
|  | *Cicuta virosa* L. |  |  |  | 25.5 |  |
| Asteraceae | *Artemisia* sp. | + |  |  |  |  |
|  | *Artemisia scoparia* Waldst. & Kit. |  |  |  |  | + |
|  | subfamily Asteroideae (Tubuliflorae) | 0.6 |  |  |  |  |
|  | *Endocellion sibiricum* (J.F. Gmel.) J. Toman |  |  |  | 0.5 | 0.1 |
| Betulaceae | *Alnus* sp. | 0.9 |  |  |  |  |
|  | *Betula* sp. | 1.2 |  |  |  |  |
|  | *Betula* sect. *Apterocaryon* | 0.3 |  |  |  |  |
| Cyperaceae | Indet. | 3.6 | +++ |  |  |  |
|  | *Carex aquatilis* Wahlenb. |  |  | 6.1 |  | 0.1 |
|  | *Carex rostrata* Stokes |  |  |  | 1.7 |  |
|  | *Eriophorum* sp. |  |  | 66.7 |  |  |
|  | *Eriophorum angustifolium* Honck. |  |  |  | 14.4 | 0.8 |
| Ericaceae | *Pyrola* sp. | 0.3 |  |  |  |  |
|  | *Vaccinium vitis-idaea* L. |  |  |  |  | + |
| Indet |  | 0.2 |  |  |  |  |
| Menyanthaceae | *Menyanthes trifoliata* L. |  |  |  | 0.6 | + |
| Onagraceae | *Epilobium palustre* L. |  |  |  | 0.7 |  |
| Orobanchaceae | *Pedicularis sudetica* Willd. |  |  |  |  | + |
| Papaveraceae | *Papaver* sp. (*Papaver rhoeas*-type) | + |  |  |  |  |
| Pinaceae | indet. | 0.1 |  |  |  |  |
|  | *Abies* sp. | 0.1 |  |  |  |  |
|  | *Pinus* subgenus *Pinus* | 0.2 |  |  |  |  |
| Plantaginaceae | *Plantago* sp. | 0.1 |  |  |  |  |
|  | *Hippuris* sp. |  |  |  |  | + |
| Poaceae | indet. | 91.6 | + |  |  |  |
|  | subtribe Agrostidinae |  |  | 5.6 |  |  |
|  | *Arctagrostis latifolia* Griseb. |  |  |  | 2.3 | 4.2 |
|  | *Arctophila fulva* (Trin.) Andersson |  |  |  |  | 3.4 |
|  | *Arctophila fulva/ Dupontia fisheri* |  |  | 2.4 |  |  |
|  | *Calamagrostis* sp. |  |  |  |  | 0.7 |
|  | *Calamagrostis stricta* Koeler |  |  |  | 5.6 |  |
|  | *Dupontia fisheri* R.Br. |  |  |  | 44.2 |  |
|  | *Poa arctica* R.Br. |  |  |  |  | 1.7 |
|  | tribe Poeae |  |  | 4.5 |  |  |
| Pteridophyta | indet. | 0.3 |  |  |  |  |
| Ranunculaceae | indet. | 0.2 |  |  |  |  |
|  | *Caltha* *palustris* L. |  |  |  | 3.1 |  |
| Rosaceae | *Comarum palustre* L. |  |  |  | 1.4 |  |
|  | *Geum* sp. |  |  |  |  | + |
| Salicaceae | *Salix* sp. | 0.4 |  | 14.7 |  | 15.7 |
| **Cryptogams** |  |  |  |  |  |  |
| **Bryophyta** |  |  |  |  |  |  |
| Amblystegiaceae | *Campylium* cf. *stellatum* (Hedw.) C.E.O.Jensen |  | + |  |  |  |
| Ditrichaceae | *Ceratodon purpureus* (Hedw.) Brid. |  |  |  |  | 5.3 |
| Family indet. |  | 0.7 |  | + |  |  |
| Mniaceae | *Plagiomnium* cf. *ellipticum* (Brid.) T.J. Kop. |  | + |  |  |  |
|  | *Rhizomnium* cf. *pseudopunctatum* (Bruch & Schimp.) T.J. Kop. |  | + |  |  |  |
| Polytrichaceae | indet. |  |  | + |  |  |
|  | *Polytrichastrum alpinum* (Hedw.) G.L. Sm. |  | + |  |  | 68.1 |
| Sphagnaceae | *Sphagnum* sp. | + | + |  |  |  |

### Table S6.5 Yakutian bison (±10.5kyr)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Family/order** | **Taxon** | **Pollen**  **(%)** | **Macro** | ***trn*L**  **(%)** | **nrITS1**  **(%)** | **nrITS2**  **(%)** |
| **Phanerogams** |  |  |  |  |  |  |
| Adoxaceae | *Sambucus williamsii* Hance |  |  | + |  |  |
| Apiaceae | indet. | 8.9 | + |  |  |  |
|  | *Cicuta virosa* L. |  |  |  | 54.9 | 44.4 |
|  | tribe Oenantheae |  |  | 14.4 |  |  |
| Asteraceae | *Artemisia* sp. | 0.1 |  |  |  |  |
|  | subfamily Asteroideae (Tubuliflorae) | 0.1 |  |  |  |  |
|  | *Endocellion sibiricum* (J.F. Gmel.) J. Toman |  |  |  | 0.8 | 5.5 |
| Betulaceae | *Alnus* sp. | 3.0 |  |  |  |  |
|  | *Betula* sp. | 1.4 |  |  |  | 2.1 |
|  | *Betula* sect. *Apterocaryon* | 2.3 |  |  |  |  |
|  | *Betula* sect. *Betula* | 0.8 |  |  |  |  |
| Caryophyllaceae | indet. | + |  |  |  |  |
|  | *Stellaria* sp. |  |  |  |  | + |
| Cyperaceae | indet. | 6.1 | ++ |  |  |  |
|  | *Carex* sp. |  | + |  |  |  |
|  | *Carex aquatilis* Wahlenb. |  |  | 1.4 | 0.3 | 0.1 |
|  | *Carex* subgenus *Carex* |  |  | 13.3 |  |  |
|  | *Carex chordorrhiza* L.f. |  |  |  | 0.7 |  |
|  | *Carex nigra*subsp.*juncea* (Fries) Soó |  |  |  | + |  |
|  | *Carex rostrata* Stokes |  |  |  | 1.7 | + |
|  | *Carex vesicaria* L. |  |  |  | 0.2 | + |
|  | *Eriophorum* sp. |  | + | 14.2 |  |  |
|  | *Eriophorum angustifolium* Honck. |  |  |  | 16.2 | 1.2 |
| Dennstaedtiaceae | *Pteridium* sp. | 0.2 |  |  |  |  |
| Equisetaceae | *Equisetum* sp. | 3.0 | + | + |  |  |
| Fabaceae | indet. | 1.4 |  |  |  |  |
| Liliaceae | indet. | 0.2 |  |  |  |  |
| Menyanthaceae | *Menyanthes trifoliata* L. |  | + | 2.8 | 0.5 | 3.4 |
| Onagraceae | *Epilobium palustre* L. |  |  |  | 0.7 | 1.0 |
| Pinaceae | indet. | 0.2 |  |  |  |  |
|  | *Pinus* subgenus *Strobus* | 0.2 |  |  |  |  |
|  | *Pinus* subgenus *Pinus* | 0.2 |  |  |  |  |
| Plantaginaceae | *Hippuris* sp. |  |  |  |  | 0.6 |
| Poaceae | indet. | 71.1 | ++ |  |  |  |
|  | subtribe Agrostidinae |  |  | 1.0 |  |  |
|  | *Arctophila fulva* (Trin.) Andersson |  |  |  |  | 0.2 |
|  | *Dupontia fisheri* R.Br. |  |  |  | 0.3 |  |
|  | *Calamagrostis* sp. |  |  |  |  | 0.1 |
|  | *Poa arctica* R.Br. |  |  |  |  | + |
| Pteridophyta | indet. | 2.2 |  |  |  |  |
| Ranunculaceae | indet. | 0.2 |  |  |  |  |
|  | *Anemonastrum narcissiflorum* (L.) Holub |  |  |  |  | + |
|  | *Anemone patens* L. |  |  |  |  | 0.1 |
|  | *Caltha palustris* L. |  |  | 2.9 | 2.5 | 5.7 |
| Rosaceae | *Alchemilla* sp. |  |  | + |  |  |
|  | *Comarum palustre* L. |  | + | 7.3 | 2.9 | 9.3 |
|  | subtribe Fragariinae(*Potentilla-*type) | 0.6 |  |  |  |  |
|  | subfamily Rosoideae |  |  | + |  |  |
| Salicaceae | *Salix* sp. | 0.5 | + | 42.6 | 18.6 | 26.3 |
| **Cryptogams** |  |  |  |  |  |  |
| **Algae** |  |  |  |  |  |  |
| Zygnemataceae | *Spirogyra* sp. | + |  |  |  |  |
| **Bryophyta** |  |  |  |  |  |  |
| Amblystegiaceae | *Calliergon* cf. *giganteum* (Schimp.) Kindb. |  | + |  |  |  |
| indet. | Type HdV-817 (bryophyte spores) | 7.4 |  |  |  |  |
| Sphagnaceae | *Sphagnum* sp. | 0.4 |  |  |  |  |

### Table S6.6 Cape Blossom mammoth (±14.4kyr)

N.B. nrITS1 and nrITS2 did not produce any results.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Family/order** | **Taxon** | **Pollen (%)** | **Macro** | ***trn*L**  **(%)** |
| **Phanerogams** |  |  |  |  |
| Amaranthaceae | cf. *Chenopodium* sp. |  | + |  |
| Apiaceae | indet. | 6.0 |  |  |
|  | apioid superclade |  |  | + |
|  | subfamily Apioideae |  |  | 0.8 |
|  | tribe Oenantheae |  |  | 0.3 |
|  | tribe Selineae |  |  | 1.1 |
| Asteraceae | indet. |  |  | + |
|  | tribe Anthemideae |  |  | 32.6 |
|  | *Arnica* sp. |  |  | 1.2 |
|  | subtribe Artemisiinae |  |  | + |
|  | *Artemisia* sp. | 7.2 |  |  |
|  | *Artemisia gmelinii* Web. ex Stechm. |  |  | 0.1 |
|  | subfamily Asteroideae (Tubuliflorae) | 1.9 |  | 0.2 |
| Betulaceae | *Betula* sp. | 4.5 |  |  |
| Boraginaceae | *Eritrichium* sp. |  |  | + |
|  | *Mertensia paniculata* (Aiton) G.Don |  |  | 2.1 |
|  | *Myosotis alpestris* F.W.Schmidt |  |  | 0.6 |
| Brassicaceae | cf. *Draba* sp. |  | + |  |
| Caryophyllaceae | indet. | 0.8 |  |  |
|  | tribe Alsineae (*Cerastium/Silene* sp.) |  | + |  |
|  | *Minuartia rubella* (Wahlenb.) Hiern |  | + |  |
| Cyperaceae | indet. | 4.8 | 90% (est.) |  |
|  | *Carex* sp. |  | +++ |  |
|  | *Carex aquatilis* Wahlenb. |  |  | 5.8 |
|  | *Carex maritima* Gunnerus |  |  | 0.8 |
|  | *Carex microchaeta* Holm |  |  | + |
|  | *Carex* subgenus *Vignea* |  | + | 5.0 |
|  | *Carex* subgenus *Euthyceras* |  |  | 9.0 |
| Fabaceae | *Astragalus* sp. |  |  | + |
| Juncaceae | *Luzula* sp. |  | + |  |
| Menyanthaceae | *Menyanthes trifoliata* L. |  |  | 0.1 |
| Onagraceae | indet. | 1.3 |  |  |
|  | *Chamaenerion angustifolium* (L.) Scop. |  |  | 28.5 |
| Plantaginaceae | *Plantago* sp. | 0.7 |  |  |
|  | *Plantago* sect. *Lamprosantha* |  |  | 0.3 |
| Poaceae | indet. | 69.8 | 5% (est.) |  |
|  | tribe Agrostidinae |  |  | 2.0 |
|  | *Alopecurus* sp. |  | + |  |
|  | *Bromus* sp. |  |  | + |
|  | *Bromus pumpellianus* Scribn. |  |  | 1.8 |
|  | *Elymus* sp. |  | + |  |
|  | *Festuca kolymensis* Drobow |  |  | + |
|  | *Koeleria asiatica* Domin |  |  | + |
|  | *Poa* sp. |  | + |  |
|  | tribe Poeae |  |  | 1.6 |
|  | tribe Triticeae |  |  | 0.3 |
| Polemoniaceae | *Polemonium* sp. | 0.8 |  |  |
|  | *Polemonium boreale* Adams |  |  | 0.2 |
| Polygonaceae | subfamily Polygonoideae (*Rumex acetosella*-type) | 0.2 |  |  |
|  | *Rumex* sp. (*Rumex aquaticus*-type) | 0.2 |  |  |
| Ranunculaceae | *Caltha palustris* L. |  |  | 1.7 |
| Rosaceae | indet. |  |  |  |
|  | *Comarum palustre* L. |  |  | 0.1 |
|  | subtribe Fragariinae(*Potentilla-*type) | 1.0 |  |  |
|  | *Potentilla* sp. |  | + | 0.2 |
|  | *Potentilla* cf. *hyparctica* Malte |  | + |  |
|  | *Potentilla* cf*. stipularis* L. |  | + |  |
|  | *Sanguisorba officinalis* L. | 0.5 |  | 1.1 |
| Salicaceae | *Salix* sp. | 0.3 |  |  |
| **Cryptogams** |  |  |  |  |
| **Bryophyta** |  |  |  |  |
| Sphagnaceae | *Sphagnum* sp. | 0.2 |  |  |
| Thuidiaceae | *Thuidium abietinum* (Hedw.) Schimp. |  | + |  |

### Table S6.7 Yukagir mammoth (±22.5kyr)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Family/order** | **Taxon** | **Pollen**  **(%)** | **Macro** | ***trn*L**  **(%)** | **nrITS1**  **(%)** | **nrITS2 (%)** |
| **Phanerogams** |  |  |  |  |  |  |
| Amaranthaceae | indet. | 0.1 | + |  |  |  |
| Apiaceae | indet. | 0.3 |  |  |  |  |
|  | subfamily Apioideae |  |  | + |  |  |
|  | tribe Oenantheae |  |  | 0.1 |  |  |
| Asteraceae | tribeAnthemideae |  |  | 9.8 |  |  |
|  | subtribe Artemisiinae |  |  | + |  |  |
|  | *Artemisia* sp. | 16.0 |  |  |  |  |
|  | *Artemisia scoparia* Waldst. & Kit. |  |  |  | 0.5 | 2.6 |
|  | *Artemisia gmelinii* Web. ex Stechm. |  |  | + |  |  |
|  | subfamily Asteroideae (Tubuliflorae) | 0.2 | + |  |  |  |
|  | subfamily Cichorioideae (Liguliflorae) | 0.2 |  |  |  |  |
| Boraginaceae | *Eritrichium* sp. |  |  | 0.6 |  |  |
|  | *Eritrichium sericeum* DC. |  |  |  | 5.6 | 8.0 |
|  | *Myosotis alpestris* F.W.Schmidt |  |  | 16.7 | 69.0 | 60.0 |
| Brassicaceae | indet. | 0.7 |  |  |  |  |
|  | *Draba* sp. |  | + |  |  |  |
|  | *Parrya nudicaulis* (L.) Regel |  |  | + |  |  |
|  | *Smelowskia* sp. |  |  | + |  |  |
|  | *Smelowskia alba* (Pall.) Regel |  |  |  | 6.0 | 11.8 |
| Caryophyllaceae | indet. | 4.7 |  |  |  |  |
|  | *Cerastium arvense* L. |  |  | + | 0.1 |  |
|  | *Eremogone* sp. |  |  | + |  |  |
|  | *Eremogone capillaris* (Poir.) Fenzl |  |  | + |  |  |
|  | *Sagina nivalis* Fr. |  | + |  |  |  |
|  | *Silene* sp. |  |  | + |  |  |
| Crassulaceae | *Rhodiola rosea* L. |  |  | + |  |  |
| Cyperaceae | indet. | 0.1 |  |  |  |  |
|  | *Carex* sp. |  | ++ | 0.1 |  |  |
|  | *Carex dioica* L. |  | ++ |  |  |  |
|  | *Carex nardina* Fr. |  | ++ |  |  |  |
|  | *Carex nigra*subsp.*juncea* (Fries) Soó |  |  |  | 0.3 |  |
| Ericales | indet. | 0.1 |  |  |  |  |
| Fabaceae | indet. | 1.4 |  |  |  |  |
|  | *Astragalus* sp. |  |  | 0.3 |  |  |
|  | *Astragalus alpinus* L. |  |  |  |  | 0.8 |
|  | *Lotus* sp. | 0.2 |  |  |  |  |
|  | *Oxytropis* sp. |  |  | 0.1 |  |  |
|  | *Oxytropis deflexa* DC. |  |  | + | + | 2.0 |
|  | *Oxytropis splendens* Douglas |  |  |  | 0.4 |  |
| Juncaceae | *Juncus* sp. |  | + |  |  |  |
| Liliaceae | Indet. | + |  |  |  |  |
| Menyanthaceae | *Menyanthes trifoliata* L. |  |  | + |  |  |
| Orchidaceae | *Epipactis* sp. | + |  |  |  |  |
| Orobanchaceae | *Pedicularis* sp. |  |  | + |  |  |
|  | *Pedicularis sudetica* Willd. |  |  | + |  |  |
| Papaveraceae | *Papaver* sp. | 0.1 |  | + |  |  |
|  | *Papaver* sect. *Scapiflora* |  | + |  |  |  |
| Plantaginaceae | *Lagotis* sp. |  |  | + |  |  |
|  | *Plantago* sp. | 0.8 |  | 0.1 |  |  |
| Plumbaginaceae | tribe Limonieae (*Armeria*-type) | + |  |  |  |  |
| Poaceae | indet. | 70.6 | +++ |  |  |  |
|  | indet. (cf. *Agrostis* sp.) |  | + |  |  |  |
|  | *Deschampsia cespitosa* (L.) P.Beauv. |  |  |  | 0.4 | 0.9 |
|  | *Festuca kolymensis* Drobow |  |  | 0.3 |  |  |
|  | *Festuca ovina* L. |  |  |  | 0.2 | 1.0 |
|  | *Glyceria* sp. |  | + |  |  |  |
|  | *Hordeum* sp. |  | + |  |  |  |
|  | *Pleuropogon sabinei* R.Br. |  |  | + |  |  |
|  | *Poa* cf*. arctica* R.Br. |  | + |  |  |  |
|  | *Poa glauca* Vahl |  |  |  | 1.1 |  |
|  | tribe Poeae |  |  | 0.1 |  |  |
| Polemoniaceae | *Polemonium* sp. | 0.2 |  |  |  |  |
|  | *Phlox hoodii* Richardson |  |  | + |  |  |
| Polygonaceae | *Persicaria* sp. (*P. maculosa*-type) | 0.3 |  |  |  |  |
|  | subfamily Polygonoideae (*Rumex acetosella*-type) | 0.8 |  |  |  |  |
|  | *Rumex* sp. |  | + |  |  |  |
|  | *Rumex acetosella* L. |  | + |  |  |  |
| Potamogetonaceae | *Stuckenia* sp. |  |  | + |  |  |
| Primulaceae | cf. *Androsace* | 0.2 |  |  |  |  |
|  | *Androsace lehmanniana* Spreng. |  |  | + |  |  |
|  | *Lysimachia* sp. |  | + |  |  |  |
| Ranunculaceae | indet. | 0.7 |  |  |  |  |
|  | *Anemonastrum narcissiflorum* (L.) Holub |  |  | + |  | + |
|  | *Caltha palustris* L. |  | + | 2.0 |  |  |
|  | *Ranunculus* sp. |  |  | + |  |  |
|  | *Ranunculus* cf*. nivalis* L. |  | + |  |  |  |
|  | *Ranunculus pedatifidus var. affinis* (R.Br.) L.D.Benson |  |  | + |  |  |
|  | *Ranunculus* cf. *pygmaeus* Wahlenb. |  | + |  |  |  |
| Rosaceae | indet. | 0.2 |  |  |  |  |
|  | subtribe Fragariinae(*Potentilla-*type) | 0.9 |  |  |  |  |
|  | *Geum* sp. |  |  | 0.2 |  |  |
|  | *Potentilla* sp. |  | + | 1.7 | + |  |
|  | *Potentilla hookeriana* Lehm. |  |  |  |  | 0.4 |
|  | *Potentilla hyparctica* Malte |  | + |  |  |  |
|  | cf. *Rubus chamaemorus* L. | 1.9 |  |  |  |  |
|  | *Sanguisorba officinalis* L. | 0.1 |  |  |  |  |
| Salicaceae | indet. |  |  | 67.3 |  |  |
|  | *Salix* cf. *arctica* Pall. |  | + |  |  |  |
|  | *Salix* sp. | 0.2 | +++ |  | 15.4 | 12.4 |
| Saxifragaceae | *Micranthes* sp. |  |  | + |  |  |
| **Cryptogams** |  |  |  |  |  |  |
| **Algae** |  |  |  |  |  |  |
| Zygnemataceae | *Spirogyra* sp. | + |  |  |  |  |
| Hydrodictyaceae | Pediastrum sp. | 0.1 |  |  |  |  |
| **Bryophyta** |  |  |  |  |  |  |
| Amblystegiaceae | *Drepanocladus* sp. |  |  |  |  | + |
|  | *Drepanocladus aduncus* (Hedw.) Warnst. |  | + | + |  |  |
|  | *Drepanocladus sordidus* (Müll. Hal.) Hedenäs |  |  |  | + |  |
| Bryaceae | *Bryum* sp. |  | + | + |  |  |
| Entodontaceae | *Entodon concinnus* Paris |  | + |  |  |  |
| Hypnales | indet. |  |  | + |  |  |
| Polytrichaceae | *Polytrichastrum alpinum* (Hedw.) G.L. Sm. |  | + |  |  |  |
| Pottiaceae | indet. |  | + |  |  |  |

### Table S6.8 Adycha mammoth (±25.6kyr)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Family/order** | **Taxon** | **Pollen (%)** | **Macro** | ***trn*L (%)** | **nrITS1 (%)** | **nrITS2 (%)** |
| **Phanerogams** |  |  |  |  |  |  |
| Amaranthaceae | indet. | 0.8 |  |  |  |  |
| Apiaceae | indet. | 0.2 |  |  |  |  |
|  | tribe Apioideae (*Peucedanum*-type) | + |  |  |  |  |
|  | *Peucedanum* sp. |  |  | 0.2 |  |  |
|  | tribe *Selineae* |  |  | + |  |  |
| Asteraceae | tribe *Anthemideae* |  |  | 4.2 |  |  |
|  | *Artemisia* sp. | 18.1 |  |  |  |  |
|  | *Artemisia scoparia* Waldst. & Kit. |  |  |  |  | + |
|  | tribe Cardueae (*Arctium*-type; *Carlina*-type) | 0.5 |  |  |  |  |
|  | subfamily Cichorioideae (Liguliflorae) | 0.5 |  |  |  |  |
|  | tribe Gnaphalieae |  |  | + |  |  |
|  | *Saussurea* sp. |  |  | 1.0 |  |  |
| Betulaceae | *Betula* sp. | 0.7 |  |  |  |  |
| Boraginaceae | *Eritrichium* sp. |  |  | + |  |  |
| Brassicaceae | indet. | 1.2 |  | + |  |  |
| Caryophyllaceae | indet. |  |  |  |  |  |
|  | *Minuartia* sp. | 0.1 |  |  |  |  |
|  | *Stellaria* sp. |  |  |  | + |  |
| Cyperaceae | indet. | 2.9 |  |  |  |  |
|  | *Carex* subgenus *Vignea* |  |  | 0.9 |  |  |
|  | *Carex maritima* Gunnerus |  |  | + |  |  |
| Ericales | indet. | 0.1 |  |  |  |  |
|  | *Vaccinium vitis-idaea* L. |  |  |  |  | + |
| Fabaceae | indet. | 0.1 |  |  |  |  |
|  | *Astragalus alpinus* L. |  |  |  |  | + |
| Juncaceae | *Juncus biglumis* L. |  |  | + |  |  |
| Onagraceae | *Chamaenerion angustifolium* (L.) Scop. |  |  | 0.4 |  |  |
| Pinaceae | *Pinus* sp. |  |  | + |  |  |
|  | *Pinus* subgenus *Strobus* | 0.1 |  |  |  |  |
|  | *Pinus* subgenus *Pinus* | 1.0 |  |  |  |  |
| Poaceae | indet. | 72.4 | +++ |  |  |  |
|  | *Alopecurus magellanicus* Lam. |  |  |  | 0.2 |  |
|  | *Arctagrostis latifolia* Griseb. |  |  |  |  | + |
|  | *Bromus* sp. |  |  | + |  |  |
|  | *Bromus pumpellianus* Scribn. |  |  | 16.2 |  |  |
|  | *Deschampsia cespitosa* (L.) P.Beauv. |  |  |  | 0.2 |  |
|  | *Dupontia fisheri* R.Br. |  |  |  | 0.1 |  |
|  | *Festuca ovina* L. |  |  |  |  | + |
|  | *Poa arctica* R.Br. |  |  |  |  | + |
|  | *Puccinellia* sp. |  |  | 76.8 | 38.5 | 1.0 |
|  | *Puccinellia tenuiflora/vahliana* |  |  |  |  | 99.0 |
|  | *Puccinellia vahliana* Scribn. & Merr. |  |  |  | 61.0 |  |
| Polypodiophyta | indet. | 0.8 |  |  |  |  |
| Ranunculaceae | indet. | 0.4 |  |  |  |  |
| Salicaceae | *Salix* sp. | 0.5 |  |  | + |  |
| Saxifragaceae | *Saxifraga sibirica* L. |  |  |  |  | + |
| **Cryptogams** |  |  |  |  |  |  |
| **Bryophyta** |  |  |  |  |  |  |
| Dicranaceae | *Dicranum scoparium* Hedw. |  |  |  | + |  |
| Funariaceae | *Funaria* sp. |  |  |  | + |  |
| Glomeraceae | *Glomus* sp. | 5.9 |  |  |  |  |
| Hylocomiaceae Hylocomium splendens (Hedw.) Schimp. | *Hylocomium splendens* (Hedw.) Schimp. |  |  |  |  | + |
| hypnales | indet. |  |  | + |  |  |
| **Algae** |  |  |  |  |  |  |
| Zygnemataceae | *Zygnema*-type | 0.1 |  |  |  |  |

### Table S6.9 Yukon horse (±30.9)

N.B. nrITS1 and nrITS2 did not produce any results.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Family/order** | **Taxon** | **Pollen (%)** | **Macro** | ***trn*L**  **(%)** |
| **Phanerogams** |  |  |  |  |
| Amaranthaceae | indet. | 2.2 |  |  |
| Amaryllidaceae | *Allium* sp. | 0.2 |  |  |
| Apiaceae | indet. | 0.9 |  |  |
| Asteraceae | tribe Anthemideae |  |  | 13.6 |
|  | *Artemisia* sp. | 27.4 | + |  |
|  | *Artemisia gmelinii* Web. ex Stechm. |  |  | + |
|  | subfamily Asteroideae (Tubuliflorae) | 1.9 |  |  |
|  | subfamily Cichorioideae (Liguliflorae) | 0.6 |  |  |
| Betulaceae | *Alnus crispa* (Aiton) Pursh |  | + |  |
|  | *Alnus incana* (L.) Moench |  | + |  |
|  | *Betula* sp. |  | + |  |
| Brassicaceae | indet. | 0.2 | ++ |  |
|  | *Braya* sp. |  |  | 6.0 |
|  | *Braya rosea* Bunge |  |  | 21.1 |
| Caryophyllaceae | indet. |  | ++ |  |
|  | *Silene* sp. (*Silene vulgaris*-type) | 0.4 |  |  |
| Cyperaceae | indet. | 2.2 | ++ |  |
| Ericaceae | *Pyrola grandiflora* Radius |  |  | + |
| Fabaceae | indet. | 0.4 |  |  |
|  | *Oxytropis* sp. |  |  | 11.7 |
| Gentianaceae | *Gentianella* sp. | 0.2 |  |  |
| Juncaceae | *Juncus* sp. |  |  | 0.1 |
|  | *Juncus alpinoarticulatus* Chaix |  |  | + |
| Orobanchaceae | *Pedicularis sudetica* Willd. |  |  | 0.1 |
| Papaveraceae | *Papaver* sp. | 0.2 | ++ |  |
| Plantaginaceae | *Plantago* sp. | 0.6 |  |  |
| Poaceae | indet. | 57.1 | ++ |  |
|  | *Bromus pumpellianus* Scribn. |  |  | 2.9 |
|  | tribe Poeae |  |  | 29.2 |
|  | tribe Triticeae |  |  | 4.9 |
| Polemoniaceae | *Polemonium* sp | 0.2 |  |  |
| Polygonaceae | *Persicaria* sp. (*P. maculosa*-type) | 3.7 |  |  |
|  | subfamily Polygonoideae (*Rumex acetosella*-type) | 0.4 |  |  |
| Primulaceae | *Androsace septentrionalis* L. |  | ++ |  |
| Ranunculaceae | indet. | 0.2 |  |  |
|  | *Anemonastrum narcissiflorum* (L.) Holub |  |  | 0.1 |
| Rosaceae | subtribe Fragariinae (*Potentilla*-type) | 0.9 |  |  |
|  | *Geum* sp. |  |  | 1.4 |
|  | *Potentilla* sp. |  | ++ | 8.9 |
|  | *Sanguisorba officinalis* L. | 0.2 |  |  |
| Salicaceae | *Salix* sp. |  | + |  |

### Table S6.10 Abyland mammoth (±32.4kyr)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Family/order** | **Taxon** | **Pollen**  **(%)** | **Macro** | ***trn*L**  **(%)** | **nrITS1**  **(%)** | **nrITS2**  **(%)** |
| **Phanerogams** |  |  |  |  |  |  |
| Amaranthaceae | indet. | + |  |  |  |  |
| Apiaceae | indet. | + |  |  |  |  |
|  | tribe Oenantheae |  |  | 0.6 |  |  |
|  | tribe Selineae |  |  | + |  |  |
| Asteraceae | indet. |  |  | + |  |  |
|  | tribe Anthemideae |  |  | 10.7 |  |  |
|  | subtribe Artemisiinae |  |  | + |  |  |
|  | *Artemisia* sp. | 26.7 |  |  |  |  |
|  | *Artemisia gmelinii* Web. ex Stechm. |  |  | + |  |  |
|  | *Artemisia scoparia Waldst. & Kit.* |  |  |  | 0.2 |  |
|  | *Arnica* sp. |  |  | 0.2 |  |  |
|  | subfamily Asteroideae (*Aster*-type; *Senecio*-type; Tubuliflorae) | 0.3 |  | + |  |  |
|  | tribe Cardueae (*Carduu*s-type) | + |  |  |  |  |
|  | subfamily Cichorioideae (Liguliflorae) | 0.3 |  |  |  |  |
|  | *Saussurea* sp. |  |  | 0.9 |  |  |
|  | *Tephroseris* sp. |  |  | 0.1 |  |  |
|  | *Tripleurospermum maritimum* (L.) W.D.J.Koch |  |  | + |  |  |
| Boraginaceae | *Eritrichium* sp. |  |  | 0.1 |  |  |
|  | *Mertensia paniculata* (Aiton) G.Don |  |  | + |  |  |
|  | *Myosotis alpestris* F.W.Schmidt |  |  | 0.7 |  |  |
| Brassicaceae | indet. | 3.8 |  | 0.3 |  |  |
|  | tribe Thelypodieae |  |  | + |  |  |
|  | *Sisymbrium linifolium* Nutt. |  |  |  | 2.2 | + |
| Caryophyllaceae | indet. | 1.5 |  |  |  |  |
|  | *Cerastium arvense* L. |  |  | 0.1 | + |  |
|  | *Cerastium maximum* L. |  |  | + |  |  |
|  | *Dianthus* sp. | + |  | + |  |  |
|  | *Eremogone capillaris* (Poir.) Fenzl |  |  | + |  |  |
|  | *Silene* sp. (*Silene vulgaris*-type) | + |  |  |  |  |
|  | tribe Sileneae (*Lychnis*/*Viscaria*-type) | + |  |  |  |  |
|  | *Silene samojedorum* (Sambuk) Oxelman |  |  | 0.1 |  |  |
|  | *Stellaria* sp. |  |  | + |  | + |
|  | *Stellaria borealis* Bigelow |  |  | + |  |  |
| Crassulaceae | *Rhodiola integrifolia* Raf. |  |  | + |  |  |
| Cyperaceae | indet. | 0.5 |  |  |  |  |
|  | *Carex* sp. |  | + | + |  |  |
|  | *Carex nigra*subsp.*juncea* (Fries) Soó |  |  |  | 7.3 |  |
|  | *Carex duriuscula* C.A.Mey. |  |  |  | 53.0 | 0.2 |
|  | *Carex* subgenus *Euthyceras* |  |  | + |  |  |
|  | *Carex* subgenus *Vignea* |  |  | 10.2 |  |  |
| Fabaceae | indet. | 1.0 |  |  |  |  |
|  | *Astragalus* sp. |  |  | + |  |  |
|  | *Oxytropis* sp. |  |  | + |  |  |
|  | tribe Trifolieae (*Trifolium repens*-type) | + |  |  |  |  |
| Juncaceae | *Juncus* sp. |  |  | + |  |  |
|  | *Juncus alpinoarticulatus* Chaix |  |  | + |  |  |
|  | *Luzula* sp. |  |  | + |  |  |
| Menyanthaceae | *Menyanthes trifoliata* L. |  |  | 0.1 |  |  |
| Onagraceae | *Chamaenerion angustifolium* (L.) Scop. |  |  | 1.0 |  |  |
| Orobanchaceae | indet. (*Rhinanthus*-type) | + |  |  |  |  |
|  | *Pedicularis* sp. |  |  | + |  |  |
|  | *Pedicularis sudetica* Willd. |  |  | + |  |  |
|  | *Pedicularis verticillata* L. |  |  | + |  |  |
| Papaveraceae | *Papaver* sp. | 0.8 |  | 0.2 |  |  |
| Plantaginaceae | *Plantago* sp. | 2.1 |  |  |  |  |
|  | *Plantago* sect. *Lamprosantha* |  |  | 2.0 |  |  |
| Poaceae | indet. | 61.1 | +++ |  |  |  |
|  | subtribe Agrostidinae |  |  | 0.2 |  |  |
|  | *Alopecurus magellanicus* Lam. |  |  |  | 2.9 |  |
|  | *Bromus* sp. |  |  | + |  |  |
|  | *Bromus pumpellianus* Scribn. |  |  | 11.3 |  |  |
|  | *Deschampsia cespitosa* (L.) P.Beauv. |  |  |  |  | 0.3 |
|  | *Festuca altaica* Trin. |  |  | + |  |  |
|  | *Festuca kolymensis* Drobow |  |  | + |  |  |
|  | *Hordeum* sp. |  |  | 0.2 |  |  |
|  | *Koeleria asiatica* Domin |  |  | 0.1 |  |  |
|  | *Poa* sp. |  |  |  | 2.5 |  |
|  | tribe Poeae |  |  | 3.2 |  |  |
|  | tribe Triticeae |  |  | 0.5 |  |  |
|  | *Puccinellia tenuiflora/vahliana* |  |  |  |  | 4.3 |
| Polemoniaceae | *Polemonium* sp. | 0.3 |  | + |  |  |
| Potamogetonaceae | *Stuckenia* sp. |  |  | 0.3 |  |  |
| Polygonaceae | *Persicaria* sp. (*P.* *maculosa*-type) | + |  |  |  |  |
| Ranunculaceae | indet. | + |  |  |  |  |
|  | *Anemonastrum narcissiflorum* (L.) Holub |  |  | + |  | + |
|  | *Anemone* sp. | + |  | + | 0.3 |  |
|  | *Anemone patens* L. |  |  | 49.6 | 30.9 | 70.6 |
|  | *Caltha palustris* L. |  |  | 0.4 |  |  |
|  | *Thalictrum* sp. | + |  |  |  |  |
| Rosaceae | indet. | 0.3 |  |  |  |  |
|  | *Comarum palustre* L. |  |  | 0.1 |  |  |
|  | subtribe Fragariinae (*Potentilla*-type) | 2.1 |  |  |  |  |
|  | *Geum* sp. |  |  | 0.5 |  |  |
|  | *Potentilla* sp. |  |  | 2.4 |  |  |
|  | subfamily Rosoideae |  |  | + |  |  |
|  | *Sanguisorba officinalis* L. | 0.3 |  | 0.2 |  |  |
| Rubiaceae | tribe Rubieae (*Galium*-type) | + |  | + |  |  |
| Salicaceae | *Salix* sp. |  |  | 3.0 |  | 24.6 |
| Saxifragaceae | section Mesogyne |  |  | + |  |  |
| **Cryptogams** |  |  |  |  |  |  |
| **Bryophyta** |  |  |  |  |  |  |
| Pottiaceae | *Barbula unguiculata* Hedw. |  |  |  | 0.7 |  |
|  | *Didymodon icmadophilus* (Müll.Hal.) K.Saito |  |  | + |  |  |

### Table S6.11 Maly Lyakhovsky mammoth (±32.7kyr)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Family/order** | **Taxon** | **Pollen**  **(%)** | **Macro** | ***trn*L**  **(%)** | **nrITS1**  **(%)** | **nrITS2**  **(%)** |
| **Phanerogams** |  |  |  |  |  |  |
| Apiaceae | tribe Oenantheae |  |  | 0.6 |  |  |
| Asteraceae | *Artemisia* sp. | 1.0 |  |  |  |  |
|  | subtribe Artemisiinae |  |  | + |  |  |
|  | subfamily Asteroideae (Tubuliflorae) | 0.2 |  |  |  |  |
|  | subfamily Cichorioideae (Liguliflorae) | + |  |  |  |  |
|  | tribe Gnaphalieae |  |  | + |  |  |
|  | *Saussurea* sp. |  |  | + |  |  |
| Brassicaceae | indet. | 0.2 |  |  |  |  |
|  | *Arabidopsis lyrata* (L.) O'Kane & Al-Shehbaz |  |  | 0.2 |  |  |
|  | *Eutrema edwardsii* R.Br. |  |  | 0.1 |  |  |
| Caryophyllaceae | indet. | 0.4 |  |  |  |  |
|  | *Stellaria* sp. |  |  | 0.3 | 2.6 | 4.9 |
|  | *Stellaria borealis* Bigelow |  |  | + |  |  |
|  | *Stellaria longifolia* Muhl. ex Willd. |  |  | + |  |  |
| Crassulaceae | *Rhodiola rosea* L. |  |  | 0.1 |  |  |
| Cyperaceae | indet. | 0.4 |  |  |  |  |
|  | *Carex* sp. |  |  | 0.1 |  |  |
|  | *Carex nigra*subsp.*juncea* (Fries) Soó |  |  |  | 4.2 |  |
|  | *Eriophorum* sp. |  |  | 22.9 | 0.7 |  |
|  | *Eriophorum angustifolium* Honck. |  |  |  | 3.3 | 0.8 |
| Fabaceae | indet. | 0.1 |  |  |  |  |
|  | *Oxytropis deflexa* DC. |  |  |  |  | + |
| Juncaceae | *Juncus biglumis* L. |  |  | 1.0 |  |  |
|  | *Juncus oxymeris* Engelm. |  |  |  | + |  |
| Menyanthaceae | *Menyanthes trifoliata* L. |  |  | 0.1 | + | + |
| Orobanchaceae | cf*. Pedicularis* sp. | 0.1 |  | 0.3 |  |  |
|  | *Pedicularis sudetica* Willd. |  |  | 0.1 |  |  |
| Poaceae | indet. | 96.9 | +++ |  |  |  |
|  | tribe Agrostidinae |  |  | 0.3 |  |  |
|  | *Arctophila fulva* (Trin.) Andersson |  |  |  |  | 7.5 |
|  | *Arctophila fulva/Dupontia fisheri* |  |  | 21.5 |  |  |
|  | *Alopecurus magellanicus* Lam. |  |  |  | 28.7 | 9.8 |
|  | *Bromus* sp. |  |  | + |  |  |
|  | *Bromus pumpellianus* Scribn. |  |  | 1.3 |  |  |
|  | *Dupontia fisheri* R.Br. |  |  |  | 9.5 | 5.0 |
|  | *Deschampsia cespitosa* (L.) P.Beauv. |  |  |  | 42.2 | 21.6 |
|  | *Festuca altaica* Trin. |  |  | + |  |  |
|  | *Hordeum* sp. |  |  | 0.1 |  |  |
|  | *Pleuropogon sabinei* R.Br. |  |  | 0.6 |  |  |
|  | tribe Poeae |  |  | 40.6 |  |  |
|  | tribe Triticeae |  |  | + |  |  |
|  | *Puccinellia* sp. |  |  | 2.1 | 3.2 |  |
|  | *Puccinellia vahliana* Scribn. & Merr. |  |  |  | 0.6 |  |
| Papaveraceae | *Papaver* sp. | 0.5 |  |  |  |  |
| Pinaceae | *Pinus* sp. |  |  | + |  |  |
| Plantaginaceae | *Hippuris* sp. |  |  |  |  | + |
| Polemoniaceae | *Polemonium* sp. | + |  |  |  |  |
| Polygonaceae | subfamily Polygonoideae (*Rumex acetosella*-type) | 0.3 |  |  |  |  |
|  | *Rumex* sp. |  |  | + |  |  |
| Ranunculaceae | indet. | + |  |  |  |  |
|  | *Anemonastrum narcissiflorum* (L.) Holub |  |  |  |  | + |
|  | *Anemone patens* L. |  |  |  |  | 0.4 |
|  | *Caltha palustris* L. |  |  | 2.4 |  | 7.0 |
|  | *Comarum palustre* L. |  |  | 0.1 |  |  |
|  | *Ranunculus pedatifidus var. affinis* (R.Br.) L.D.Benson |  |  | 0.1 |  |  |
| Rosaceae | *Geum* sp. |  |  | 0.1 |  |  |
|  | *Potentilla* sp. |  |  | 0.1 |  |  |
| Salicaceae | indet. |  |  | 3.0 |  |  |
|  | *Salix* sp. |  |  |  | + |  |
| Saxifragaceae | *Micranthes* sp. |  |  | 0.1 |  |  |
|  | *Saxifraga sibirica* L. |  |  |  |  | 8.1 |
|  | *Saxifraga* sect. *Mesogyne* |  |  | 1.0 |  |  |
| **Cryptogams** |  |  |  |  |  |  |
| **Bryophyta** |  |  |  |  |  |  |
| Amblystegiaceae | *Campylium stellatum* (cf. var. *stellatum*) (Hedw.) C.E.O.Jensen |  | + |  |  |  |
|  | *Cratoneuron filicinum* (Hedw.) Spruce |  |  | + |  |  |
|  | *Drepanocladus* sp. |  | + | + |  |  |
|  | *Drepanocladus sordidus* (Müll. Hal.) Hedenäs |  |  |  | 0.2 | 1.2 |
|  | *Warnstorfia sarmentosa* Hedenäs |  | + |  |  |  |
| Bartramiaceae | *Philonotis cf. arnellii* Husn. |  | + |  |  |  |
| Bryaceae | *Bryum* sp. |  | + | + |  |  |
|  | *Pohlia cf. nutans* (Hedw.) H. Lindb. |  | + |  |  |  |
| Dicranaceae | *Dicranum bonjeanii* De Not. |  |  | + |  |  |
|  | *Dicranoweisia cf. cirrata* (Hedw.) Lindb. |  | + |  |  |  |
| Distichiaceae | *Distichium* sp. |  | + |  |  |  |
| Funariaceae | *Funaria* sp. |  |  |  | 2.8 |  |
| Hypnales | indet. |  |  | + |  |  |
| Mniaceae | *Cinclidium stygium* Sw. |  | + |  |  |  |
| Polytrichaceae | *Polytrichastrum alpinum* (Hedw.) G.L. Sm. |  | + |  |  | 33.4 |
| Pottiaceae | *Didymodon icmadophilus* (Müll.Hal.) K.Saito |  |  |  | 1.9 |  |
| **Liverwort** |  |  |  |  |  |  |
| Ricciaceae | *Riccia* sp. | + |  |  |  |  |