Survey of the vascular plants of Alert (Ellesmere Island, Canada), a polar desert at the northern tip of the Americas

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Abstract
Long-term monitoring is critical to guide conservation strategies and assess the impacts of climatic changes and anthropogenic activities. In High Arctic ecosystems, information on distribution and population trends of plants is dramatically lacking. During two field expeditions in 2018 and 2019, we conducted a systematic floristic survey together with opportunistic collecting in the polar desert surrounding Alert (Nunavut, Canada) to update past vascular plant inventories. We recorded 58 species, of which 54 species were recorded over the last seven decades, and four species that are additions to the local flora (Draba pauciflora R. Brown, Festuca edlundiae S.G. Aiken, Consaul, & Lefkovitch, Festuca hyperborea Holmen ex Frederiksen, and ×Pucciphippsia vacillans (T. Fries) Tzvelev). With the addition of 19 species that were previously reported but not found in our survey, we estimate the species richness in the study area at 77 species.

Keywords
Arctic endemic species, Floristic inventory, High Arctic, imperiled species, northern distribution

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Introduction

Polar deserts are among the most extreme environments in the world. These seemingly barren landscapes are characterized by a short growing season, low annual and summer mean temperatures, low precipitations, severe limitation in nutrients, and soil disturbance due to freeze-thaw cycles (Billings 1987, Peterson 2014). Because of these important environmental constraints, High Arctic ecosystems support persistent but sparse and short vegetation (Bliss and Svoboda 1984; Bliss et al. 1984; Lévesque 1997; Peterson 2014; Zwolicki et al. 2020). These ecosystems are expected to be the most impacted by the ongoing climate change due to Arctic amplification, which refers to the greater climatic changes occurring near the North pole compared to the rest of the globe (Smith et al. 2019). With the steep climate warming occurring over the last decades (Meehl et al. 2007), Arctic regions have already experienced changes in vegetation composition, biomass, and diversity (Elmendorf et al. 2012a, 2012b; Ravolainen et al. 2020). Therefore, establishing ecological baselines and updating past inventories are critical scientific endeavors to monitor, predict, and manage future impacts of climate change (Mihoub et al. 2017). Despite the remoteness and considerable logistical constraints associated with working in the High Arctic, there is a long history of botanical collecting at High Arctic research stations, particularly in the mid-20th century (Panchen et al. 2019). However, current collections from some High Arctic locales are lacking and synthesized, published data regarding plant biodiversity in polar deserts remains scarce (CAFF 2013).

Located at the northern tip of Ellesmere Island in the Canadian Arctic Archipelago, only 817 km from the North Pole, Alert is the northernmost permanently inhabited settlement on Earth. Here, an Environment and Climate Change Canada weather station operates year-round, and a Canadian Forces Station (CFS Alert) was established in 1958 (Johnson 1990). The Alert region is characterized by continuous permafrost and is one of the most arid places in the Northern Hemisphere (Parks Canada 1994). Alert occurs in Circumpolar Arctic Bioclimatic Subzone A, which is the coldest bioclimatic subzone in the Canadian Arctic, with an average July temperature of 3°C (CAVM Team 2003). This subzone landscape is mostly barren, with some lichen and moss cover, and a <5% vascular plant cover (CAVM Team 2003; Christensen et al. 2013).

The history of vascular plant collecting in the Alert region began with the British Arctic Expedition in 1875–1876, when H.W. Feilden, the expedition’s naturalist, made the first known vascular plant collections from the site (Bruggemann and Calder 1953). Later, during R. Peary’s expeditions to the North Pole in 1905–1906 and 1908–1909, plants were collected by expedition members L.J. Wolf, R.A. Bartlett, and J.W. Goosdell (Bruggemann and Calder 1953). It was only during the establishment of the weather station at Alert in 1950 that the next plant collections occurred. From April to September 1950, an airstrip mechanic, J.P. Johnson was sent to Alert, where he explored the area and collected various samples (Johnson 1990), including vascular plants deposited at the National Herbarium of Canada at the Canadian Museum of Nature (CAN; herbarium acronyms follow Thiers 2020). In subsequent years, collections of the local flora greatly expanded. From April to September 1951, P.F. Bruggemann collected insects and carried out botanical investigations for the Northern Insect Survey at and around Alert, at Mt. Grant in the United States Range, and at the Wood River, located 40 km and 65 km west of Alert, respectively (Bruggemann and Calder 1953). During the botanical survey, Bruggemann was accompanied by S.D. MacDonald of the National Museum of Canada (the precursor to the Canadian Museum of Nature); MacDonald deposited vascular plants of his own collecting at the National Herbarium of Canada (CAN). Bruggemann deposited his collection at National Collection of Vascular Plants at Agriculture and Agri-Food Canada (DAO) and later summarized his own 1951 vascular plant inventory with the addition of the previous regional surveys from Feilden in 1875–1876, Bartlett in 1908, and Polunin in 1940 (Bruggemann and Calder 1953). In this paper, he also estimated that 65 species of vascular plants were present in the eastern Canadian Arctic north of 82°N. In 1952, P. Gadbois and C. Laverdière, from Université de Montréal, were sent to Alert by the Canadian Department of Mines and Technical Surveys to perform geographical surveys and mapping of the region (Gadbois and Laverdière 1954). They made several vascular plant samplings deposited at the Marie-Victorin Herbarium (MT) (Gadbois and Laverdière 1954). During the International Geophysical Year from 1957 to 1959, botanists, glaciologists, limnologists, earth science researchers, and biologists were sent to Alert. Among them, C.R. Harington went back to Alert in 1959, where he also collected many plant specimens (GBIF 2020). Following this, K.V. Pilon in 1975, D. Drew in 1976, and R. Pomereau in 1983 collected vascular plant specimens at Alert that they deposited at the University of British Columbia Herbarium (UBC), Canadian Museum of Nature (CAN), and Louis-Marie Herbarium (QFA), respectively (GBIF 2020).

Here, we report the results of a systematically conducted vascular plant survey supplemented with opportunistic collecting in the polar desert surrounding Alert in 2018–2019. This provides a current inventory of the vascular plants, and a temporal snapshot of current species diversity to inform continued botanical work at the station.

Study Area

Our study area surrounds CFS Alert (82°30′N, 062°20′W) and is located on the north-eastern tip of Ellesmere Island, Nunavut, Canada (Fig. 1). It is roughly delimited
by the Lincoln Sea to the north and the boundaries of CFS Alert property in other directions. The study site encloses an area of 170 km$^2$, including five lakes (White Pond [0.12 km$^2$], Self Pond [0.25 km$^2$], Kirk Lake [0.58 km$^2$], Lower Dumbell Lake [0.94 km$^2$], Upper Dumbell Lake [1.18 km$^2$]), three bays (Ravine Bay [3.01 km$^2$], Colan Bay [3.49 km$^2$], Dumbell Bay [4.65 km$^2$]), and one inlet (Alert Inlet [1.09 km$^2$]). The local topography consists of rugged and undulating terrain with mountains (to a maximum height of 525 m a.s.l.), hills, valleys, and creeks. The surficial deposit ranges from 2.4 to 4 m thick and is mostly composed of till (sandy clay loam) and shattered rock filled with ice (Taylor et al. 1982; Tam 2014). The underlying bedrock is highly calcareous, composed of argillite with greywacke in some places, and the permafrost is >600 m thick (Smith et al. 2012).

Because of isostatic rebound, the post-glacial marine limit is estimated at 135 m a.s.l (England 1976) and many beds of marine silts and clays occur, containing masses of recent marine shells (Bruggemann and Calder 1953). No glacial striae, trough-shaped valleys, or cirques are observed at Alert, and the present topography has been shaped entirely by water erosion and frost action (Bruggemann and Calder 1953). Alert is free of the Innuitian Ice Sheet since ~9.6 ka calibrated BP (Dalton et al. 2020). The uplands are mostly mesic, xeric, or barren, and consist mainly of boulder, frost-shattered rock, gravel, and polygonal nets of till, with very low vegetation cover growing inside soil interstices. In the lowlands, where some soil moisture accumulates, a more continuous vegetation cover develops, consisting primarily of grasses and sedges (Bruggemann and Calder 1953).

At Alert, a 24-h direct sunlight period occurs from early April to early September, while the sun remains
under the horizon from mid-October to late February. July temperatures average 3.4 °C and annual snowfall and rainfall average respectively 184.6 and 1.7 cm (corresponding to a combined water equivalent of 158 mm; Government of Canada 2010). The ground is generally covered with snow from early September to mid-June, leaving only about 2.5 months per year for plant growth (E Desjardins, S Lai, and D Berteaux personal observations).

Methods

Data collection. The floristic study was carried out during two field expeditions between 26 June and 24 August 2018, and 25 June and 4 September 2019. We conducted a systematic survey, which involved a random stratified design, as described below. The survey was supplemented with opportunistic sampling, collecting vascular plants of interest along marked trails and while traveling within the study area.

Selection of survey locations. We selected systematic survey locations based on a habitat map (Appendix 1) constructed from a multispectral satellite picture of the study area (Fig. 1). The habitat map consisted of six classes, including snow/water and five broad vegetation gradients classified into habitat types, namely barren ground, xeric, xeric-mesic, mesic, and wetland (Fig. 2). A $2 \times 2$ km grid was overlaid on the study area and, for each grid cell, we performed vegetation surveys at one or more random locations for each of the five habitat types present in the grid (Fig. 3A). ArcGIS 10.6.1 (ESRI 2018) was used to complete these steps.

Field surveys. Each vegetation survey corresponded to a vegetation plot consisting of five $1 \times 1$ m quadrats, each located 5 m from a central point and at equal distance from one another (Fig. 3B; Bay 1998). All species inside the quadrats (Fig. 3C) were identified and recorded (Fig. 3D). If a species was opportunistically encountered at a surveyed site but out of a quadrat, specimens were collected to contribute to our floristic survey.

Specimen collection. The first flowering (or fruiting) specimens encountered of each species (in or outside the vegetation plots) were collected and dried in a standard plant press. Specimens were identified subsequently by the authors (ED, SL, SP, MD, PS, AS, JL, and LS) using keys from the Flora of the Canadian Arctic Archipelago (Aiken et al. 2007), Flora of North America (Flora of North America Editorial Committee 1993, 1997, 2000, 2002, 2005, 2006, 2007, 2009, 2010, 2014), Flore nordique du Québec et du Labrador (Payette 2013, 2015, 2018), Vascular Plants of Continental Northwest Territories, Canada (Porsild and Cody 1980), The Flora of Canada (Scoggan 1978a, 1978b, 1979), and other taxonomic literature (Aiken et al. 1995; Aares et al. 2000; Brysting and Elven 2000; Consaul and Gillespie 2001; Harris 2006; Consaul et al. 2008a, 2008b; Elven and Al-Shehbaz 2008; Al-Shehbaz and Mulligan 2013; Saarela et al. 2020; Solstad and Elven, unpublished). Collected specimens were also compared to those conserved at the Louis-Marie Herbarium (Université Laval, Quebec City, Quebec, Canada). Species names were updated based on the Database of Vascular Plants of Canada (VASCAN) (Brouillet et al. 2010+; Desmet and Brouillet 2013) and synonyms used in Saarela et al. 2020 (and other current Arctic floristic treatments; Elven et al. 2011) are also indicated. These specimens are deposited at the Louis-Marie Herbarium (QFA), with duplicates deposited at the Canadian Museum of Nature Herbarium (CAN).

Vascular plant descriptions and comparisons. Descriptions of species include their plant habit and distinctive characteristics and are roughly organized according to the template provided by Aiken et al. (2007). All size measurements and character states (e.g., pubescence, shape, color) represent specimens collected at Alert. Species descriptions are based on at least 10 specimens of various sizes, with the exception of Draba pauciflora R. Brown and Pedicularis hirsuta Linnaeus, for which only three specimens were available. In the species comparisons, we indicate the characteristics which, based on literature sources, are important to distinguish a given species from congeneric species found at Alert or elsewhere on Ellesmere Island. We also indicate when our collected specimens present characteristics that do not fully correspond to those reported in published floras. Botanical terms used in the descriptions and comparisons follow Beentje (2016) and Payette (2013, 2015, 2018).

Vascular plant habitats. The main habitat of each species was determined as follows. For species recorded in vegetation plots, we considered the species’ main habitat as the habitat with the highest frequency of occurrence (highest number of vegetation plots). For species recorded only opportunistically (i.e., outside vegetation plots), we copied the GPS location of the collection on our habitat map to identify the species habitat.

Results

We conducted a total of 264 vegetation surveys, hence systematically inventorying 1,320 quadrats of 1 m$^2$ each. The xeric and xeric-mesic habitats were too similar to be distinguished in the field. We, therefore, merged them in the xeric class for further analyses, yielding four main vegetated habitat types (Table 1).

We found 58 species during our systematic surveys and opportunistic collecting in 2018 and 2019, distributed among 33 genera and 14 families (Table 1). We found four species through opportunistic collections (Carex aquatilis Wahlenberg var. minor Boott, Eriophorum scheuchzeri Hoppe subsp. arcticum Novoselova, Puccinellia phyrganodes (Trinius) Scribner & Merrill subsp. neoarctica (Å. Löve & D. Löve) Elven, and Saxifraga tricuspidata Rottbøll) not recorded during the systematic approach. This result highlights the need to use
both survey methodologies. Overall, the most diverse family was Poaceae (18 spp.), followed by Brassicaceae (9 spp.), Caryophyllaceae (6 spp.), Saxifragaceae (6 spp.), Cyperaceae (4 spp.), Ranunculaceae (3 spp.), Equisetaceae (2 spp.), Juncaceae (2 spp.), Polygonaceae (2 spp.), and Rosaceae (2 spp.). The families Asteraceae, Orobanchaceae, Papaveraceae, and Salicaceae were each represented by a single species. Only two species, Dryas integrifolia Vahl subsp. integrifolia and Salix arctica Pallas, are dwarf shrubs. Among the 58 recorded species, one is listed by NatureServe as imperiled in Nunavut (Festuca viviparoidea Krajina ex Pavlick subsp. viviparoidea), and 15 are endemic to the Canadian Arctic ecozone, including an intergeneric hybrid species (×Pucchiphippsia vacillans (T. Fries) Tzvelev; Table 1).

In Table 1, we present the species found during our two field seasons and indicate if each taxon was recorded by previous collecting expeditions. Occurrences from
Table 1. List of species found in the study area (Alert, Ellesmere Island, Nunavut, Canada) based on 2018–2019 inventory, including specimens accession numbers at the Louis-Marie Herbarium (QFA) (Québec City, Québec, Canada) and Canadian Museum of Nature Herbarium (CAN) (Ottawa, Ontario, Canada). Previous literature records for each taxon from Bruggemann and Calder (1953) and occurrences recorded by other collectors found in GBIF (2020) are also indicated, along with the main habitat, and the proposed status by IUCN Red List of Threatened Species (2020) and NatureServe (2020). Names are based on VASCAN (Brouillet et al. 2010+; Desmet and Brouillet 2013), while synonyms used in Saarela et al. 2020 and Elven et al. 2011 are also indicated. A star symbol (*) following a name indicates an Arctic endemic species (Daniëls et al. 2020). Habitat: B = barren ground, X = xeric, M = mesic, W = wetland. IUCN status: NA = not available, LC = least concern. NatureServe status: NA = not available, NSR = no status rank, S = secure, AS = apparently secure, H = hybrid, I = imperiled. The NatureServe status is indicated separately for Canada (Can) and Nunavut (Nu) when they differ.

| Species | Voucher(s) 2018–2019 | Previous records | Habitat | IUCN status | NatureServe status |
|---------|----------------------|------------------|---------|-------------|--------------------|
| **Asteraceae** | | | | | |
| Tanacetum phymatocarpum J. Vahl | Desjardins et al. s.n. (QFA0634995) | Johnson 1950 | X | NA | NSR |
| **Brassicaceae** | | | | | |
| Brevia purpurascens (R. Brown) Bunge ex Ledebour | Desjardins et al. s.n. (QFA0635558, QFA0635559, QFA0635560) | Johnson 1950 | X | LC | AS (Can) NSR (Nu) |
| Cardamine arctia Th. Fries | Desjardins et al. s.n. (QFA0635557 [CAN], QFA0635589) | MacDonald 1951 | X | NA | NSR |
| Cardamine brevifolia Linnaeus | Desjardins et al. s.n. (QFA0635556) | Bruggemann and Calder 1953 | W | NA | S (Can) NSR (Nu) |
| Chichorium intybus L. | Desjardins et al. s.n. (QFA0635554, QFA0635555, QFA0635584) | Macdonald 1951 | W | LC | S (Can) NSR (Nu) |
| Draba arctica R. Brown ex de Candolle | Desjardins et al. s.n. (QFA0635552 [CAN], QFA0635553 [CAN], QFA0635584) | Johnson 1950 | X | NA | NSR |
| Draba lacina Adams | Desjardins et al. s.n. (QFA0635551 [CAN]) | Bruggemann and Calder 1953 | W | NA | S (Can) NSR (Nu) |
| Draba micropetala Hooker* | Desjardins et al. s.n. (QFA0635549, QFA0635586 [CAN]) | Johnson 1950 | X | NA | AS (Can) NSR (Nu) |
| Draba pasciflora R. Brown* | Desjardins et al. s.n. (QFA0635550 [CAN]) | Johnson 1950 | X | NA | AS (Can) NSR (Nu) |
| Draba subapiculata Simmons | Desjardins et al. s.n. (QFA0635585 [CAN]) | Johnson 1950 | X | NA | AS (Can) NSR (Nu) |
| **Caryophyllaceae** | | | | | |
| Canadensis arcticum Lange* | Desjardins et al. s.n. (QFA0635574) | Johnson 1950 | X | NA | NA |
| Canadensis nigril Ostenfeld | Desjardins et al. s.n. (QFA0635520, QFA0635576) | Bruggemann and Calder 1953 | W | NA | AS (Can) NSR (Nu) |
| Sabulina rossii (R. Brown ex Richardson) Dillonberger & Kaderrett* | Desjardins et al. s.n. (QFA0635571) | Bruggemann and Calder 1953 | W | NA | S (Can) NSR (Nu) |
| Silene arctica (Ruprecht) Bosquet subsp. arctica* Syn.: Silene arctica subsp. arctica (Fr.) Bosquet | Desjardins et al. s.n. (QFA0635570) | Bruggemann and Calder 1953 | W | NA | NSR |
| Stellaria longipes Goldie subsp. longipes | Desjardins et al. s.n. (QFA0635575) | Johnson 1950 | M | NA | S (Can) NSR (Nu) |
| **Cyperaceae** | | | | | |
| Carex aquatilis var. minor Boott Syn.: Carex aquatilis subsp. submer (Drejer) Hultén | Desjardins et al. s.n. (QFA0635568, QFA0635569) | Gadbois and Lavendière 1952 | W | LC | NSR |
| Carex fulginosa Schkuhr Syn.: Carex fulgiosa subsp. misandra (R. Br.) Nyman | Desjardins et al. s.n. (QFA0635566, QFA0635567) | Bruggemann and Calder 1953 | W | NA | NSR |
| Eriophorum triste (Th. Fr.) Hadac & A. Lève | Desjardins et al. s.n. (QFA0635565) | Macdonald 1951 | W | LC | S |
| Eriophorum scheuchzeri Hoppe subsp. arcticum Novoselova | Desjardins et al. s.n. (QFA0635564) | Gadbois and Lavendière 1952 | W | LC | NSR |
| **Equisetaceae** | | | | | |
| Equisetum arvense L. | Desjardins et al. s.n. (QFA0634994) | MacDonald 1951 | W | LC | S |
| Equisetum variegatum Schleicher ex F. Weber & D. Mohr subsp. variegatum | Desjardins et al. s.n. (QFA0634993) | Bruggemann and Calder 1953 | W | LC | S |
### Junaceae

| Species | Voucher(s) 2018–2019 | Previous records | Habitat | IUCN status | NatureServe status |
|---------|----------------------|------------------|---------|-------------|-------------------|
| Juncus biglumis Linnaeus | Desjardins et al. s.n. (QFA0635561, QFA0635562) | MacDonald 1951 Bruggemann and Calder 1953 Harington 1959 | W | LC | S |
| ... | ... | ... | ... | ... | ... |

### Orobancheaceae

| Species | Voucher(s) 2018–2019 | Previous records | Habitat | IUCN status | NatureServe status |
|---------|----------------------|------------------|---------|-------------|-------------------|
| Pedicularis hirsuta Linnaeus | Desjardins et al. s.n. (QFA0635577) | Bruggemann and Calder 1953 Harington 1959 | W | NA | S (Can) NSR (Nu) |

### Papaveraceae

| Species | Voucher(s) 2018–2019 | Previous records | Habitat | IUCN status | NatureServe status |
|---------|----------------------|------------------|---------|-------------|-------------------|
| Papaver dahlii H. Northagen | Desjardins et al. s.n. (QFA0634992) | MacDonald 1951 Johnson 1950 Harington 1959 | X | NA | A5 (Can) NSR (Nu) |

### Poaceae

| Species | Voucher(s) 2018–2019 | Previous records | Habitat | IUCN status | NatureServe status |
|---------|----------------------|------------------|---------|-------------|-------------------|
| Alopecurus magellanicus Lamarck Syn.: Alopecurus bnowlo Trinuss | Desjardins et al. s.n. (QFA0635548) | Johnson 1950 MacDonald 1951 Bruggemann and Calder 1953 Harington 1959 | W | LC | S |
| ... | ... | ... | ... | ... | ... |

### Polygonaceae

| Species | Voucher(s) 2018–2019 | Previous records | Habitat | IUCN status | NatureServe status |
|---------|----------------------|------------------|---------|-------------|-------------------|
| Bistorta vivipara (Linnaeus) Delarbre | Desjardins et al. s.n. (QFA0635578) | Johnson 1950 MacDonald 1951 Bruggemann and Calder 1953 Harington 1959 | W | NA | S (Can) NSR (Nu) |
| ... | ... | ... | ... | ... | ... |

### Ranunculaceae

| Species | Voucher(s) 2018–2019 | Previous records | Habitat | IUCN status | NatureServe status |
|---------|----------------------|------------------|---------|-------------|-------------------|
| Ranunculus hyperboreus Rottboll Syn.: Ranunculus hyperboreus subsp. hyperboreus | Desjardins et al. s.n. (QFA0634991) | Bruggemann and Calder 1953 Harington 1959 | W | LC | S (Can) NSR (Nu) |
| ... | ... | ... | ... | ... | ... |
Check List 17 (1)

| Species | Voucher(s) 2018–2019 | Previous records | Habitat | IUCN status | NatureServe status |
|---------|----------------------|------------------|---------|--------------|-------------------|
| **Rosaceae** | | | | | |
| Dryas integrifolia Vahl subsp. integrifolia | Desjardins et al. s.n. (QFA0635001) | MacDonald 1951, Bruggemann and Calder 1953, Pilon 1975 | W | NA | S (Can) NSR (Nu) |
| Potentilla pulchella R. Brown | Desjardins et al. s.n. (QFA0635000) | MacDonald 1951, Bruggemann and Calder 1953, Harington 1959 | M | NA | AS (Can) NSR (Nu) |
| **Salicaceae** | | | | | |
| Salix arctica Pallas | Desjardins et al. s.n. (QFA0635521) | Johnson 1950, Bruggemann and Calder 1953, MacDonald 1951 | W | NA | S (Can) NSR (Nu) |
| **Saxifragaceae** | | | | | |
| Microcentra tenella (Wahlenberg) Small | Desjardins et al. s.n. (QFA0634988) | MacDonald 1951, Bruggemann and Calder 1953, Harington 1959 | W | NA | S (Can) NSR (Nu) |
| Saxifraga cernua Linnaeus | Desjardins et al. s.n. (QFA0635006) | Johnson 1950, Bruggemann and Calder 1953, Harington 1959 | W | NA | S (Can) NSR (Nu) |
| Saxifraga crispa Linnaeus | Desjardins et al. s.n. (QFA0635005) | Johnson 1950, Bruggemann and Calder 1953, Harington 1959 | M | NA | S (Can) NSR (Nu) |
| Saxifraga flagellaris Willdenow subsp. platysepala (Trautvetter) A.E. Porsild | Desjardins et al. s.n. (QFA0635003) | Johnson 1950, Bruggemann and Calder 1953, Harington 1959, Pilon 1975, Drew 1976, Pomerleau 1983 | W | NA | NSR |
| Saxifraga oppositifolia Linnaeus subsp. oppositifolia | Desjardins et al. s.n. (QFA0635002) | MacDonald 1951, Bruggemann and Calder 1953, Harington 1959, Pilon 1975 | X | NA | S (Can) NSR (Nu) |
| Saxifraga tricuspidata Rottboll | Desjardins et al. s.n. (QFA0635004) | Bruggemann and Calder 1953 | M | NA | S (Can) NSR (Nu) |

**Figure 3.** Systematic survey. **A.** Habitat map of the study area overlapped by 2 × 2 km grid showing locations of 264 vegetation plots (white squares) randomly distributed in five habitat types: barren ground, xeric, xeric-mesic, mesic, and wetland. **B.** Set up of the vegetation plot with the five 1m² quadrats. **C.** Top view of a quadrat. **D.** Vegetation sampling by an observer (right) helped by a scribe (left).
previous expeditions were compiled and reported as they appear in the Global Biodiversity Information Facility database (GBIF 2020) and were not revised by us. Additional collection data recorded during the 2018–2019 inventory are available in Supplementary Data 1. In the Identification subsections, we describe all species found in our 2018–2019 inventory and we compare collected specimens with similar or related species. Taxa are listed alphabetically by family and then by species.

Asteraceae – Daisy family

**Taraxacum phymatocarpum J. Vahl**

*Figure 4*

**Materials examined.** CANADA – Nunavut • Ellesmere Island, CFS Alert; 82°27′48″N, 062°47′33″W; 14 m a.s.l.; 8 Jul. 2019; habitat: river delta, with silty sand and rocks as substrates; QFA0634995.

**Identification.** Plants 2.5–5.5 cm high; herbaceous; not caespitose. Taproots present. Stems 1.5–4.0 cm long; ascending or erect; glabrous. Leaves basal; horizontal or patent; alternate; petiolate. Petioles 2–7 mm long; winged; glabrous. Leaf blades 5–25 mm long; oblanceolate; acute lobes on each side; dark green; abaxial and adaxial surfaces both glabrous; apices obtuse or acute. Calyculi 1.5–5.0 mm long; appressed or spreading; ovate; dark green or dark purple; surface glabrous; apices acute. Phyllaries 7–15 mm long; appressed; lanceolate; dark green or dark purple; surface glabrous. Inflorescence a solitary capitulum; 13–20 mm wide; with 30–40 zygomorphic florets. Sepals represented by pappi; 4–7 mm long; pale yellow or white. Petals 5; fused; pale yellow. Ray floret limbs 6–12 mm long, 1–4 mm wide; ligulate. Androecium with 5 stamens and 3–5 mm long anther tubes. Gynoecium with 1 style and 2 stigmas. Fruit an achene.

**Taraxacum phymatocarpum** can be differentiated from the three other *Taraxacum* F.H. Wiggers species present on Ellesmere Island (*T. ceratophorum* (Ledebour) de Candolle, *T. holmenianum* Sahlin, and *T. hyparcticum* Dahlstedt; Aiken et al. 2007; GBIF 2020) by the following: plant height <10 cm; flowering head small (15–20 mm wide); petals yellow without pink-grey stripes (as in *T. hyparcticum*); and ligulate floret limbs ≤9 mm wide (Brouillet 2006; Aiken et al. 2007).

Brassicaceae – Draba family

**Braya purpurascens (R. Brown) Bunge ex Ledebour**

*Figure 5A*

**Materials examined.** CANADA – Nunavut • Ellesmere Island, CFS Alert; 82°28′11″N, 062°41′60″W; 154 m a.s.l.; 14 Aug. 2019; habitat: xeric, with polygonal patterned ground made of till and rocks, and sparse dominance of *Saxifraga oppositifolia*; QFA0635559 • same locality; 82°29′46″N, 062°44′07″W; 30 m a.s.l.; 4 Jul. 2019; habitat: barren ground in a slope, with till and rocks as substrates, and sparse dominance of *Saxifraga oppositifolia*; QFA0635559 • same locality; 82°27′48″N, 062°47′33″W; 14 m a.s.l.; 8 Jul. 2019; habitat: river delta, with silty sand and rocks as substrates; QFA0635560.

**Identification.** Plants 1.5–4.5 cm high; herbaceous; caespitose. Taproots present. Stems 0.5–4.0 cm long; erect, ascending, or decumbent; hairy, with simple and branched hairs (2 rays: Y, T, and V). Leaves basal; alternate; petiolate. Petioles 2–5 mm long; winged; margins ciliate, with simple hairs. Leaf blades 4–19 mm long, 0.8–2.7 mm wide; linear or oblanceolate; unlobed or lobed, with 1–2 triangular acute lobes on each side; bases attenuate; abaxial and adaxial surfaces both shiny (living specimens) and glabrous; margins ciliate, with simple hairs; apices acute or obtuse. Inflorescence a solitary capitulum; 13–20 mm wide; with 30–40 zygomorphic florets. Sepals represented by pappi; 4–7 mm long; pale yellow or white. Petals 4; 2.4–3.8 mm long, 0.8–1.6 mm wide; obovate or oblong; purple; surface glabrous; margins glabrous or ciliate, with simple hairs; apices rounded. Petals 4; 2.4–3.8 mm long, 0.8–1.6 mm wide; obovate or obtruncated; unlobed; white and purple-tinged proximally. Androecium with 6 stamens and 0.3–0.5 mm long anthers. Gynoecium with 1 style and 1 stigma. Fruit a silique; 5.0–10.2 mm long, 1.5–3.0 mm wide; elliptic or oblanceolate; cylindrical; yellowish purple or greyish green; surface glabrous or sparsely hairy, with simple and branched hairs (2 rays: T and V). Styles are persisting in fruit 0.7–1.2 mm long, 0.2–0.4 mm wide. Stigmas 0.5–0.7 mm wide; larger than the styles.

**Braya Sternberg & Hoppe species** can be differentiated from white-flowered *Draba* Linnaeus species by the

• same locality; 82°29′46″N, 062°44′07″W; 30 m a.s.l.; 4 Jul. 2019; habitat: barren ground in a slope, with till and rocks as substrates, and sparse dominance of *Saxifraga oppositifolia*; QFA0635559 • same locality; 82°27′48″N, 062°47′33″W; 14 m a.s.l.; 8 Jul. 2019; habitat: river delta, with silty sand and rocks as substrates; QFA0635560.
terete or ovoid fruits; ciliate sepal margins; and presence of simple and 2-forked hairs on the leaves (Aiken et al. 2007; Saarela et al. 2020). Among the four Braya species present on Ellesmere Island (GBIF 2020), B. purpurascens, B. thorild-wulffii Ostenfeld subsp. thorild-wulffii, and B. glabella subsp. glabella and subsp. prostrata J.G. Harris have one or no cauline leaf and ovoid to cylindrical-elliptic fruits, whereas B. humilis (C.A. Meyer) B.L. Robinson subsp. humilis and subsp. ellesmerensis J.G. Harris have more than one cauline leaf and linear fruits (Aiken et al. 2007; Harris 2010; Saarela et al. 2020).

B. thorild-wulffii subsp. thorild-wulffii has short styles persisting in fruits (0–1 mm long), whereas B. purpurascens and both B. glabella subspecies have mostly longer styles (0.3–2.0 mm long; Harris 2006, 2010). The fruits of B. purpurascens and both B. glabella subspecies are oblong, ovoid-elliptic, or cylindrical-lanceolate, whereas they are ovoid or globose in B. thorild-wulffii subsp. thorild-wulffii (Harris 2006; Saarela et al. 2020).

Fruits of B. glabella subsp. glabella are oblong or narrowly oblong-lanceoloid, often curved, and 3.5–8.3 times as long as wide, whereas they are ovoid-elliptic or oblong-elliptic, usually straight, and 2.5–3.7 times as long as wide in B. purpurascens and B. glabella subsp. prostrata (Harris 2010).

**Braya thorild-wulffii Ostenfeld subsp. thorild-wulffii**

Figure 5B

**Materials examined.** CANADA – Nunavut • Ellesmere Island, CFS Alert; 82°25′52″N, 062°07′49″W; 296 m a.s.l.; 16 Jul. 2019; habitat: wetland in a mountain pass, with peat and rocks as substrates, dominated by moss and Saxifraga cernua Linnaeus; QFA0635556.

**Identification.** Plants 1.5–4.0 cm high; herbaceous; caespitose. Taproots present. Stems 1–3 cm long; erect or ascending; glabrous. Leaves basal and cauline; isomorphic; alternate; petiolate. Petioles 5–9 mm long; not winged; glabrous. Leaf blades 3–6 mm long, 1.5–4.2 mm wide; ovate; bases cuneate or obtuse; abaxial and adaxial surfaces both glabrous; margins glabrous; apices rounded or obtuse. Inflorescence a raceme, with 2–4 flowers; not elongating or slightly elongating as the fruit matures. Pedicels glabrous. Sepals 4; 1.8–2.2 mm long, 0.7–1.2 mm wide; ovate or oblong; green or purple, with hyaline margins; surface glabrous; margins glabrous; apices rounded or obtuse. Petals 4; 2.6–3.8 mm long, 0.8–1.4 mm wide; obovate; not clawed; white. Androecium with 6 stamens and 0.4–0.5 mm long anthers. Gynoecium with 1 style and 1 stigma. Fruit a silique; 7–16 mm long, 0.6–1.1 mm wide; elongate-linear or elongate-elliptic; flattened; dark purple; glabrous. Styles persisting in fruit 0.6–1.4 mm long, 0.4–0.5 mm wide. Stigmas 0.4–0.5 mm wide; as wide as the styles.

**Cardamine bellidifolia Linnaeus**

Figure 5C

**Materials examined.** CANADA – Nunavut • Ellesmere Island, CFS Alert; 82°25′56″N, 062°19′19″W; 48 m a.s.l.; 8 Aug. 2019; habitat: xeric near the sewage outlet, with till and rocks as substrates, and sparse dominance of Puccinellia angustata (R. Brown) E.L. Rand & Redfield and Cochlearia groenlandica (H. Christ.); QFA0635554 • same locality; 82°31′13″N, 062°25′46″W; 44 m a.s.l.; 27 Jul. 2019; habitat: mesic, with polygonal patterned ground made of till, dominated by Alopecurus magellanicus.
Lamarck and *Saxifraga oppositifolia*; QFA0635555.

**Identification.** Plants 2.5–6.0 cm high; herbaceous; caespitose. Taproots present. Stems 1.0–4.5 cm long; erect, ascending, or decumbent; glabrous. Leaves basal and cauline; heterophyllous; alternate; long-petiolate (basal leaves), short-petiolate (lower cauline leaves), and sessile (upper cauline leaves). Basal leaf petioles 8–13 mm long; not winged; glabrous. Basal leaf blades 4–6 mm long, 5–7 mm wide; ovate or deltate; bases truncate or subcordate; abaxial and adaxial surfaces both glabrous; margins glabrous; apices rounded or obtuse. Cauline leaf
Among the yellow-flowered Draba species present on Ellesmere Island (D. alpina Linnaeus, D. arctoa-genus (E. Ekman) E. Ekman, D. micropetala Hooker, D. oblongata R. Brown ex Candolle, and D. pauciflora; Aiken et al. 2007; GBIF 2020), D. corymbosa and D. simmonsii Elven & Al-Shebaz are characterized by larger petals (2–4 mm wide; Aiken et al. 2007; Elven and Al-Shebaz 2008; Garneau and Sabourin 2018). D. corymbosa also has wider fruits (3.1–5.5 mm wide) and longer styles persisting in fruits (0.4–1.0 mm long) compared to D. alpina, D. micropetala, and D. simmonsii, which have 1.9–3.8 mm wide fruits and 0.05–0.30 mm long styles (Elven and Al-Shebaz 2008; Al-Shebaz et al. 2010b; Garneau and Sabourin 2018). D. corymbosa has mainly branched hairs on the abaxial leaf surface, whereas the other yellow-flowered Draba species have simple or simple and branched hairs (Al-Shebaz and Mulligan 2013; Saarela et al. 2020).

**Draba corymbosa R. Brown ex Candolle**

**Materials examined.** CANADA – Nunavut • Ellesmere Island, CFS Alert; 82°26′22″N, 062°50′39″W; 201 m a.s.l.; 7 Aug. 2019; habitat: barren ground in a slope, with till and rocks as substrates; QFA0635552, CAN • same locality; 82°31′35″N, 062°26′21″W; 57 m a.s.l.; 26 Jun. 2019; habitat: barren ground, with polygonal patterned ground made of till and rocks, and sparse dominance of Saxifraga oppositofolia and Poa abbreviata R. Brown; QFA0635553, CAN • same locality; 82°31′35″N, 062°18′19″W; 5 m a.s.l.; 3 Aug. 2019; habitat: wetland, with peat as substrate, dominated by Salix arctica, Saxifraga oppositofolia, and moss; QFA0635584.

**Identification.** Plants 2–4 cm high; herbaceous; caespitose. Taproots present. Stems 2.0–4.5 cm long; erect; glabrous or hairy, with simple branched hairs (2–8 rays; Y and dendritic). Leaves basal and sometimes 1 cauline; alternate or whorled; petiolate or subpetiolate. Petioles 2–3 mm long; slightly winged; margins glabrous or ciliate, with simple hairs. Basal leaf blades 4.1–9.0 mm long, 0.9–2.4 mm wide; oblongolate; bases attenuate; abaxial surface sparsely hairy, with branched hairs (2–6 rays: Y, ternate, and dendritic); adaxial surface glabrous; margins ciliate with erect or deflexed, simple hairs and branched hairs (2–4 rays: Y and dendritic); apices acute or obtuse. Inflorescence a raceme, with 2–3 flowers; slightly elongating as the fruit matures. Pedicels 1.5–4.5 mm long; glabrous. Sepals 4; 1.3–2.6 mm long, 1.0–1.6 mm wide; ovate or oblong; green or purple, with hyaline margins; surface glabrous or hairy, with a few sparse simple hairs apically; margins glabrous; apices obtuse. Petals 4; 3.1–3.9 mm; long; 1.7–2.2 mm wide; obovate; unlobed or undulating; white. Androecium with 6 stamens and 0.4–0.6 mm long anthers. Gynoecium with 1 style and 1 stigma. Fruit a siliqua; 3.0–5.5 mm long, 2.0–3.2 mm wide; spherical; yellowish green. Styles persisting in fruit 0.2–0.4 mm long; distinctly larger than the styles.
and glabrous fruits (in contrast to *D. arctica*, *D. cinerea*, and *D. subcapitata*; Aiken et al. 2007; Garneau and Sbourrin 2018). Glabrous pedicels and fruits are unique to *D. fladnizensis* and *D. lactea*, but they differ in few characters: *D. lactea* has branched hairs (2–12 rays) rather than simple and 2-forked hairs seen in *D. fladnizensis* (Al-Shehbaz et al. 2010b); *D. lactea* has bigger petals (3–5 mm long, 1.8–3.0 mm wide) than *D. fladnizensis* (2.0–2.5 mm long, 0.8–1.5 mm wide; Al-Shehbaz and Mulligan 2013; Saarela et al. 2020); and margin leaf hairs of *D. fladnizensis* are straight and pointing strongly forward in contrast to *D. lactea* whose simple hairs can be deflexed and not strongly directed forward (Svalbard Flora 2020).

**Draba micropetala** Hooker

**Materials examined.** CANADA – Nunavut • Ellesmere Island, CFS Alert; 82°25′52″N, 062°07′49″W; 296 m a.s.l.; 16 Jul. 2019; habitat: wetland in a mountain pass, with peat and rocks as substrates, dominated by moss and Saxifraga cernua; QFA0635549 • same locality; 82°26′34″N, 062°19′06″W; 178 m a.s.l.; 13 Aug. 2019; habitat: barren ground on a river bed, with rocks as substrate; QFA0635586, CAN.

**Identification.** Plants 2.0–4.5 cm high; herbaceous; caespitose. Taproots present. Stems 1.0–3.5 cm long; erect or ascending; hairy, with simple and branched hairs (2–5 rays: T, Y, cruciform, ternate, and dendritic). Leaves basal; alternate or whorled; petiolate or subsessile. Petioles 1–4 mm long; winged; margins ciliate, with simple hairs. Basal leaf blades 5.7–8.0 mm long, 2.1–3.9 mm wide; obovate or obovate; bases attenuate; abaxial surface moderately or densely hairy, with simple and branched hairs (2–4 rays: Y, ternate, cruciform, and dendritic); adaxial surface glabrous or sparsely hairy, with simple and branched hairs (2–3 rays: Y, and ternate); margins ciliate, with simple and branched hairs (2 rays: Y); apices obtuse. Inflorescence a raceme, with 2–4 flowers; elongating or not elongating as the fruit matures. Pedicels 1.0–4.5 mm long; hairy. Sepals 4; 2.1–2.4 mm long, 0.8–1.0 mm wide; obovate or oblanceolate; bases attenuate; abaxial surface moderately hairy, with simple and branched hairs (2 rays: Y); margins glabrous; apices obtuse or acute. Petals 4; 2.8–3.7 mm, long; 0.8–1.4 mm wide; oblong; slightly lobed or undulating; pale yellow. Androecium with 6 stamens and 0.3–0.5 mm long anthers. Gynoecium with 1 style and stigma. Fruit a silique; 4.0–9.9 mm long, 2.7–3.5 mm wide; oblanceolate or obovate; slightly lobed or undulating; green and purple-tinted, with yellow margins; surface hairy, with simple and branched hairs (2–3 rays: Y and ternate); margins glabrous; apices obtuse or acute. Petals 4; 2.8–3.7 mm, long; 0.8–1.4 mm wide; oblong; slightly lobed or undulating; pale yellow. Androecium with 6 stamens and 0.3–0.5 mm long anthers. Gynoecium with 1 style and stigma. Fruit a silique; 4.0–9.9 mm long, 2.7–3.5 mm wide; oblanceolate or obovate; flattened; green; hairy, with simple hairs and branched hairs (2 rays: Y). Styles persisting in fruit 0.05–0.20 mm long, 0.3–0.5 mm wide. Stigma 0.3–0.5 mm wide; as wide as, or slightly larger than, the styles.

**Draba micropetala** and **D. pauciflora** both have narrow petals (<2 mm wide) compared to all the other yellow-flowered Draba species on Ellesmere Island (*D. alpina*, *D. arctica*, *D. oblongata*, and *D. simmonsii*; Aiken et al. 2007; Al-Shehbaz et al. 2010b; GBIF 2020). In addition, pedicels are usually shorter (1–4 mm long) in *D. micropetala* than in *D. alpina* and *D. simmonsii*, which have 2.5–30.0 mm long pedicels (Al-Shehbaz et al. 2010b). *D. micropetala* and *D. pauciflora* can usually be distinguished on other characters. *D. micropetala* has leaves with an obtuse to rounded apex, whereas *D. pauciflora* has leaves with an acute apex; the leaves of *D. micropetala* have a predominance of cruciform hairs on the leaves, whereas those of *D. pauciflora* have a simple and forked hairs; and *D. micropetala* has ovate-elliptic, 2.0–3.2 mm wide fruits, whereas *D. pauciflora* has obovate, 3–5 mm wide fruits (Elven and Al-Shehbaz 2008; Saarala et al. 2020). The difference in the fruits did not fit exactly with our specimens from Alert. Instead, we found mainly obovate or oblanceolate, 2.7–3.5 mm wide fruits in *D. micropetala*, and lanceolate or elliptic, 1.8–4.0 mm wide fruits in *D. pauciflora*. However, based on the specimens from Alert, we found that using the dimensions of the styles and stigmas persisting on the fruits were good additional criteria to differentiate the two species; *D. micropetala* had shorter styles (0.05–0.20 mm long) with stigmas as wide as the styles (or very slightly wider), whereas *D. pauciflora* had longer styles (0.2–0.4 mm long) with stigmas always wider than the styles. As for the other yellow-flowered *Draba* found at Alert, *D. corymbosa*, it had even longer styles (0.4–0.7 mm long) and the stigmas were even more distinctly wider than the styles (the two structures appearing like a T).

**Draba pauciflora** R. Brown

**Materials examined.** CANADA – Nunavut • Ellesmere Island, CFS Alert; 82°29′58″N, 062°33′36″W; 66 m a.s.l.; 11 Aug. 2019; habitat: mesic, with polygonal patterned ground made of till, dominated by Stellaria longipes; QFA0635550, CAN.

**Identification.** Plants 1.7–3.5 cm high; herbaceous; caespitose. Taproots present. Stems 0.4–3.0 cm long; erect or ascending; hairy, with simple and branched hairs (2–3 rays: T, Y, and ternate). Leaves basal; alternate or whorled; petiolate or subsessile. Petioles 2–5 mm long; winged; margins glabrous or ciliate, with simple hairs. Basal leaf blades 5.2–9.0 mm long, 1.8–3.4 mm wide; oblanceolate or oblong; margins ciliate, with simple hairs. Taproots present. Stems 0.4–3.0 cm long; erect or ascending; hairy, with simple and branched hairs (2–5 rays: T, Y, and ternate). Leaves basal; alternate or whorled; petiolate or subsessile. Petioles 2–5 mm long; winged; margins glabrous or ciliate, with simple hairs. Basal leaf blades 5.2–9.0 mm long, 1.8–3.4 mm wide; oblanceolate or oblong; bases attenuate; abaxial surface moderately hairy, with simple and branched hairs (2–5 rays: Y); margins ciliate, with simple and branched hairs (2 rays: Y); apices obtuse. Inflorescence a raceme, with 2–5 flowers; elongating or not elongating as the fruit matures. Pedicels 1.0–4.5 mm long; hairy. Sepals 4; 2.1–2.4 mm long, 0.8–1.0 mm wide; obovate or oblong; green and purple-tinted, with yellow margins; surface hairy, with simple and branched hairs (2–3 rays: Y and ternate); margins glabrous; apices obtuse or acute. Petals 4; 2.8–3.7 mm, long; 0.8–1.4 mm wide; oblong; slightly lobed or undulating; pale yellow. Androecium with 6 stamens and 0.3–0.5 mm long anthers. Gynoecium with 1 style and stigma. Fruit a silique; 4.0–9.9 mm long, 2.7–3.5 mm wide; oblanceolate or obovate; flattened; green; hairy, with simple hairs and branched hairs (2 rays: Y). Styles persisting in fruit 0.05–0.20 mm long, 0.3–0.5 mm wide. Stigma 0.3–0.5 mm wide; as wide as, or slightly larger than, the styles.
elliptic; flattened; green; hairy, with simple and branched hairs (2 rays: Y, T, and V). Styles persisting in fruit 0.2–0.4 mm long, 0.3–0.5 mm wide. Stigmas 0.4–0.7 mm wide; larger than the styles.

Characteristics allowing to distinguish *D. pauciflora* from the other yellow-flowered *Draba* species present on Ellesmere Island can be found under *D. corymbosa* and *D. micropetala*.

**Draba sub capitata** Simmons

Figure 5F

**Materials examined.** CANADA – Nunavut • Ellesmere Island, CFS Alert; 82°28′51″N, 062°10′58″W; 86 m a.s.l.; 15 Aug. 2019; habitat: xeric, with till and rocks as substrate, and sparse dominance of *Saxifraga oppositifolia*; QFA0635585, CAN.

**Identification.** Plants 1–2 cm high; herbaceous; caespitose. Taproots present. Stems 0.5–1.5 cm long; erect or ascending; hairy, with simple and branched hairs (2–4 rays: T, V, and dendritic). Leaves basal; alternate or whorled; petiolate or subsessile. Petioles 1.0–1.5 mm long; slightly winged; margins glabrous or ciliate, with simple hairs. Basal leaf blades 3.7–5.0 mm long, 1–2 mm wide; linear or narrowly obtrullate; bases attenuate; mid-vein prominent; abaxial surface glabrous or sparsely hairy, with simple and branched hairs (2 rays: Y and T); adaxial surface glabrous; margins slightly revolute and ciliate, with simple long hairs; apices acute or obtuse. Inflorescence a raceme, with 2 or 3 flowers; not or slightly elongating as the fruit matures. Pedicels 1.2–2 mm long; hairy. Sepals 4; 1.2–1.6 mm long, 0.7–0.8 mm wide; ovate or oblanceolate; green or purple, with hyaline margins; surface hairy, with simple hairs, margins glabrous; apices obtuse. Petals 4; 1.3–2.2 mm, long; 0.8–1.1 mm wide; obovate; unlobed, slightly lobed, or undulating; white. Androecium with 6 stamens and 0.3–0.4 mm long anthers. Gynoecium with 1 style and 1 stigma. Fruit a silique; 3–5 mm long, 2.0–2.3 mm wide; ovate or elliptic; slightly bulged; dark purple; glabrous or sparsely hairy, with simple hairs. Styles persisting in fruit 0.05–0.30 mm long, 0.2–0.3 mm wide. Stigmas 0.2–0.3 mm wide; as wide as the styles.

*Draba sub capitata* differs from the five other white-flowered *Draba* species present on Ellesmere Island (Aiken et al. 2007; GBIF 2020) by having smaller petals (<2.5 mm long and ≤1.0 mm wide; in contrast to *D. arctica*, *D. cinerea*, *D. fladnizensis*, *D. lactea*, *D. nivalis*; Aiken et al. 2007), and by the combination of predominantly simple and branched hairs (2–4 rays) on leaves and stems (in contrast to the presence of hairs with >4 rays in *D. arctica*, *D. lactea*, and *D. nivalis*; Garneau and Sabourin 2018).

Caryophyllaceae – Pink family

**Cerastium arcticum** Lange

Figure 6A

**Materials examined.** CANADA – Nunavut • Ellesmere Island, CFS Alert; 82°25′52″N, 062°07′49″W; 296 m a.s.l.; 16 Jul. 2019; habitat: wetland in a mountain pass, with peat and rocks as substrates, dominated by moss and *Saxifraga cernua*; QFA0635574.

**Identification.** Plants 1–12 cm high; herbaceous; caespitose. Taproots and rhizomes present. Stems 2–12 cm long; prostrate, or ascending; hairy, with sepal glandular hairs and sepal non-glandular hairs. Leaves basal and cauleine; opposite; subsessile (basal and lower cauline leaves) or sessile (upper cauleine leaves). Basal leaf blades 5–12 mm long, 2–5 mm wide; elliptic, lanceolate, obovate, or oblanceolate; abaxial and adaxial surfaces both hairy, with sepal glandular hairs and sepal non-glandular hairs (hairs 1.0–3.4 mm long); margins ciliate; apices acute, acuminate, or obtuse. Cauleine leaf blades 1.7–3.6 mm long, 0.5–1.2 mm wide; abaxial and adaxial surface both hairy; margins hyaline and ciliate. Inflorescence a solitary flower or a dichasium, with 2–4 flowers. Bracts 4–9 mm long, 0.8–2.0 mm wide; surface hairy; margins hyaline (0.1–0.2 mm wide) and ciliate. Pedicels hairy. Sepals 5; 5.0–7.8 mm long, 1–3 mm wide; elliptic or lanceolate; green to purple; hairy, with sepal glandular hairs and sepal non-glandular hairs; margins hyaline and glabrous; apices acute. Petals 5; 6.0–9.8 mm long, 2.7–4.0 mm wide; obtriangular or oblanceolate; notched; white. Androecium with 10 stamens and 0.9–1.5 mm long, yellow anthers. Gynoecium with 5 styles and 1 stigma per style. Fruit a capsule; 9–11 mm long, 3.5 mm wide; cylindrical; straw-colored; ending with 8–10 teeth; glabrous.

*Cerastium* Linnaeus species can be differentiated from *Arenaria* Linnaeus and *Stellaria* Linnaeus species by the petals: *Cerastium* species have petals cleft at most to 25 %, whereas *Arenaria* species have unlobed petals and *Stellaria* species have petals cleft nearly to the base (Aiken et al. 2007). *C. arcticum* is very similar to *C. alpinum* Linnaeus subsp. *alpinum* and subsp. *lanatum* (Lamarck) Cesati, *C. beeringianum* Chamisso & Schlechttendal, and *C. bialynickii* Tolmatchew that are present on Ellesmere Island (GBIF 2020), but a few characters help differentiate them. *C. arcticum* has leaves with hairs that are always >0.3 mm long, whereas both *C. alpinum* subspecies have long but also short hairs (<0.3 mm long); bracts have more distinct hyaline margins in both *C. alpinum* subspecies (0.3–0.8 mm wide) than in *C. arcticum* (≤0.3 mm wide; Blondeau 2015a). As for the differences between *C. beeringianum* and *C. arcticum*, hairs on leaves are longer in *C. arcticum* (≥0.9 mm long) than in *C. beeringianum* (≤0.9 mm long); bract leaves of *C. arcticum* (4–9 mm long) are longer than those of *C. beeringianum* (2.5–3.0 mm long); and fruits of *C. arcticum* are also larger (3–5 mm wide) than those of *C. beeringianum* (2–3 mm wide; Aiken et al. 2007; Blondeau 2015a). *C. bialynickii* has a pulvinate growth form with short stems (1–10 cm long), whereas *C. arcticum*, both *C. alpinum* subspecies, and *C. beeringianum* have rhizomatous or mat-forming, not pulvinate growth form (cushion-like) with longer stems (5–50 cm long; Morton 2005).
The stem length of the specimens of *C. arcticum* from Alert ranges from 2 to 12 cm and some specimens had a cushion growth form rather than a mat-forming growth form, and therefore do not exactly match the criteria above. Although, *C. bialynickii* is considered a synonym of *C. beeringianum* in Aiken et al. (2007), it is treated as a distinct species in FNA (Flora of North America Editorial Committee 2005), Tropicos (2020), and VASCAN (Brouillet et al. 2010+; Desmet and Brouillet 2013).

**Cerastium regelii** Ostenfeld
Figure 6B, C

**Materials examined.** CANADA – Nunavut • Ellesmere Island, CFS Alert; 82°29’09”N, 062°00’03”W; 36 m a.s.l.; 30 Jul. 2019; habitat: mesic in a slope, with hummocks made of till and rocks, dominated by *Stellaria longipes* and moss; QFA0635520 • same locality; 82°26’48”N, 062°26’12”W; 178 m a.s.l.; 28 Jul. 2019; habitat: wetland, with peat and rocks as substrates, dominated by *Alopecurus magellanicus* and moss; QFA0635576.

**Identification.** Plants 1–5 cm high; herbaceous; caespitose. Taproots and rhizomes present. Stems 1–4 cm long; prostrate, decumbent, or ascending; hairy, with septate non-glandular hairs. Axillary branches present. Leaves basal and cauline; isomorphic; opposite; petiolate (basal leaves) or sessile (cauline leaves). Petiole 1.4–2.0 mm.
long; hairy. Basal leaf blades 3–6 mm long, 1.8–3.0 mm wide; elliptic or ovate; abaxial and adaxial surfaces both glabrous; margins glabrous or ciliate, with sepal non-glandular hairs; apices obtuse. Cauline leaf blades 2.8–4.8 mm long, 0.5–1.7 mm; abaxial and adaxial surfaces both glabrous; margins ciliate, with sepal non-glandular hairs; apices obtuse. Inflorescence a solitary flower or a dichasium with 2 flowers. Bracts 2–4 mm long, 1–2 mm wide; surface hairy; margins hyaline (<0.1 mm wide) and ciliate. Pedicels hairy. Sepals 5; 4–5 mm long, 1–3 mm wide; lanceolate or elliptic; green and purple-tinged, with hyaline margins; surface hairy, with sepal non-glandular hairs and sepal glandular hairs; margins ciliate; apices acute. Petals 5; 5.1–8.0 mm long, 2.3–5.0 mm wide; obtrangular, oblancoeolate, or obovate; notched; white. Androecium with 7–10 stamens and 0.6–1.2 mm long, pale yellow anthers. Gynoecium with 5 styles and 1 stigma per style. Fruit a capsule; 8.0–10.4 mm long, 2–3 mm wide; cylindrical; straw-colored; ending with 8–10 teeth; glabrous.

Cerastium regelii differs from C. alpinum, C. arcticum, C. beeringianum, and C. bialynickii by having shiny, glabrous leaf surfaces, whereas the four latter species have dull, densely hairy leaves (Aiken et al. 2007).

**Sabulina rossii** (R. Brown ex Richardson) Dillenberger & Kadereit

**Materials examined.** CANADA – Nunavut • Ellesmere Island, CFS Alert; 82°26′22″N, 062°50′39″W; 201 m a.s.l.; 7 Aug. 2019; habitat: barren ground in a slope, with till and rocks as substrates; QFA0635573.

**Identification.** Plants 1.5–3.5 cm high; herbaceous; caespitose. Taproots present. Stems 0.8–2.5 cm long; prostrate, decumbent, or ascending; hairy, with glandular hairs. Leaves cauleine; opposite; sessile. Leaf blades 3.0–5.7 mm long, 0.5–1.0 mm wide; lanceolate or linear; straight or ascending; veins 3; green; abaxial and adaxial surfaces both glabrous; margins ciliate, with glandular hairs; apices acute or apiculate. Inflorescence a solitary flower. Pedicels hairy. Sepals 5; 2–3 mm long, 0.5–1.4 mm wide; lanceolate; purple or green, with hyaline margins; surface glabrous or hairy, with glandular hairs; margins glabrous; apices acute. Petals 5; 2–3 mm long, 1.0–1.5 mm wide; oblancoeolate or obovate; unlobed; white. Androecium with 10 stamens and 0.2–0.3 mm long, yellow anthers. Gynoecium with 3 styles and 1 stigma per style. Fruit a capsule; 2.8–3.0 mm long, 1.4–1.6 mm wide; ovoid or conical; straw-colored; glabrous. Characteristics allowing to distinguish S. rubella from the other Sabulina species present on Ellesmere Island can be found under S. rossii.

**Silene uralensis** (Ruprecht) Boquet subsp. uralensis

**Syn.:** Silene uralensis subsp. arctica (Fr.) Boquet

**Materials examined.** CANADA – Nunavut • Ellesmere Island, CFS Alert; 82°28′35″N, 062°28′23″W; 117 m a.s.l.; 15 Jul. 2019; habitat: xeric on a plateau between two creeks, with till and rocks as substrates; QFA0635570.

**Identification.** Plants 3–5 cm high; herbaceous; not caespitose. Taproots present. Stems 1.5–3.5 cm long; erect; hairy, with sepal non-glandular hairs. Leaves basal and cauleine; opposite; petiolate (basal and lower cauleine leaves) or sessile (upper cauleine leaves). Petioles 3–5 mm long; glabrous. Basal leaf blades 5–11 mm long, 1–3 mm wide; obovate or oblancoeolate; green or purple; abaxial and adaxial surfaces both glabrous; margins ciliate, with sparse hyaline, sepal non-glandular hairs; apices acute. Cauline leaf blades 6–9 mm long, 1–2 mm wide; abaxial and adaxial surfaces both sparsely hairy, with sepal non-glandular hairs; margins ciliates; apices acute. Inflorescence a solitary flower. Bracts 3–4 mm long, 0.8–2.0 mm wide. Pedicels hairy. Sepals 5; fused. Calyx bell-shaped; 9–15 mm long, 7–11 mm wide; 5-lobed; hyaline, whitish purple or pink, with dark purple longitudinal ribs; hairy, with sepal non-glandular hairs. Petals 5; same length or slightly longer than the calyx (emerging of 1.2–2.5 mm long from the calyx); oblancoeolate; notched; pinkish purple. Androecium with 8–10 stamens and 0.6–0.8 mm long, greenish-yellow anthers. Gynoeicum with 5 styles and 1 stigma per style.
Silene uralensis subsp. uralensis differs from the three other Silene species present on Ellesmere Island (S. acaulis (Linnaeus) Jacquin, S. involucrata (Chamisson & Schlechtendal) Bocquet subsp. involucrata and subsp. tenella (Tolmachev) Bocquet, and S. sorensensis (B. Boivin) Bocquet; Aiken et al. 2007; GBIF 2020) by having petals of the same length as the calyx or slightly longer; the others have petals largely exceeding the calyx (Aiken et al. 2007).

**Stellaria longipes Goldie subsp. longipes**

*Figure 6F, G*

**Materials examined.** CANADA – Nunavut • Ellesmere Island, CFS Alert; 82°29′59″N, 062°27′56″W; 82 m a.s.l.; 27 Jul. 2019; habitat: xeric in a slope, with polygonal patterned ground made of till and rocks, and sparse dominance of Saxifraga oppositifolia; QFA0635575.

**Identification.** Plants 1–8 cm high; herbaceous; caespitose. Taproots and thin rhizomes present. Stems 2–8 cm long; prostrate, decumbent, or erect; glabrous. Axillary branches present. Leaves cauleine; opposite; sessile. Cauleine leaf blades 4–9 mm long, 1.1–3.0 mm wide; lanceolate; appearing single-veined (midrib prominent); abaxial surface keeled; abaxial and adaxial surfaces both glabrous; margins glabrous; apices acute or acuminate. Inflorescence a solitary flower or a dichasium, with 2 flowers. Bracts 2.2–7.0 mm long, 0.6–2.0 mm wide. Pedicels glabrous. Sepals 5; 2–4 mm long, 1.0–1.5 mm wide; lanceolate; green, with hyaline margins; surface; margins ciliate; apices acute. Petals 5; 3–5 mm long, 3–4 mm wide; obovate or obtriangular; deeply cleft; white. Anthers ciliate; apices acute or acuminate. Perigynium with 3 styles and 1 stigma per style.

The deeply cleft petals distinguish *Stellaria* species from the other Caryophyllaceae genus (Aiken et al. 2007). *S. longipes* subsp. *longipes* can be differentiated from the two *Stellaria* species on present on Ellesmere Island (GBIF 2020) by the following: *S. longipes* has red anthers, whereas *S. humifusa* and *S. sorensenis* are both yellow anthers. Gynoe- cium with 3 styles and 1 stigma per style.

Carex aquatilis – Sedge family

*Carex aquatilis* Wahlenberg var. minor Boot

*Syn.: Carex aquatilis subsp. stans* (Drejer) Hultén

**Materials examined.** CANADA – Nunavut • Ellesmere Island, CFS Alert; 82°28′57″N, 062°23′11″W; 22 m a.s.l.; 5 Aug. 2019; habitat: wetland on the margins of a river delta, with peat as substrates, dominated by *Eriophorum triste* and moss; QFA0635568 • same locality; 82°30′08″N, 062°52′60″W; 91 m a.s.l.; 2 Aug. 2019; habitat: wetland in a mountain pass on the margins of a pond, with tussocks made of peat, dominated by *Eriophorum triste*; QFA0635569.

**Identification.** Plants 5–9 cm high; herbaceous; not caespitose. Fibrous roots and rhizomes present. Stems 2.5–11.0 cm long; erect, ascending, or decumbent; scabrous on angles. Leaves basal and cauleine; alternate. Sheath margins glabrous. Ligules 0.6–2.0 mm long. Basal leaf blades 35–75 mm long, 1.8–4.0 mm wide; linear; flat or folded; abaxial and adaxial surfaces both glabrous; margins scabrous. Inflorescence a raceme, with 2–6 spikelets; 19–40 mm long. Bracts exceeding the inflorescence; 28–50 mm long. Lateral spikelets unisexual; pistillate; pedunculate; erect. Terminal spikelets unisexual; stamine; erect; pedunculate. Pistillate scales 1.1–2.8 mm long, 0.6–1.5 mm wide; ovate; purple or purplish brown, with midvein paler in color or pale green; apices acute. Stamine scales 2.0–2.8 mm long, 0.5–1.0 mm wide; oblanceolate; purple, with midvein paler in color; apices acuminate. Perigynium 1.1–2.5 mm long, 0.6–1.8 mm wide; ovate or obovate; flattened; green or pale brown proximally and purplish-brown apically; surface glabrous; margins glabrous; apices beaked. Androecium with 3 stamens and 1.8–2.8 mm long anthers. Gynoe- cium with 1 style and 2 stigmas.

Carex aquatilis var. minor differs from all other *Carex* Linnaeus species on Ellesmere Island by having the lower bract exceeding the inflorescence (Aiken et al. 2007).

*Carex fuliginosa Schkuhr*

*Syn.: Carex fuliginosa subsp. misandra* (R. Br.) Nyman

**Figure 7A**

**Materials examined.** CANADA – Nunavut • Ellesmere Island, CFS Alert; 82°30′25″N, 062°36′45″W; 24 m a.s.l.; 8 Aug. 2019; habitat: wetland on the margins of a small river, with peat and till as substrates, dominated by *Alopecurus magellanicus* and moss; QFA0635566 • same locality; 82°27′37″N, 062°51′53″W; 16 m a.s.l.; 20 Jul. 2019; habitat: wetland on the margins of a lake, with peat and till as substrates, dominated by moss, *Eriophorum scheuchzeri*, and *Eriophorum triste*; QFA0635567.

**Identification.** Plants 4–13 cm high; herbaceous; caespitose. Fibrous roots present. Stems 3.5–11.5 cm long; erect or ascending; glabrous. Leaves basal and cauleine; alternate. Sheath margins scabrous. Ligule absent or inconspicuous. Basal leaf blades 20–45 mm long, 2–4 mm wide; linear; flat or folded; curled; abaxial and adaxial surfaces both glabrous; margins scabrous. Inflorescence a raceme, with 2–4 spikelets; 12–40 mm long. Bracts shorter than the inflorescence; 8–32 mm long. Lateral spikelets pistillate or sometimes gynoeandrous; pedunculate; inclined or pendent. Terminal spikelets bisexual; gynoeandrous; pedunculate; inclined. Pistillate scales 2.5–4.0 mm long, 0.8–1.5 mm wide; lanceolate; purplish brown, with hyaline margins or paler in color (sometimes midvein paler in color); apices acute or acuminate. Stamine scales 3.2–3.6 mm long, 0.8–1.3 mm wide; oblanceolate; pinkish purple or brownish purple, with hyaline margins; apices acute or acuminate. Perigynium 3.0–4.5
mm long, 0.7–1.4 mm wide; pyriform or lanceoloid; green or pale brown proximally and dark purple apically; surface glabrous; margins scabrous; apices beaked, bidentate. Androecium with 3 stamens and 1.8–2.4 mm long anthers. Gynoecium with 1 style and 3 stigmas.

Among the 12 Carex species present on Ellesmere Island with compound spikes (GBIF 2020), Carex fulgignosa can be differentiated by the following: pedunculate and mostly unisexual spikelets (in contrast to C. marina Dewey and C. maritima Gurnerus with only bisexual, sessile spikelets); terminal gynaecandrous spikelet (in contrast to terminal stamine spikelet in C. atrofusca Schkuhr, C. capillaris Linnaeus subsp. fuscula (V.I. Kreczetovicz ex T.V. Egorova) Á. Löve & D. Löve, C. glacialis Mackenzie, and C. membranacea Hooker); 2.5–5.0 mm long pistillate scales (in contrast to C. krausei Boeckeler with 1.6–2.1 mm long pistillate scales); fused perigynum margins (in contrast to open perigynum margins in C. simpliciuscula Wahlenberg); and three stigmas (in contrast to two stigmas in C. aquatilis var. minor, C. bigelowii Torrey ex Schweinitz subsp. bigelowii, and C. saxatilis Linnaeus; Saarela et al. 2020).

**Eriophorum scheuchzeri** Hoppe subsp. arcticum Novoselova

Figure 7B

**Materials examined.** CANADA – Nunavut • Ellesmere Island, CFS Alert; 82°27′37″N, 062°51′53″W; 16 m a.s.l.; 20 Jul. 2019; habitat: wetland on the margins of a lake, with peat and till as substrates, dominated by moss, *Eriophorum scheuchzeri*, and *Eriophorum triste*; QFA0635564.

**Identification.** Plants 8–13 cm high; herbageous; not caespitose. Fibrous roots and rhizomes present. Stems 7.0–16.5 cm long; erect; glabrous. Leaves basal and cauline; alternate. Sheath margins scabrous. Ligules 0.6–1.7 mm long. Basal leaf blades 30–90 mm long, 1.3–4.0 mm wide; linear; flat or folded; straight; abaxial surface scabrous; adaxial surface glabrous; margins scabrous. Inflorescence a raceme, with 2–4 spikelets; 15–30 mm long. Lower bracts shorter than the inflorescence; 13–24 mm long. Peduncles 5–18 mm long; scabrous all around the surface. Lateral spikelets and terminal spikelet bisexual, with both sexes in each floret; pedunculate; erect or pendent. Proximal scales 3.8–5.3 mm long, 2.0–3.1 mm wide; ovate or lanceolate; greyish black sometimes purple or red-tinged, with or without narrow, hyaline margins at the apex; apices acute or acuminate. Perianth represented by bristles; white or yellowish-brown. Androecium with 3 stamens and 1.9–3.8 mm long anthers. Gynoecium with 1 style and 3 stigmas. Fruit an achene; 2.0–2.4 mm long, 0.9–1.9 mm wide; obovoid; keeled; glabrous.

*Eriophorum triste* is similar to *E. angustifolium* subsp. *angustifolium* by having more than two spikelets, but can be differentiated by culms, peduncles, scale, and anther characters: *E. triste* has shorter culms (<30 cm) than *E. angustifolium* (20–100 cm; Ball and Wujek 2002); *E. triste* has scabrous, arcuate, ≤2 cm peduncles, whereas *E. angustifolium* has glabrous (or scabrous on angles), drooping, ≤10 cm long peduncles (Ball and Wujek 2002; Saarela et al. 2020); *E. triste* has grey to black scales with or without hyaline margins, whereas *E. angustifolium* has brownish grey, greyish, reddish or ferruginous scales with broad hyaline margins (Ball and Wujek 2002; Saarela et al. 2020); anders of *E. triste* are usually shorter (1.8–3.0 mm long) than those of *E. angustifolium* (2.5–5.0 mm long; Saarela et al. 2020); and fruits are obovoid, 2.0–2.5 mm long in *E. triste*, whereas they are oblong-obovoid or oblong-elliptical, 2.5–3.5 mm long.
in *E. angustifolium* (Saarela et al. 2020). The culm height from the specimens of Alert (9–16 cm), as well as the peduncle length and scabrousity, and the fruit dimensions and shape correspond with those reported in the literature, but not the scale color and the anther length. The scales were not only grey to black, but some scales also had a reddish-purple tinge in the center. The anthers were also longer than the maximum anther length known in *E. triste*. Only *E. triste* has previously been found at Alert and the surrounding areas (GBIF 2020).

**Equisetaceae – Horsetail family**

**Equisetum arvense** Linnaeus

Syn.: *Equisetum arvense* subsp. *alpestre* (Wahlenb.) Schönswetter & Elven

**Materials examined.** CANADA – Nunavut • Ellesmere Island, CFS Alert; 82°28′22″N, 062°36′20″W; 78 m a.s.l.; 17 Jul. 2019; habitat: xeric on the margins of a river inside a creek; QFA0634994.

**Identification.** Plants 2–7 cm high; herbaceous; not caespitose. Fibrous roots and rhizomes present. Rhizomes black or reddish-brown. Vegetative stems 2–7 cm long; annual; ascending or decumbent; green or yellowish-green; simple or branched from the whorls (branches ascending). Leaves reduced to fused sheaths in whorls. Cauline sheaths 0.5–2.0 mm long; yellowish-green proximally and purplish-brown apically, and sometimes with hyaline margins; ending with 4–8 teeth. Cauline teeth lanceolate; apices acute. Rameal sheaths 0.3–0.8 mm long; attenuate; green and sometimes brown apically; ending with 3 or 4 teeth. Teeth triangular or lanceolate; apices acute. Sporiferous stems annual; erect; green or yellowish-green; simple. Strobilus 4.5 mm long, 2 mm wide.

Three *Equisetum* Linnaeus species are present on Ellesmere Island, although *E. pratense* Ehrhart has only been found once near Eureka (GBIF 2020). *Equisetum arvense* and *E. pratense* both have vegetative stems bearing whorls of branches, whereas the vegetative stems are unbranched in *E. variegatum* (Hauke 1993). *Equisetum arvense* has ascending branches with attenuate, rameal sheath teeth, whereas *E. pratense* has spreading branches with deltate, rameal sheath teeth (Hauke 1993).

*Equisetum variegatum* Schleicher ex F. Weber & D. Mohr subsp. *variegatum*

**Materials examined.** CANADA – Nunavut • Ellesmere Island, CFS Alert; 82°30′25″N, 062°36′45″W; 24 m a.s.l.;
8 Aug. 2019; habitat: wetland on the margins of a small river, with peat and till as substrates, dominated by *Alaspecurus magellanicus* and moss; QFA0634993.

**Identification.** Plants 2–10 cm high; herbaceous; not caespitose. Fibrous roots and rhizomes present. Rhizomes black, purplish brown, or orange. Vegetative stems 2.5–9.0 cm long; evergreen; ascending or decumbent; green or yellowish-green; simple. Leaves reduced to fused sheaths in whorls. Cauline sheaths 1–3 mm long; green or yellowish-green proximally, with an apical broad black band, and white margins; ending with 4–8 teeth. Teeth triangular or lanceolate; apices acute or awned. Sporiferous stems not seen at Alert.

Characteristics allowing to distinguish *E. variegatum* from the other *Equisetum* species present on Ellesmere Island can be found under *E. arvense*.

**Juncaceae – Rush family**

**Juncus biglumis** Linnaeus

**Materials examined.** CANADA – Nunavut • Ellesmere Island, CFS Alert; 82°27′17″N, 062°35′55″W; 166 m a.s.l.; 11 Jul. 2019; habitat: mesic in a slope; QFA0635561 • same locality; 82°29′09″N, 062°00′03″W; 36 m a.s.l.; 30 Jul. 2019; habitat: mesic in a slope, with hummocks made of till and rocks, dominated by *Stellaria longipes* and moss; QFA0635562.

**Identification.** Plants 2–8 cm high; herbaceous; caespitose or not caespitose. Fibrous roots and short rhizomes present. Stems 1.0–7.5 cm long; erect; glabrous. Leaves basal. Sheaths hyaline or pale reddish-brown; margins glabrous. Basal leaf blades 16–40 mm long, 0.6–1.2 mm wide; linear; canaliculate or folded; green or purple; abaxial and adaxial surfaces both glabrous; margins glabrous; apices acute, sometime calloused, and black or dark purple. Inflorescence an anthela, with 1–4 glomerules and ≤ 60 flowers; 6–13 mm long. Bracts 4–12 mm long; not exceeding the inflorescence; lanceolate; red; margins glabrous; apices acute or acuminate. Androecium with 6 stamens and 0.3–0.5 mm long anthers. Gynoecium with 3 styles and 1 stigma per style. Fruit a capsule; 1.9–2.5 mm long, 1.0–1.4 mm wide; ovoid; slightly flattened; green to dark purple; with a small beak; glabrous.

*Luzula nivalis* (Laestadius) Sprengel

**Materials examined.** CANADA – Nunavut • Ellesmere Island, CFS Alert; 82°28′24″N, 062°14′38″W; 109 m a.s.l.; 18 Jul. 2019; habitat: mesic on the margins of a river active during spring snowmelt; QFA0635563.

**Identification.** Plants 4–14 cm high; herbaceous; caespitose or not caespitose. Fibrous roots and short rhizomes present. Stems 3.0–12.5 cm long; erect; glabrous. Leaves basal and cauline. Sheaths brown or straw-colored; margins glabrous. Basal leaf blades 18–55 mm long, 0.8–4.0 mm wide; linear; flat; green and pale orange; abaxial and adaxial surfaces both glabrous; margins hairy, with non-glandular hairs; apices mucronulate or acute, calloused, and dark purple. Cauline leaf blades 12–20 mm long, 0.6–1.5 mm wide; folded or involute. Inflorescence an anthela, with 1–4 glomerules and ≤60 flowers; 6–13 mm long. Bracts 4–12 mm long; not exceeding the inflorescence; lanceolate; red; margins glabrous; apices acute or acuminate. Androecium with 6 stamens and 0.3–0.5 mm long anthers. Gynoecium with 3 styles and 1 stigma per style. Fruit a capsule; 1.9–2.5 mm long, 1.0–1.5 mm wide; ovoid; slightly flattened; green to dark purple; with a small beak; glabrous.

*Pedicularis hirsuta* Linnaeus

**Figure 8**

**Materials examined.** CANADA – Nunavut • Ellesmere Island, CFS Alert; 82°31′03″N, 062°28′48″W; 36 m a.s.l.; 27 Jul. 2019; habitat: mesic, with hummocks made of till, dominated by *Stellaria longipes*, *Saxifraga oppositifolia*, and moss; QFA0635577.

**Identification.** Plants 4–9 cm high; herbaceous; not caespitose. Taproots present. Stems 2–7 cm long; erect; hairy, with woolly hairs; with cataphylls. Leaves basal and cauline; heterophyllous; alternate; petiolate (basal and lower cauline leaves) or sessile (upper cauline leaves). Petioles 0.8–1.7 mm long, 0.6–0.8 mm wide; ovate; dark brown or dark purple; margins hyaline; apices acute or obtuse. Androecium with 6 stamens and 0.3–0.5 mm long anthers. Gynoecium with 3 styles and 1 stigma per style. Fruit a capsule; 1.9–2.5 mm long, 1.0–1.4 mm wide; ovoid; slightly flattened; green to dark purple; with a small beak; glabrous.

Orobanchaceae – Broomrape family

*Luzula nivalis* is similar to *L. confusa* Lindeberg, also present on Ellesmere Island, but the two differ in the following characters: *L. nivalis* has narrow, flat basal leaves (≤5 cm long, 2–4 mm wide), whereas *L. confusa* has larger, subcanaliculate to flat leaves (6–9 cm long, 1.5–2.5 mm wide; Saarela et al. 2020); *L. nivalis* has leaves calloused tip but not *L. confusa* (Hay 2013); and *L. nivalis* has mucronulate leaf apices, whereas *L. confusa* has acuminate apices (Saarela et al. 2020).
Bracts floccose. Pedicels hairy. Flowers zygomorphic. Sepals 5; fused. Calyx tubular; 2.5–6.0 mm long, 2–4 mm wide; with 5 lobes apically; purple; surface hairy, with floccose hairs; margins ciliate; apices obtuse. Petals 5; fused; white and pink. Corolla bilabiata; 6–13 mm long with an inferior 2- or 3-lobed lip, and a superior narrow galeate lip. Galeate lip with 2 small teeth apically. Androecium with 4 stamens and 1.0–1.4 mm long anthers. Gynoecium with 1 style and 1 stigma. Stamens and stigma not protruding from the corolla tube.

*Pedicularis hirsuta* can be differentiated from the four other *Pedicularis* Linnaeus species present on Ellesmere Island (Aiken et al. 2007; GBIF 2020) by the following: leaves distributed along the stem (in contrast to mainly scapose stems in *P. sudetica* Willdenow subsp. *alboliata* Hultén and subsp. *arctoeuropaea* Hultén; Aiken et al. 2007; Saarela et al. 2020); floccose hairs on stems and petioles (in contrast to glabrous stems and petioles in *P. sudetica*; Aiken et al. 2007); basal leaf blades less than twice as long as wide; ovoid; hairy, with dense brown hairs. Inflorescence a solitary flower. Sepals 10–12 mm long, 6–8 mm wide; ovate; green or pinkish-brown; margins ciliolate; abaxial and adaxial surfaces both hairy, with dense white, yellow, or pale brown hairs; margins ciliate. Buds 10–12 mm long, 6–8 mm wide; less than twice as long as wide; ovoid; hairy, with dense dark brown hairs. Inflorescence a solitary flower. Sepals 2; 8–10 mm long, 4–6 mm wide; ovate; green or pinkish-brown; surface hairy, with dense dark brown hairs. Petals 4; 9–21 mm long, 12–22 mm wide; overlapping; obovate; unlobed; yellow or pale yellow (greenish-blue when withered); margins sometimes fringed. Androecium with 28–35 stamens and 0.9–1.0 mm long anthers. Gynoecium with 6 stigmatic rays. Fruit a capsule; 10 mm long, 7 mm wide; obpyriform (with its broadest part apically); slightly constricted just beneath the flat stigmatic disc; green; hairy, with dark brown hairs.

*Papaver dahlianum* can be differentiated from some Canadian Arctic *Papaver* Linnaeus species by the pinnaidf blades, in contrast to pinnatisect blades found in *P. labradoricum* (Fedde) Solstad & Elven, *P. lapponicum* (Tolmatchew) Nordhagen, and *P. hultenii* Knaben (Solstad and Elven, unpublished). *P. dahlianum* is nearly flat stigmatic discs, whereas they are convex in *P. cornwallisense* (Solstad and Elven unpublished).

**Papaver dahlianum** Nordhagen

Identification. Plants 2–13 cm high; herbaceous; caespitose. Taproots present. Stems 1–11 cm long; erect or ascending; hairy, with brown hairs. Leaves basal; alternate; petiolate. Petioles 5–30 mm long; flat; hairy, with pale brown hairs. Basal leaf blades 5–17 mm long, 2–10 mm wide; pinnatifid, with 1 terminal lobe and 2 or 3 main, ovate or oblong, acute lobes on each side (sometimes with secondary lobes); abaxial and adaxial surfaces both hairy, with dense white, yellow, or pale brown hairs; margins ciliate. Buds 10–12 mm long, 6–8 mm wide; less than twice as long as wide; ovoid; hairy, with dense dark brown hairs. Inflorescence a solitary flower. Sepals 2; 8–10 mm long, 4–6 mm wide; ovate; green or pinkish-brown; surface hairy, with dense dark brown hairs. Petals 4; 9–21 mm long, 12–22 mm wide; overlapping; obovate; unlobed; yellow or pale yellow (greenish-blue when withered); margins sometimes fringed. Androecium with 28–35 stamens and 0.9–1.0 mm long anthers. Gynoecium with 6 stigmatic rays. Fruit a capsule; 10 mm long, 7 mm wide; obpyriform (with its broadest part apically); slightly constricted just beneath the flat stigmatic disc; green; hairy, with dark brown hairs.

**Papaver dahlianum** can be differentiated from some Canadian Arctic *Papaver* Linnaeus species by the pinnaidf blades, in contrast to pinnatisect blades found in *P. labradoricum* (Fedde) Solstad & Elven, *P. lapponicum* (Tolmatchew) Nordhagen, and *P. hultenii* Knaben (Solstad and Elven, unpublished). *P. dahlianum* is nearly flat stigmatic discs, whereas they are convex in *P. cornwallisense* (Solstad and Elven unpublished).

**Alopecurus magellanicus** Lamarck

Syn.: *Alopecurus borealis* Trinuis

Identification. Plants 9–16 cm high; herbaceous; not caespitose. Fibrous roots and rhizomes present. Stems 8.0–14.5 cm long; erect; glabrous. Leaves basal and cauline; alternate. Sheath margins glabrous. Ligules

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Figure 8. *Pedicularis hirsuta* Linnaeus habit. Photo by Audrey Le Pogam.
0.9–1.0 mm long. Basal leaf blades 27–38 mm long, 2–4 mm wide; linear; flat and sometimes rolled in bud apically; abaxial surface glabrous; adaxial surface scabrous; margins glabrous or scabrous. Flag leaf blades 10–14 mm long, 2.0–4.5 mm wide. Inflorescence a dense ovate panicle; 9–11 mm long. Branches at lowest inflorescence node 2–4; 0.5–1.5 mm long. Pedicels hairy. Spikelets 2.6–3.2 mm long, 1.1–1.5 mm wide. Floret per spikelet 1. First glumes 2.5–2.8 mm long; lanceolate; surface hairy, with long silky hairs; margins ciliate; apices acute. Second glumes 2.6–2.9 mm long (almost as long as, or longer than, the lowest floret); lanceolate; keeled; veins 3; surface hairy, with long silky hairs; margins ciliate; apices acute. Lemmas 2.2–2.9 mm long, 0.8–1.1; ovate or lanceolate; keeled; veins 3–5; surface dull, glabrous, and hairy, with few hairs on and between the veins; apices rounded or erose, and ciliate; awned. Awns 1.8–2.0 mm long; arising from the middle to below the apices. Palea absent. Androecium with 3 stamens and 1.3–2.2 mm long anthers. Gynoeicum with 2 styles.

*Arctagrostis latifolia* (R. Brown) Grisebach subsp. *latifolia*

Materials examined. CANADA – Nunavut • Ellesmere Island, CFS Alert; 82°29′14″N, 062°02′05″W; 20 m a.s.l.; 30 Jul. 2019; habitat: wetland near the ocean shore, with tussocks made of peat, dominated by *Eriophorum triste* and *Alopecurus magellanicus*; QFA0635519 • same locality; 82°27′49″N, 062°34′42″W; 126 m a.s.l.; 25 Jul. 2019; habitat: wetland, with tussocks made of peat and till, dominated by *Eriophorum triste*, *Arctagrostis latifolia*, and *Alopecurus magellanicus*; QFA0635547.

Identification. Plants 14–27 cm high; herbaceous; not caespitose. Fibrous roots and rhizomes present. Stems 10–21 cm long; erect; glabrous. Leaves basal and cauline; alternate. Sheath margins scaberulous. Ligules 1.3–2.1 mm long. Basal leaf blades 16–58 mm long, 1.6–6.0 mm wide; linear; flat or involute; abaxial and adaxial surfaces both scabrous; margins scabrous. Flag leaf blades 9–12 mm long, 0.8–1.5 mm wide. Inflorescence a dense or diffuse panicle; 30–75 mm long. Branches at lowest inflorescence node 4–5; 2.1–18.0 mm long. Pedicels scabrous. Spikelets 4.0–4.8 mm long, 1.1–1.3 mm wide. Florets per spikelet 1–2. First glumes 2.4–2.9 mm long; lanceolate; surface glabrous; margins glabrous; apices acute. Second glumes 2.9–3.7 mm long (shorter than the lowest floret); lanceolate; vein 1; surface glabrous; margins glabrous; apices acute. Lemmas 4.1–4.7 mm long, 0.7–0.9 mm wide; lanceolate; keeled; veins 3–5; surface dull and scabrous; apices acute and glabrous; awnless. Palea 3.9–4.1 mm long; veins scabrous. Rachilla between first and second lemmas 0.4–1.0 mm long. Androecium with 3 stamens and 2.0–2.4 mm long anthers. Gynoeicum with 2 styles.

*Deschampsia cespitosa* (Linnaeus) Palisot de Beauvois subsp. *septentrionalis* Chiapella

Syn.: *Deschampsia brevifolia* R. Brown

Figure 11A

Materials examined. CANADA – Nunavut • Ellesmere Island, CFS Alert; 82°26′40″N, 062°43′09″W; 210 m a.s.l.; 14 Jul. 2019; habitat: mesic, with peat and till as substrates, dominated by *Juncus biglumis*, moss, and blue-green algae (macroscopic sheet colonies dominated by *Nostoc* sp.); QFA0635545 • same locality; 82°27′49″N, 062°33′46″W; 65 m a.s.l.; 6 Jul. 2019; habitat: mesic, with polygonal patterned ground made of till, dominated by *Alopecurus magellanicus* and moss; QFA0635546.

Identification. Plants 4–10 cm high; herbaceous; caespitose. Fibrous roots present. Stems 2–8 cm long; erect; glabrous. Leaves basal and cauline; alternate. Sheath margins scaberulous. Ligules 2.6–3.7 mm long. Basal leaf blades 15–45 mm long, 0.4–1.1 mm wide; linear; rolled in bud or...
folded; abaxial surface glabrous; adaxial surface scabrous and hairy, with few short hairs apically; margins scabrous. Flag leaf blades 11.0–13.3 mm long, 0.5–0.6 (1.0–1.1 flat) mm wide. Inflorescence a dense panicle; 17–22 mm long. Branches at lowest inflorescence node 3–4; 1.8–6.2 mm long. Pedicels glabrous. Spikelets 3.6–4.9 mm long, 0.6–1.8 mm wide. Florets per spikelet 1–2. First glumes 2.7–3.1 mm long; lanceolate; surface glabrous; margins glabrous; apices acuminate or acute. Second glumes 2.8–3.4 mm long (almost as long as the lowest floret); lanceolate; veins 1–3; surface glabrous; margins glabrous; apices acute. Lemmas 2.7–3.1

Figure 10. Poaceae. A. Alopecurus magellanicus Lamarck habitat and B. habit. C. Festuca brachyphylla Schultes & Schultes f. subsp. brachyphylla habit. D. Poa abbreviata R. Brown subsp. abbreviata habit and E. inflorescence. F. Puccinellia angustata (R. Brown) E.L. Rand & Redfield habit. Photos A by Audrey Le Pogam, B, D, by Émilie Desjardins, C by Jacob Caron Carrier, E by Sandra Lai, and F by Andrew Tam.
Festuca hyperborea Schultes & Schultes f. subsp. bravophylla

Figures 10C, 12A

Materials examined. CANADA – Nunavut • Ellesmere Island, CFS Alert; 82°26′38″N, 062°11′23″W; 178 m a.s.l.; 23 Jul. 2019; habitat: mesic, with polygonal patterned ground made of till, dominated by Alopecurus magellanicus; QFA063544.

Identification. Plants 3.5–8.5 cm high; herbaceous; caespitose. Fibrous roots present. Stems 2.5–8.0 cm long; erect, ascending, or semi-prostrate; glabrous. Leaves basal and caudinal. Sheath margins glabrous. Ligules 0.2–0.4 mm long. Basal leaf blades 14–22 mm long, 0.4–1.1 mm wide; linear; rolled in bud; abaxial surface glabrous; adaxial surface glabrous or scabrous; margins scabrous. Flag leaf blades 2.8–7.0 mm long, 0.2–0.4 mm wide; tip linear. Inflorescence a dense panicle; 10–18 mm long. Branch at lowest inflorescence node 1; 1.9–2.1 mm long. Pedicels scabrous. Spikelets 5.9–6.2 mm long, 3.0–4.1 mm wide. Florets per spikelet 2–4. First glumes 1.8–2.3 mm long; lanceolate; surface glabrous; margins ciliate; apices acuminate. Second glumes 2.7–3.4 mm long (shorter than the lowest floret); lanceolate; veins 3; surface glabrous; margins ciliate; apices acute. Lemmas 3.3–4.1 mm long, 0.6–0.8 mm wide; lanceolate; rounded on the back; veins 5; surface dull and sparsely scabrous; apices glabrous or ciliate; awned. Awn 0.7–1.2 mm long; arising from the tip. Palea 3.6–3.9 mm long; veins scabrous. Rachilla between first and second lemmas 0.6–1.1 mm long. Androecium with 3 stamens and 0.6–1.0 mm long. Gynoeicum with 2 styles.

Festuca bravophylla Schultes & Schultes f. subsp. bravophylla

Materials examined. CANADA – Nunavut • Ellesmere Island, CFS Alert; 82°26′38″N, 062°11′23″W; 178 m a.s.l.; 23 Jul. 2019; habitat: mesic, with polygonal patterned ground made of till, dominated by Alopecurus magellanicus; QFA063544.

Identification. Plants 3.5–8.5 cm high; herbaceous; caespitose. Fibrous roots present. Stems 2.5–8.0 cm long; erect, ascending, or semi-prostrate; glabrous. Leaves basal and caudinal. Sheath margins glabrous. Ligules 0.2–0.4 mm long. Basal leaf blades 14–22 mm long, 0.4–1.1 mm wide; linear; rolled in bud; abaxial surface glabrous; adaxial surface glabrous or scabrous; margins scabrous. Flag leaf blades 2.8–7.0 mm long, 0.2–0.4 mm wide; tip linear. Inflorescence a dense panicle; 10–18 mm long. Branch at lowest inflorescence node 1; 1.9–2.1 mm long. Pedicels scabrous. Spikelets 5.9–6.2 mm long, 3.0–4.1 mm wide. Florets per spikelet 2–4. First glumes 1.8–2.3 mm long; lanceolate; surface glabrous; margins ciliate; apices acuminate. Second glumes 2.7–3.4 mm long (shorter than the lowest floret); lanceolate; veins 3; surface glabrous; margins ciliate; apices acute. Lemmas 3.3–4.1 mm long, 0.6–0.8 mm wide; lanceolate; rounded on the back; veins 5; surface dull and sparsely scabrous; apices glabrous or ciliate; awned. Awn 0.7–1.2 mm long; arising from the tip. Palea 3.6–3.9 mm long; veins scabrous. Rachilla between first and second lemmas 0.6–1.1 mm long. Androecium with 3 stamens and 0.6–1.0 mm long. Gynoeicum with 2 styles.

Festuca hyperborea Schultes & Schultes f. subsp. bravophylla

Identification. Plants 3.5–8.5 cm high; herbaceous; caespitose. Fibrous roots present. Stems 2.5–8.0 cm long; erect, ascending, or semi-prostrate; glabrous. Leaves basal and caudinal. Sheath margins glabrous. Ligules 0.2–0.4 mm long. Basal leaf blades 14–22 mm long, 0.4–1.1 mm wide; linear; rolled in bud; abaxial surface glabrous; adaxial surface glabrous or scabrous; margins scabrous. Flag leaf blades 2.8–7.0 mm long, 0.2–0.4 mm wide; tip linear. Inflorescence a dense panicle; 10–18 mm long. Branch at lowest inflorescence node 1; 1.9–2.1 mm long. Pedicels scabrous. Spikelets 5.9–6.2 mm long, 3.0–4.1 mm wide. Florets per spikelet 2–4. First glumes 1.8–2.3 mm long; lanceolate; surface glabrous; margins ciliate; apices acuminate. Second glumes 2.7–3.4 mm long (shorter than the lowest floret); lanceolate; veins 3; surface glabrous; margins ciliate; apices acute. Lemmas 3.3–4.1 mm long, 0.6–0.8 mm wide; lanceolate; rounded on the back; veins 5; surface dull and sparsely scabrous; apices glabrous or ciliate; awned. Awn 0.7–1.2 mm long; arising from the tip. Palea 3.6–3.9 mm long; veins scabrous. Rachilla between first and second lemmas 0.6–1.1 mm long. Androecium with 3 stamens and 0.6–1.0 mm long. Gynoeicum with 2 styles.
shorter plants of *F. brachyphylla* are superficially similar to *F. hyperborea* but are separated by the shape of the second glumes, which are supposed to be lanceolate in *F. brachyphylla* and obovate in *F. hyperborea* (Aiken et al. 1995; Aiken et al. 2007). However, we did not observe obovate second glumes in *F. hyperborea*; instead, they were more lanceolate or oblong.

**Festuca edlundiae** S.G. Aiken, Consaul, & Lefkovitch

**Materials examined.** CANADA – Nunavut • Ellesmere Island, CFS Alert; 82°26′58″N, 062°33′50″W; 198 m a.s.l.; 17 Jul. 2019; habitat: mesic, with polygonal patterned ground made of till and rocks, dominated by *Phippsia*
algida (Solander) R. Brown, Juncus biglumis, and moss; QFA0635542 • same locality; 82°26’42″N, 062°12’12″W; 184 m a.s.l.; 23 Jul. 2019; habitat: xeric, with polygonal patterned ground made of till and rocks, and sparse dominance of Saxifraga oppositifolia; QFA0635543.

**Identification.** Plants 5.5–7.5 cm high; herbaceous; caespitose. Fibrous roots present. Stems 4.5–7.0 cm long; prostrate, semi-prostrate, or ascending; glabrous. Leaves basal and cauline. Sheath margins glabrous. Ligules 0.4–0.5 mm long. Basal leaf blades 20–26 mm long, 0.4–0.7 mm wide; linear; rolled in bud; abaxial surface glabrous or scabrous; adaxial surface glabrous; margins scabrous or glabrous. Flag leaf blades 5–14 mm long, 0.3–0.4 mm wide; tip linear. Inflorescence a dense panicle; 11–20 mm long. Branches at lowest inflorescence node 1–2; 1.1–3.2 mm long. Pedicels scabrous. Spikelets 6.0–7.9 mm long, 3.3–3.8 mm wide. Florets per spikelet 2–4. First glumes 1.8–2.2 mm long; lanceolate; surface glabrous; margins glabrous; apices acuminata. Second glumes 2.4–4.3 mm long (shorter than the lowest floret); ovate; veins 1–3; surface glabrous; margins ciliate; apices acute. Lemmas 3.2–4.1 mm long, 0.7–0.9 mm wide; lanceolate; rounded on the back; veins 5; surface dull and sparsely scabrous; apices ciliate; awned. Awn 0.9–1.3 mm long; arising from the tip. Palea 3.6–3.8 mm long; veins scabrous. Rachilla between first and second lemmas 0.9–1.0 mm long. Androecium with 3 stamens and 1.0–1.9 mm long anthers. Gynoecium with 2 styles.

Characteristics allowing to distinguish *F. edlundiae* from the other *Festuca* species present on Ellesmere Island can be found under *F. baffinensis* and *F. brachyphylla* subsp. brachyphylla.

**Festuca hyperborea Holmen ex Frederiksen**

Figures 11C, D, 12C

**Materials examined.** CANADA – Nunavut • Ellesmere Island, CFS Alert; 82°27’41″N, 062°01’06″W; 121 m a.s.l.; 6 Aug. 2019; habitat: mesic habitat, with till and rocks as substrates, dominated by Saxifraga oppositifolia and moss; QFA0635522.

**Identification.** Plants 4.5–9.0 cm high; herbaceous; caespitose. Fibrous roots present. Stems 3.5–7.0 cm long; erect or ascending; glabrous. Leaves basal and cauline. Sheath margins glabrous. Ligules 0.3–0.5 mm long. Basal leaf blades 3.5–28.0 mm long, 0.2–0.6 mm wide; linear; rolled in bud; adaxial and adaxial surfaces both glabrous; margins scabrous. Flag leaf blades 0.3–3.7 mm long, 0.2–0.4 mm wide; tip spoon-shaped. Inflorescence a dense panicle; 12–18 mm long. Branch at lowest inflorescence node 1; 0.9–2.3 mm long. Pedicels scabrous. Spikelets 6.4–6.8 mm long, 2.5–2.9 mm wide. Florets per spikelet 2–4. First glumes 1.8–2.7 mm long; lanceolate; surface glabrous; margins ciliate; apices acuminata. Second glumes 2–3 mm long (shorter than the lowest floret); lanceolate or oblong; veins 3; surface glabrous; margins ciliate; apices acute. Lemmas 3.4–3.9 mm long, 0.8–0.9 mm wide; lanceolate; rounded on the back; veins 5; surface dull and sparsely scabrous; apices ciliate; awned. Awn 1.3–1.7 mm long; arising from the tip or slightly below. Palea 3.3–3.6 mm long; veins scabrous. Rachilla between first and second lemmas 0.7–1.0 mm long. Androecium with 3 stamens and 0.5–1.5 mm long anthers. Gynoecium with 2 styles.

Characteristics allowing to distinguish *F. hyperborea* from the other *Festuca* species present on Ellesmere Island can be found under *F. baffinensis* and *F. brachyphylla* subsp. brachyphylla.

**Festuca viviparoidea Krajina ex Pavlick subsp. viviparoidea**

Figures 11E, 12D

**Materials examined.** CANADA – Nunavut • Ellesmere Island, CFS Alert; 82°27’41″N, 062°01’06″W; 184 m a.s.l.; 23 Jul. 2019; habitat: xeric, with polygonal patterned ground made of till and rocks, and sparse dominance of Saxifraga oppositifolia; QFA0635543.
Island, CFS Alert; 82°30′04″N, 062°52′41″W; 93 m a.s.l.; 2 Aug. 2019; habitat: xeric in a slope, with hummocks made of till and rocks, dominated by Saxifraga oppositifolia and moss; QFA0635517 • same locality; 82°29′12″N, 062°50′55″W; 86 m a.s.l.; 27 Aug. 2019; habitat: mesic in a slope, with peat and till as substrates, dominated by Salix arctica, Saxifraga oppositifolia, Stellaria longipes, and Puccinellia vahliana (Liebmann) Scribn & Merrill; QFA0635540 • same locality; 82°30′21″N, 062°41′20″W; 66 m a.s.l.; 1 Aug. 2019; habitat: mesic in a slope, with till and rocks as substrates, dominated by Salix arctica; QFA0635587.

**Identification.** Plants 7.0–15.5 cm high; herbaceous; caespitose. Fibrous roots present. Stems 6–14 cm long; erect; glabrous and scabrous on angles below the inflorescence. Leaves basal and cauline. Sheath margins glabrous or hairy, with short simple hairs. Ligules 0.2–0.5 mm long. Basal leaf blades 12–25 mm long, 0.3–0.7 mm wide; linear; folded or rolled in bud; abaxial surface glabrous or scabrous; adaxial surface scabrous; margins glabrous or scabrous. Flag leaf blades 10.9–11.2 mm long, 0.2–0.3 mm wide; tip linear. Inflorescence a dense panicule, with bulbils allowing vegetative reproduction; 26–30 mm long. Branch at lowest inflorescence node 1; 1.5–2.2 mm long. Pedicels scabrous. Spikelets 10–14 mm long, 1.1–2.0 mm wide. Florets per spikelet 2 or 3. First glumes 2.8–3.1 mm long; lanceolate; surface glabrous or hairy, with hairs at the apices only; margins ciliate; apices acuminate. Second glumes 3.9–4.0 mm long (shorter than the lowest lemma); lanceolate; veins 3; surface glabrous and scabrous apically; margins ciliate; apices acute. Lemmas 4.1–6.7 mm long, 0.6–0.8 mm wide; lanceolate; keeled; veins 5; surface dull, sparsely scabrous, and hairy apically (on the projection), with short hairs; apices acuminate and glabrous; awnless. Palea vestigial or absent. Rachilla absent. Bulbils 3.3–9.6 mm long. Androecium and gynoecium absent.

Among the five Festuca species present on Ellesmere Island (GBIF 2020), *F. viviparoides* subsp. *viviparoides* is the only one with pseudoviviparous spikelets (in contrast to *F. bannensis*, *F. brachyphylla* subsp. *brachyphylla*, *F. edlundiae*, and *F. hyperborea*: Aiken et al. 2007).

**Phippsia algida** (Solander) R. Brown

**Figure 11F**

**Materials examined.** CANADA – Nunavut • Ellesmere Island, CFS Alert; 82°26′40″N, 062°43′09″W; 210 m a.s.l.; 14 Jul. 2019; habitat: mesic, with peat and rocks as substrates, dominated by *Juncus biglumis*, moss, and blue-green algae (macroscopic sheet colonies dominated by *Nostoc* sp); QFA0635538 • same locality; 82°25′52″N, 062°07′49″W; 296 m a.s.l.; 16 Jul. 2019; habitat: wetland in a mountain pass, with peat and rocks as substrates, dominated by moss and Saxifraga cernua; QFA0635539.

**Identification.** Plants 3.5–6.0 cm high; herbaceous; caespitose. Fibrous roots present. Stems 2.5–4.0 cm long; erect, ascending, or decumbent; glabrous. Leaves basal and cauline. Sheath margins glabrous. Ligules 0.8–1.0 mm long. Basal leaf blades 8–20 mm long, 0.8–1.2 (1.5–2.8 flat) mm wide; linear; folded or flat; abaxial and adaxial surfaces both glabrous; margins glabrous. Flag leaf blades 6–13 mm long, 0.7–1.2 (1.7–2.1 flat) mm wide. Inflorescence a dense panicule; 9–20 mm long. Branches at lowest inflorescence node 4–6; 1.0–2.8 mm long. Pedicels glabrous. Spikelets 1.6–2.3 mm long, 0.8–1.1 mm wide. Floret per spikelet 1. First glumes 0.3–0.5 mm long; ovate; surface glabrous; margins glabrous; apices obtuse. Second glumes 0.4–0.7 mm long (shorter than the lowest floret); ovate; veins indistinct; surface glabrous; margins glabrous; apices obtuse. Lemmas 1.4–2.0 mm long, 0.7–1.1 mm wide; ovate; rounded on the back; veins 1–3; surface dull, glabrous, and hairy, with hairs on and between the veins proximally (hairs 0.07–0.17 mm long; covering the lower ½ of the lemma surface); apices acute or erose, and glabrous; awnless. Palea 1.3–1.9 mm long; veins hairy. Androecium with 1 or 2 stamens and 0.4–0.6 mm long anthers. Gynoeicum with 2 styles. Fruit a caryopsis; 1.4–1.5 mm long, 0.3–0.5 mm wide; ellipsoid.

Most authors recognize two *Phippsia* (Trinieri) R. Brown species, *P. algida* and *P. concinna* (Th. Fr.) Lindberg (Steen et al. 2004; Aiken et al. 2007; Consaul and Aiken 2007), although Soreng and contributors (2003) treated the latter taxon as *Phippsia algida* subsp. *concinna* (Th. Fr.) Á. Löve & D. Löve; both taxa are known from Ellesmere Island. The most reliable characters to differentiate the species are the number of stamens (1 or 2 stamens in *P. algida* and 1 stamen in *P. concinna*); caryopsis shape (ellipsoid in *P. algida* and ovoid in *P. concinna*); pedicel angle (5–8° in *P. algida* and 20–108° in *P. concinna*); lemma hairiness (hairs on lower ½ or entirely glabrous in *P. algida* and hairs on the ½–2½ in *P. concinna*); and lemma hair length (0.02–0.15 mm long in *P. algida*, and 0.19–0.24 mm long in *P. concinna*; Aares et al. 2000). In addition, *P. algida* has spikelets that are less than twice as long as wide, whereas *P. concinna* has spikelets 2–3 times longer than wide (Consaul and Aiken 2007). We found that the lemmas of the *P. algida* specimens from Alert had longer hairs (up to 0.17 mm long) on a larger surface (½ of the surface) than reported in the literature.

*Phippsia algida* can also be mistaken for the hybrid ×*Pucciphippsia vacillans*, which is also known from Alert and is somewhat intermediate between *Phippsia algida* and *Puccinellia vahliana* (Hedberg 1962; Steen et al. 2004). They both have very short glumes (≤0.8 mm long; Aiken et al. 2007), but ×*P. vacillans* differs from *P. algida* by having longer leaf blades (≥30 mm long), more than one floret per spikelet, and panicles with predominantly ascending branches, not erect as in *P. algida* (Aiken et al. 2007).

**Pleurogonon sabinei** R. Brown

**Materials examined.** CANADA – Nunavut • Ellesmere Island, CFS Alert; 82°26′26″N, 062°01′49″W; 147
m a.s.l.; 23 Jul. 2019; habitat: wetland on the margins of a lake, with peat as substrate, dominated by moss and *Lu-zula nivalis*; QFA0635537.

**Identification.** Plants 9.5–19.5 cm high; herbaceous; not caespitose. Fibrous roots and rhizomes present. Stems 5–14 cm long; erect or ascending; glabrous. Leaves basal and cauleine. Sheath margins glabrous. Ligules 1.8–2.6 mm long. Basal and cauleine leaf blades (attacked below the middle of the stem) 24.5–59.0 mm long, 0.9–1.1 (2.0–2.6 flat) mm wide; linear; folded or flat; abaxial and adaxial surfaces both glabrous; margins glabrous. Flag leaf blades absent or present; 8.8–16.0 mm long, 0.9–1.3 mm wide. Inflorescence a diffuse raceme with spikelets attached on one side; 43–60 mm long. Branches at lowest inflorescence node 1; 1–12 mm long. Pedicels glabrous. Spikelets 4.8–12.5 mm long, 1.6–3.5 mm wide. Florets per spikelet 6–10. First glumes 1.5–2.1 mm long; ovate; surface glabrous; margins glabrous; apices obtuse. Second glumes 1.8–2.8 mm long (shorter than the lowest floret); ovate; veins 3; surface glabrous; margins glabrous; apices rounded and glabrous. Lemmas 3.6–4.0 mm long, 1.1–1.2 mm wide; oblanceolate; rounded on the back; veins 5–7; surface dull and hairy, with short hairs on and between the veins; apices rounded and glabrous; awnless. Palea 3.6–4.2 mm long; veins scabrous; with awn arising near the base of each palea keel; awns 2.6–3.5 mm long. Rachilla between first and second lemmas 0.9–1.3 mm long. Androecium with 3 stamens and 2–2.9 mm long anthers. Gynoeicum with 2 styles.

*Poa abbreviata* R. Brown subsp. *abbreviata*

**Figures 10D, E, 11G**

**Materials examined.** CANADA – Nunavut • Ellesmere Island, CFS Alert; 82°26′26″N, 062°01′49″W; 147 m a.s.l.; 23 Jul. 2019; habitat: wetland on the margins of a lake, with peat as substrate, dominated by moss and *Lu-zula nivalis*; QFA0635534 • same locality; 82°28′11″N, 062°05′06″W; 118 m a.s.l.; 18 Jul. 2019; habitat: mesic, with polygonal patterned ground made of till and rocks, dominated by *Stellaria longipes*; QFA0635536.

**Identification.** Plants 5.0–9.5 cm high; herbaceous; caespitose. Fibrous roots present. Stems 4–8 cm long; erect or ascending; glabrous. Leaves basal and cauline. Sheath margins glabrous. Ligules 1.8–2.6 mm long; folded or flat; abaxial and adaxial surfaces both glabrous; margins glabrous. Flag leaf blades (attacked below the middle of the stem) 24.5–59.0 mm long, 0.9–1.1 (2.0–2.6 flat) mm wide; linear; folded or flat; abaxial and adaxial surfaces both glabrous; margins scabrous or glabrous. Leafllet blades 12–41 mm long, 0.2–0.8 mm wide; linear; folded or rolled in bud; abaxial surface dull and hairy, with short hairs on and between the veins; veins 1–3; surface dull and hairy, with short hairs on and between the veins; apices ovate or erose, and glabrous; awnless. Palea 2.4–3.5 mm long; veins hairy, with short (proximally) and long hairs (in the middle) (hairs also present between the veins). Rachilla between first and second lemmas 1.0–2.0 mm long. Androecium...
with 3 stamens and 1.3–1.5 mm long anthers. Gynoecium with 2 styles.

Two Poa species present on Ellesmere Island have rhizomes (P. arctica subsp. arctica and P. pratensis subsp. arctica and subsp. caespitans; GBIF 2020). They can be differentiated based on the following: P. pratensis subsp. colpodea has at least some bulbiferous spikelets (in contrast to the others that do not have bulbils at all; Aiken et al. 2007); P. arctica subsp. arctica has open, pyramidal inflorescences, whereas both P. pratensis subsp. species have usually contracted, lanceolate or narrowly pyramidal inflorescences (Aiken et al. 2007; Saarela et al. 2020); and P. arctica subsp. arctica has paleas softly puberulent between keels, whereas both P. pratensis subsp. species have paleas glabrous between keels (Saarela et al. 2020).

**Poa pratensis** Linnaeus subsp. colpodea (Th. Fries) Tzvelev

Figures 11I

**Materials examined.** CANADA – Nunavut • Ellesmere Island, CFS Alert; 82°28′N, 062°06′W; 117 m a.s.l.; 18 Aug. 2019; habitat: around an Arctic fox den; QFA0635518 • same locality; 82°28′16″N, 062°06′24″W; 122 m a.s.l.; 18 Jul. 2019; habitat: around a bird perching site; QFA0635533.

**Identification.** Plants 7.5–16.5 cm high; herbaceous; not caespitose. Fibrous roots and rhizomes present. Stems 5.5–14.0 cm long; erect; glabrous. Leaves basal and cauline. Sheath margins glabrous. Ligules 0.8–1.3 mm long. Basal leaf blades 17–46 mm long, 0.8–1.1 mm wide; linear; folded or rolled in bud; abaxial and adaxial surfaces both glabrous; margins glabrous. Flag leaf blades 8.5–9.5 mm long, 0.3–0.6 mm wide. Inflorescence a diffuse or dense panicle, with bulbils allowing vegetative reproduction; 22.0–33.5 mm long. Branches at lowest inflorescence node 2 or 3; 0.9–2.8 mm long. Pedicels glabrous. Spikelets 4–9 mm long, 1.5–2.3 mm wide. Florets per spikelet 1–3. First glumes 2.3–3.0 mm long; ovate; surface glabrous; margins glabrous; apices acute or acuminate. Second glumes 2.0–2.9 mm long (shorter than, or almost as long as, the lowest lemma); ovate or lanceolate; veins 3; surface glabrous; margins scabrous; apices acuminate. Lemmas 3.0–3.9 mm long, 0.6–0.8 mm wide; lanceolate; rounded on the back and with straight lemma tips; veins 4 or 5; surface dull, glabrous, and hairy, with hairs on and between the veins proximally; apices acute or erose, and glabrous or scabrous; awnless. Palea 2.4–2.8 mm long; veins hairy proximally, with curly simple hairs, and scabrous apically. Rachilla between first and second lemmas 1.0–1.5 mm long. Androecium with 3 stamens and 0.8–1.2 mm long anthers. Gynoecium with 2 styles.

There are seven *Puccinella* Parlatore species present on Ellesmere Island (GBIF 2020). One of them, *P. phyrganodes* subsp. neoarctica, is spreading by leafy stolons, whereas the others are caespitose and do not have stolons (Censaul and Gillespie 2001; Aiken et al. 2007). The remaining species can be separated using the following combination of characters: in *P. angustata*, *P. bruggemannii*, and *P. vahliana* the palea veins have curly, intertwined hairs proximally and are scabrous apically, in contrast to being glabrous proximally and scabrous or smooth distally in *P. andersonii* Swallen, *P. arctica* (Hooker) Fernald & Weatherby, and *P. vaginata* (Lange) Fernald & Weatherby (Aiken et al. 2007; Saarela et al. 2020). Among the three former species, *P. vahliana* has smooth pedicels, whereas they are scabrous in *P. angustata* and *P. bruggemannii* (Saarela et al. 2020). Inflorescences, second glumes, and lemmas are reported to be longer in *P. angustata* (inflorescences 4–13 cm long; second glumes 1.9–3.0 mm long, with a length-width ratio
of 0.3–0.6; lemmas 3.5–5.2 mm long) than in *P. bruggemannii* (inflorescences 1–4 cm long; second glumes 1.7–2.3 mm long, with a length-width ratio of 0.5–0.8; lemmas 2.8–3.8 mm long; Saarela et al. 2020). However, we found that using only the length of the inflorescences, glumes, and lemmas did not unambiguously differentiate the two species. Indeed, we had specimens of *P. angustata* with shorter inflorescences (e.g., 3 cm long) and lemmas (e.g., 3 mm long), and specimens of *P. bruggemannii* with longer inflorescences (e.g., 4.5 cm long), glumes (e.g., 2.9 mm long), and lemmas (e.g., 4 mm long). We found however that the presence of incurved lemma tips in *P. bruggemannii* and straight lemma tips in *P. angustata* was a good identification criterion, as well as an anther length >0.8 mm and a plant height >10 cm (Consaul et al. 2008a; Saarela et al. 2020).

**Puccinellia bruggemannii T.J. Sørensen**

*Figure 11K*

**Materials examined.** CANADA – Nunavut • Ellesmere Island, CFS Alert; 82°27′28″N, 062°03′55″W; 140 m a.s.l.; 26 Jul. 2019; habitat: xeric, with polygonal patterned ground made of till and rocks, and sparse dominance of *Stellararia longipes* and *Saxifraga oppositifolia*; QFA0635526 • same locality; 82°24′36″N, 062°43′04″W; 369 m a.s.l.; 17 Jul. 2019; habitat: barren ground, with till and rocks as substrates; QFA0635527 • same locality; 82°28′01″N, 062°10′01″W; 141 m a.s.l.; 18 Jul. 2019; habitat: xeric, with polygonal patterned ground made of till and rocks, and sparse dominance of *Saxifraga oppositifolia*; QFA0635528.

**Identification.** Plants 4–10 cm high; herbaceous; caespitose. Fibrous roots present. Stems 2–8 cm long; erect, ascending, or semi-prostrate; glabrous. Leaves basal and cauline. Sheath margins glabrous or scabrous. Ligules 0.4–1.4 mm long. Basal leaf blades 8–30 mm long, 0.4–0.9 mm wide; linear; folded or rolled in bud; abaxial and adaxial surfaces both glabrous; margins glabrous. Flag leaf blades 2.8–20.0 mm long, 0.4–0.7 mm wide. Inflorescence a dense panicle; 12–45 mm long. Branches at lowest inflorescence node 2–3; 1.5–2.4 mm long. Branches at lowest inflorescence node 2–3; 1.4–9.5 mm long. Pedicels scabrous. Spikelets 3.5–4.1 mm long, 1.6–2.5 mm wide. Florets per spikelet 2–4. First glumes 1.1–2.0 mm long; ovate; surface glabrous; margins glabrous or scabrous; apices acute. Second glumes 1.9–2.9 mm long (shorter than, or almost as long as, the lowest floret); lanceolate; veins 3; surface glabrous; margins glabrous or scabrous; apices obtuse. Lemmas 2.2–4.0 mm long, 0.5–0.9 mm wide; elliptic; rounded on the back and with incurred lemma tips; veins 5; surface dull (and shiny apically), glabrous, and hairy, with hairs on the veins proximally; apices acute or erose, and slightly scabrous; tip incurred; awnless. Palea 2.3–2.9 mm long; veins hairy proximally, with simple curly hairs, and scabrous apically. Rachilla between first and second lemmas 0.7–1.2 mm long. Androecium with 3 stamens and 0.6–0.8 mm long anthers. Gynoeicum with 2 styles.

Characteristics allowing to distinguish *P. bruggemannii* from the other *Puccinellia* species present on Ellesmere Island can be found under *P. angustata*.

**Puccinellia phyganoidea (Trinius) Scribner & Merrill subsp. neoarctica (Á. Löve & D. Löve) Elven**

*Figure 11L*

**Materials examined.** CANADA – Nunavut • Ellesmere Island, CFS Alert; 82°31′31″N, 062°11′49″W; 0 m a.s.l.; 3 Aug. 2019; habitat: ocean shore, with sand and rocks as substrates; QFA0635525.

**Identification.** Plants 2.0–3.5 cm high; herbaceous; caespitose. Fibrous roots and stolons (growing in a zigzag pattern) present. Stolons 2–8 cm long; prostrate; glabrous. Leaves basal and along the stolons. Sheath margins glabrous. Ligules 0.3–0.8 mm long. Basal leaf blades 10.0–19.8 mm long, 0.2–0.5 mm wide; linear; involute, rolled in bud, or folded; abaxial and adaxial surfaces both glabrous; margins glabrous. Cauline leaf blades (emerging from stolons) 4.0–9.8 mm long, 0.2–0.5 mm wide. Inflorescence not observed at Alert.

Characteristics allowing to distinguish *P. phyganoidea* subsp. *neoarctica* from the other *Puccinellia* species present on Ellesmere Island can be found under *P. angustata*.

**Puccinellia vahliana (Liebmann) Scribner & Merrill**

*Figure 11L*

**Materials examined.** CANADA – Nunavut • Ellesmere Island, CFS Alert; 82°26′38″N, 062°11′23″W; 178 m a.s.l.; 23 Jul. 2019; habitat: mesic, with polygonal patterned ground made of till, dominated by *Alopecurus magellanicus*; QFA0635523 • same locality; 82°31′13″N, 062°14′26″W; 10 m a.s.l.; 3 Aug. 2019; habitat: mesic in a slope, with till and rocks as substrates, dominated by *Salix arctica*; QFA0635524 • same locality; 82°27′33″N, 61°58′45″W; 120 m a.s.l.; 6 Aug. 2019; habitat: mesic, with till and rocks as substrates, dominated by *Alopecurus magellanicus* and moss; QFA0635531 • same locality; 82°27′29″N, 062°08′34″W; 155 m a.s.l.; 6 Aug. 2019; habitat: wetland, with peat, till, and rocks as substrates, dominated by *Alopecurus magellanicus* and moss; QFA0635532.

**Identification.** Plants 7.0–17.5 cm high; herbaceous; caespitose. Fibrous roots present. Stems 4.0–14.5 cm long; erect or ascending; glabrous. Leaves basal and cauline. Sheath margins glabrous. Ligules 1.8–2.7 mm long. Basal leaf blades 8–30 mm long, 0.2–0.5 mm wide; linear; involute, rolled in bud; abaxial and adaxial surfaces both glabrous; margins glabrous. Flag leaf blades 2.8–20.0 mm long, 0.4–0.7 mm wide. Inflorescence a dense panicle; 12–45 mm long. Branches at lowest inflorescence node 2–3; 1.4–9.5 mm long. Pedicels scabrous. Spikelets 3.5–4.1 mm long, 1.6–2.5 mm wide. Florets per spikelet 2–4. First glumes 1.1–2.0 mm long; ovate; surface glabrous; margins glabrous or scabrous; apices acute. Second glumes 1.9–2.9 mm long (shorter than, or almost as long as, the lowest floret); lanceolate; veins 3; surface glabrous; margins glabrous or scabrous; apices obtuse. Lemmas 2.2–4.0 mm long, 0.5–0.9 mm wide; elliptic; rounded on the back and with incurred lemma tips; veins 5; surface dull (and shiny apically), glabrous, and hairy, with hairs on the veins proximally; apices acute or erose, and slightly scabrous; tip incurred; awnless. Palea 2.3–2.9 mm long; veins hairy proximally, with simple curly hairs, and scabrous apically. Rachilla between first and second lemmas 0.7–1.2 mm long. Androecium with 3 stamens and 0.6–0.8 mm long anthers. Gynoeicum with 2 styles.
lowermost floret); ovate; veins 1–3; surface glabrous; margins glabrous or scabrous; apices acute. Lemmas 2.4–4.2 mm long, 0.5–0.9 mm wide; lanceolate; rounded on the back and with straight lemma tips; veins 3; surface dull, glabrous, and hairy, with hairs on and between the veins proximally; apices acute or erose, and glabrous; awnless. Palea 2.7–3.7 mm long; veins hairy proximally, with simple curly hairs, and scabrous apically. Rachilla between first and second lemmas 0.7–1.4 mm long. Androecium with 3 stamens and 0.8–1.8 mm long anthers. Gynoecium with 2 styles.

Characteristics allowing to distinguish *P. vahliana* from the other *Puccinellia* species present on Ellesmere Island can be found under *P. angustata*.

**×Pucciphippsia vacillans** (T. Fries) Tzvelev

Figure 11M

**Materials examined.** CANADA – Nunavut • Ellesmere Island, CFS Alert; 82°26′40″N, 062°43′09″W; 210 m a.s.l.; 14 Jul. 2019; habitat: mesic, with peat and till as substrates, dominated by *Juncus biglumis*, moss, and blue-green algae (macroscopic sheet colonies dominated by *Nostoc* sp.); QFA0635516, CAN • same locality; 82°26′49″N, 062°34′42″W; 126 m a.s.l.; 25 Jul. 2019; habitat: wetland, with tussocks made of peat and till, dominated by *Eriophorum triste*, *Arctagrostis latifolia*, and *Alopecurus magellanicus*; QFA0635588.

**Identification.** Plants 3.5–13.0 cm high; herbaceous; caespitose. Fibrous roots present. Stems 1–10 cm long; erect, ascending, or semi-prostrate; glabrous. Leaves basal and cauleine. Sheath margins glabrous. Ligules 0.9–1.3 mm long. Basal leaf blades 25–60 mm long, 0.7–1.1 mm wide; linear; folded or rolled in bud; abaxial and adaxial surfaces both glabrous; margins glabrous. Flag leaf blades 12–15 mm long, 0.9–1.1 mm wide. Inflorescence a dense or diffuse panicle; 18–35 mm long. Branches at lowest inflorescence node 4–6; 2–10 mm long. Pedicels glabrous. Spikelets 2.2–2.5 mm long, 0.8–1.2 mm wide. Florets per spikelet 1–3. First glumes 0.5–0.7 mm long; ovate; surface glabrous; margins glabrous; apices obtuse. Second glumes 0.8–1.1 mm long (shorter than the lowest floret); ovate; veins 1–3; surface glabrous; margins glabrous; apices obtuse. Lemmas 2.0–2.3 mm long, 0.6–0.8 mm wide; lanceolate; rounded on the back; veins 3; surface dull, glabrous, and hairy, with hairs on and between the veins proximally; apices acute or erose, and glabrous; awnless. Palea 2.0–2.2 mm long; veins hairy. Rachilla between first and second lemmas 0.4–0.7 mm long. Androecium with 3 stamens and 0.7–1.2 mm long anthers. Gynoecium with 2 styles. Fruit not observed at Alert.

**Oxyria digyna** (Linnaeus) Hill

Figure 13A–C

**Materials examined.** CANADA – Nunavut • Ellesmere Island, CFS Alert; 82°31′03″N, 062°26′20″W; 58 m a.s.l.; 2 Jul. 2019; habitat: barren ground near a river, with till and rocks as substrates; QFA0635579.

**Identification.** Plants 2.5–7.0 cm high; herbaceous; caespitose. Fibrous roots and rhizomes present. Stems 0.5–5.0 cm long; erect; glabrous. Leaves basal; alternate; petiolate. Petioles 8–16 mm long; glabrous; adnate, with ocrea. Basal leaf blade 5–18 mm long, 1–2 mm wide; petaloid; obovate; white or pink. Androecium with 5–8 stamens and 0.2–0.3 mm long anthers. Gynoecium with 3 styles and 1 stigma per style. Fruit not observed at Alert.

**Ranunculaceae – Buttercup family**

**Ranunculus hyperboreus** Rottbøll

**Syn.:** *Ranunculus hyperboreus* subsp. *hyperboreus*

**Materials examined.** CANADA – Nunavut • Ellesmere Island, CFS Alert; 82°26′26″N, 062°01′49″W; 147 m a.s.l.; 23 Jul. 2019; habitat: wetland on the margins of a lake, with peat as substrate, dominated by moss and *Luzula nivalis*; QFA0634991.

**Identification.** Plants 0.5–2.0 cm high; herbaceous; not caespitose. Fibrous roots and stolons (floating on...
water) present. Stems 0.8–1.8 cm long; floating on water or creeping; rooting at nodes; glabrous. Leaves basal and cauline; isomorphic; alternate; petiolate. Petioles 4–25 mm long; glabrous. Leaf blades 3–10 mm long, 2–7 mm wide; flabellate; bases cuneate or obtuse, lobed, with 3 main linear or oblong-ovate, obtuse or rounded lobes (sometimes with second lobes); abaxial and adaxial surfaces both glabrous; margins entire or crenulate and glabrous. Inflorescence a solitary flower. Sepals 3 or 4; 1.8–3.0 mm long, 1.5–3.0 mm wide; ovate or oblong-ovate; pale brown or yellow; surface glabrous; margins glabrous; apices rounded. Petals 3 or 4; 2.0–3.5 mm long, 1.5–3.0 mm; obovate; unlobed; yellow. Androecium with 8–10, 0.5–0.8 mm long stamens. Receptacle 1–3 mm high; surface glabrous.

Among the eight *Ranunculus* Linnaeus species present on Ellesmere Island (*R. arcticus* Richardson, *R. aquatilis* Linnaeus, *R. hyperboreus*, *R. nivalis* Linnaeus, *R. pygmaeus* Wahlenberg, *R. sabinei* R. Brown, *R. subrigidus* W.B. Drew, *R. sulphureus* Solander; Aiken et al. 2007; GBIF 2020), only *R. aquatilis*, *R. hyperboreus*, and *R. subrigidus* are aquatic or amphibious plants with stems creeping or floating on water and rooting at nodes (in contrast to terrestrial or paludal plants with stems

![Figure 13. Polygonaceae. A. *Oxyria digyna* (Linnaeus) Hill small plant habit, B. tall plant habit, and C. fruits. Photos A by Audrey Le Pogam, B by Émilie Desjardins, and C by Sandra Lai.](image-url)
erect or if decumbent, rooting only at base; Whittemore 1997; Aikens et al. 2007). However, \textit{R. aquatilis} and \textit{R. subrigidus} are distinctive by having at least some leaves dissected into filiform segments. As for \textit{R. hyperboreus}, it has reniform, lobed leaf blades (Aiken et al. 2007). In addition, \textit{R. hyperboreus} has yellow petals, whereas the two others have petals that are white or white with yellow claws (Whittemore 1997).

**Ranunculus sabinei** R. Brown

Figure 14A

**Materials examined.** CANADA – Nunavut • Ellesmere Island, CFS Alert; 82°27′54″N, 062°46′43″W; 14 m a.s.l.; 8 Jul. 2019; habitat: wetland surrounded by hills, with silty sand as substrate, dominated by \textit{Alopecurus magellanicus}; QFA0634990.

**Identification.** Plants 3–7 cm high; herbaceous; not caespitose. Fibrous roots present. Stems 2.5–6.0 cm long; erect or ascending; hairy, with hyaline hairs. Leaves basal and cauline; heterophyllous; alternate; petiolate (basal leaves) or sessile (cauline leaves). Petioles 5–14 mm long; glabrous. Basal leaf blades 6–10 mm long, 4–11 mm wide; widely depressed ovate or orbicular; bases cuneate, obtuse, or truncate; lobed, with 3–5 main palmate, obtuse lobes; abaxial surface glabrous or sparsely hairy, with hyaline hairs; adaxial surface glabrous; margins ciliate. Cauline leaf blades 6–9 mm long, 5–8 mm wide; lobed, with 3 deeply cleft, linear, obtuse lobes; abaxial surface glabrous; adaxial surface glabrous or sparsely hairy, with hyaline hairs; margins ciliate. Inflorescence a solitary flower. Sepals 5; 4–7 mm long, 2.0–3.5 mm; lanceolate, ovate, or obovate; pale brown or pinkish-brown, with hyaline margins; surface hairy, with hyaline hairs; margins glabrous or hairy; apices rounded or obtuse. Petals 5; 4–7 mm long, 2–4 mm wide; obovate; unlobed; yellowish-purple. Androecium with 20–30, 2.0–3.3 mm long stamens. Receptacle 3–6 mm high; surface glabrous or sparsely hairy, with hyaline hairs. Fruit an achene; 0.9–1.4 mm long, 0.7–1.0 mm wide; ovoid; yellowish-green; with curved beak; glabrous.

\textit{Ranunculus sabinei} is similar to \textit{R. arcticus} and \textit{R. pygmaeus}, both of which are found on Ellesmere Island, by having white or translucent hairs on sepals, but differ in the following characters: leaf blades of \textit{R. sabinei} and \textit{R. pygmaeus} are usually 3-lobed, whereas they are 5- to 9-lobed in \textit{R. arcticus}; sepals of \textit{R. sabinei} are bigger (4–7 mm long, 2–3 mm wide) than those of \textit{R. pygmaeus} (2–4 mm long, 1.2–1.6 mm wide); and petals of \textit{R. sabinei} are longer (5–8 mm long) than those of \textit{R. pygmaeus} (1.2–3.5 mm long) but shorter than those of \textit{R. arcticus} (7–15 mm long; Saarela et al. 2020).

**Ranunculus sulphureus** Solander

Figure 14B

**Materials examined.** CANADA – Nunavut • Ellesmere Island, CFS Alert; 82°25′52″N, 062°07′49″W; 296 m a.s.l.; 16 Jul. 2019; habitat: wetland in a mountain pass, with peat and rocks as substrates, dominated by moss and \textit{Saxifraga cernua}; QFA0634989.

**Identification.** Plants 4.0–13.5 cm high; herbaceous; caespitose or not caespitose. Fibrous roots present. Stems 3.2–11.0 cm long; erect or ascending; glabrous proximally and hairy apically, with brown hairs. Leaves basal and cauline; heterophyllous; alternate; petiolate (basal leaves) or sessile (cauline leaves). Petioles 8–25 mm long; hairy. Basal leaf blades 5–15 mm long, 8–16 mm wide; widely depressed ovate or orbicular; bases cuneate or truncate; lobed, with 3–5 main palmate, obtuse lobes; abaxial and adaxial surfaces both either glabrous or sparsely hairy, with brown hairs; margins ciliate. Cauline leaf blades 3–6 mm long, 1.6–18 mm wide; palmatisect, with 3–5 linear, obtuse lobes; abaxial and adaxial surfaces both either glabrous or sparsely hairy, with brown hairs; margins ciliate. Inflorescence a solitary flower. Sepals 5; 3–6 mm long, 3–4 mm wide; ovate or obovate; yellowish-brown; surface hairy, with brown hairs; apices rounded. Petals 5; 4–9 mm long, 3–7 mm wide; obovate; yellowish-brown; surface hairy, with brown hairs; margins ciliate; apices rounded. Receptacle 3–5 mm long, 1.2–2.0 mm wide; ovoid or obovate; yellowish-brown; surface hairy, with brown hairs; margins ciliate; apices rounded. Petioles 5; 4–9 mm long, 3–7 mm wide; obovate; unlobed; yellow. Androecium with 20–30, 1.2–2.0 mm long stamens. Receptacle 3.5–7.0 mm high; surface hairy, with brown hairs. Fruit an achene; 1.5–3.0 mm long, 1.0–1.7 mm wide; ovoid; yellowish-green; with straight or curved beak; glabrous.
**Rosaceae – Rose family**

**Dryas integrifolia** Vahl subsp. **integrifolia**

**Figure 15A–C**

**Materials examined.** CANADA – Nunavut • Ellesmere Island, CFS Alert; 82°28′34″N, 062°26′49″W; 128 m a.s.l.; 2 Jul. 2019; habitat: barren ground, with till and rocks as substrates, and sparse dominance of Saxifraga oppositifolia; QFA0635001.

**Identification.** Plants 3–8 cm high; dwarf shrubs. Taproots and rhizomes present. Branches prostrate, sometimes rooting at nodes. Leaves evergreen; basal and cauline; isomorphic; alternate; petiolate. Stipules green or reddish-brown; hairy, with white non-glandular hairs. Basal leaf blades 10–25 mm long, 10–22 mm wide; pinnate-compound, with 3–5 pinnatisect leaflets distributed along the lower ⅔ of leaf axis. Leaflet blades 6–16 mm long, 4–9 mm wide; obovate; lobed, with 3–7 lanceolate, obtuse lobes; abaxial and adaxial surfaces both hairy, with white long–silky, non-glandular hairs (sometimes adaxial surface glabrate with few hairs); margins revolute and ciliate. Cauline leaf blades simple or ternate-compound. Inflorescence a solitary flower or a cyme, with 2 or 3 flowers. Epicalyx 1–3 mm long, 0.5–1.0 mm wide; ob lanceolate. Sepals 5; 3–6 mm long, 2–3 mm wide; ovate; green; surface hairy, with hyaline non-glandular hairs; margins ciliate; apices acute. Petals 5; 3–6 mm long, 2–3 mm wide; obovate; slightly lobed, or undulating; yellow. Androecium with 17–22 stamens and 0.4–0.6 mm long anthers. Gynoecium consisting of numerous separate carpels, with 0.9–1.2 mm long conical styles.

**Potentilla pulchella** can be distinguished from the nine other Potentilla Linnaeus species present on Ellesmere Island (GBIF 2020) by the pinnate leaves (in contrast to ternate or palmate leaves in *P. arenosa* (Turczaninow) Juzepczuk subsp. *arenosa* and subsp. *chamissonis* (Hultén) Elven & D.F. Murray, *P. hyparcica* Malte subsp. *hyparcica* and subsp. *elatior* (Abromeit) Elven & D.F. Murray, *P. nivea* Linnaeus, *P. subgorodkovi* Jurtzev, *P. tikhomirovii* Jurtzev, *P. vahliana* Lehmann, and *P. vulcanicola* Juzepczuk; Ertter et al. 2014); the pin nate leaflets distributed along the ⅓∕⅔ and more of the leaf axis (in contrast to ⅓∕⅔ of the leaf axis in *P. persenii* (Rydberg) Rydberg and *P. rubricaulis* Lehmann; Ertter et al. 2014); and the ≤3 mm wide petals (in contrast to all other *Potentilla* species present on Ellesmere Island, which have ≥3 mm wide petals; Ertter et al. 2014).

At Alert, *P. pulchella* is highly polymorphic in terms of hairiness. Most individuals have silvery-white appearance due to dense hairs on leaves, whereas few individuals are sparsely hairy (Fig. 15D, E). A molecular study of this species on Svalbard has shown that there is nearly no genetic (RAPD) variation among subpubescent and pubescent plants (Hansen et al. 2000). Instead, pubes cence variation is phenotypic and is associated with different abiotic conditions: pubescent plants growing on cliffs, ridges, scree slopes, and silt shore terraces, and subpubescent plants on gravel shore terraces (Hansen et al. 2000).
trailing; glabrous. Branchlets glabrous or hairy, with long hyaline hairs. Leaves deciduous; cauline; alternate; petiolate. Stipules 1.3–1.5 mm long; green; deciduous. Petioles 1.1–4.9 mm long; glabrous or hairy. Cauline leaf blades 5.6–19.5 mm long, 2.5–7.5 mm wide; elliptic, oblanceolate, or obovate; bases obtuse, cuneate, or rounded; green; abaxial surface glaucous and hairy, with long hyaline hairs; adaxial surface dull or shiny, and glabrous or sparsely hairy, with long hyaline hairs; margins entire, flat, and ciliate; apices obtuse or acute. Inflorescences catkins. Plants dioecious. Peduncles hairy. Staminate catkins 14–25 mm long, 6–10 mm wide. Pistillate catkins 10–30 mm long, 8–14 mm wide; Bracteoles 0.8–1.6 mm long, 1.0–1.2 mm wide; reddish-brown or black; surface hairy, with white hairs; apices rounded or obtuse. Androecium with 2 stamens and 0.3–0.5 mm

Figure 15. Rosaceae. A. Dryas integrifolia Vahl subsp. integrifolia habit, B. flower, and C. fruits. D. Potentilla pulchella R. Brown subpubescent plant habit and E. pubescent plant habit. Photos A by Audrey Le Pogam, B, D by Emilie Desjardins, C by Francis Robitaille, and E by Charline Couchoux.
long anthers. Gynoecium with hairy (white hairs) pyriform ovaries (2.2 mm long, 1 mm wide), 1.1–1.3 mm long styles, and 0.3–0.6 mm long stigma lobes.

*Salix arctica* and *S. arctophila* Cockerell ex A. Heller are the only *Salix* Linnaeus species present on Ellesmere Island (GBIF 2020) and can be distinguished based on the following: the largest medial leaf blade abaxial surface is glabrous in *S. arctophila*, whereas it is usually pilose in *S. arctica* (sometimes the midrib is sparsely short-silky and the apex is long-silky bearded; Saarela et al. 2020); leaf blade margins are serrulate or crenulate (sometimes entire) in *S. arctophila*, whereas the margins are entire in *S. arctica* (Saarela et al. 2020); and the ovary hairs are white and rust-couloured, appressed, crinkled, and ribbon-like in *S. arctophila*, whereas the hairs are only white, flattened, and wavy (not crinkled) in *S. arctica* (Aiken et al. 2007).

**Saxifragaceae – Saxifrage family**

**Micranthes tenuis** (Wahlenberg) Small

**Materials examined.** CANADA – Nunavut • Ellesmere Island, CFS Alert; 82°25′52″N, 062°07′49″W; 296 m a.s.l.; 16 Jul. 2019; habitat: wetland in a mountain pass, with peat and rocks as substrates, dominated by moss and *Saxifraga cernua*; QFA0634988.

**Identification.** Plants 3–6 cm high; herbaceous; not caespitose. Fibrous roots present. Stems 1.9–5.0 cm long;

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**Figure 16.** Salicaceae. A. *Salix arctica* Pallas female catkin habit, B. male flowers, and C. male catkin habit. Photos A, B by Émilie Desjardins and C by Audrey Le Pogam.
erect; hairy, with sepal glandular hairs (0.1–0.5 mm long). Leaves basal; patent or horizontal; alternate; petiolate. Petioles 0.5–3.0 mm long; hairy, with sepal glandular hairs. Basal leaf blades 4–10 mm long, 3–7 mm wide; ovate or oblanceolate; bases cuneate or attenuate; lobed, with 5–10 triangular, obtuse lobes; green or redish-purple; abaxial and adaxial surfaces both glabrous; margins glabrous or ciliate, with sepal glandular hairs. Inflorescence a solitary flower or a capitulate cyme, with 2–5 flowers. Bracts 3–5 mm long, 1.2–2.5 mm wide; ovate or lanceolate; surface glabrous; margins ciliate. Pedicels hairy. Sepals 5; 3–5 mm long, 1.5–2.5 mm wide; elliptic or obovate; green to purple; surface glabrous; margins glabrous; apices obtuse or rounded. Petals 5; 2.5–4.0 mm long, 0.8–2.0 mm wide; obovate; unlobed; pink. Androecium with 8–10 stamens and 0.2–0.4 mm long anthers. Gynoecium with 2 styles.

Four *Micranthes* Haworth species are present on Ellesmere Island (GBIF 2020). *M. hieraciifolia* (Waldstein & Kitaibel ex Willdenow) Haworth, *M. nivalis* (Linnaeus) Small, and *M. tenuis* have inflorescences without bulbils, in contrast to *M. foliolosa* (R. Brown) Cornall, which has bulbils replacing some or all the flowers (Saarela et al. 2020). The inflorescences, however, differ among the first three species; *M. hieraciifolia* has spikelike thyrses 2–10 cm long, whereas *M. nivalis* and *M. tenuis* have capitulate thyrses or capitulate cyms 0.5–4.0 cm long (Saarela et al. 2020). *Micranthes tenuis* is similar to *M. nivalis* but the two differ in a few characters: *M. nivalis* has more slender stems with sparse hairs <1 mm long, whereas stems of *M. tenuis* are pubescent with hairs >1 mm long (Blondeau 2015c); the inflorescence of *M. tenuis* is a solitary flower or an open capitulate cyme with 2–10 distinctly pedicellate flowers, whereas inflorescence of *M. nivalis* is a compact capitulate thyrse with 5–40 densely clustered flowers (Aiken et al. 2007; Brouillet and Elvander 2009a). Moreover, *M. nivalis* is mostly found in barren grounds and hummocks, whereas *M. tenuis* is only found in wet and moist areas such as pond margins, wet meadows, and marshes (Aiken et al. 2007).

**Saxifraga cernua** Linnaeus

*Figure 17A, B*

**Materials examined.** CANADA – Nunavut • Ellesmere Island, CFS Alert; 82°26′39″N, 61°57′18″W; 159 m a.s.l.; 26 Jul. 2019; habitat: mesic, with till and rocks as substrates, dominated by *Juncus biglumis*, moss, and lichen; QFA0635005.

**Identification.** Plants 4–11 cm high; herbaceous; not caespitose. Fibrous roots present. Stems 3.5–10.0 cm long; erect or ascending; hairy, with sepal glandular hairs. Leaves basal and cauline; heterophyllous; alternate; petiolate (basal and lower cauline leaves) or sessile (upper cauline leaves). Petioles 3–25 mm long; glabrous or hairy, with sepal glandular hairs. Basal leaf blades 3–8 mm long, 3–11 mm wide; suborbicular or transversely elliptic; bases cuneate, truncate, or cordate; lobed, with 3–5 palmate, obtuse or acute lobes; green or reddish-purple; abaxial and adaxial surfaces both glabrous; margins glabrous or ciliate. Cauline leaf blades 2–10 mm long, 1–12 mm wide; ovate or lanceolate; unlobed or lobed, with 3–5 palmate lobes; abaxial surface hairy proximally, with sepal glandular hairs; adaxial surface glabrous; margins glabrous or ciliate, with sepal glandular hairs. Bulbils in cauline leaf axils 1–3 mm long; dark red. Inflorescence a solitary flower. Sepals 5; 2.5–4.0 mm long, 2–3 mm wide; ovate; reddish-purple; surface hairy, with sepal glandular hairs; margins ciliate; apices obtuse. Petals 5; 5–10 mm long, 4–6 mm wide; obovate; unlobed or slightly notched; white or ivory. Androecium with 8–10 stamens and 0.7–1.8 mm long anthers. Gynoecium with 2 styles.

Among the nine *Saxifraga* Linnaeus species present on Ellesmere Island (*S. aizoides* Linnaeus, *S. flagellaris* Willdenow subsp. *platysepala* Trautvetter) A.E. Porsild, *S. hirculus* Linnaeus, *S. oppositifolia* Linnaeus, *S. cernua*, *S. cespitosa* Linnaeus, *S. hyperborea* R. Brown, *S. rivularis* Linnaeus, and *S. tricuspidata*; GBIF 2020), only the five first species have toothed or lobed basal leaves with white, pale yellow, or purplish white petals (Aiken et al. 2007; Saarela et al. 2020). Among them, only *S. cernua* has bulbils (Aiken et al. 2007; Saarela et al. 2020). *S. cespitosa* has hairy adaxial leaf blade surface and hairy calyx, whereas these two structures are glabrous in *S. hyperborea*, *S. rivularis*, and *S. tricuspidata* (Aiken et al. 2007). In addition, *S. cespitosa* and *S. tricuspidata* have sessile basal leaves, whereas *S. hyperborea* and *S. rivularis* have distinctly petiolate basal leaves (Saarela et al. 2020). Basal leaf blades are sharply 3-toothed in *S. tricuspidata*, whereas *S. hyperborea* and *S. rivularis* have basal leaf blades with 2–7 rounded or obtuse lobes (Brouillet and Elvander 2009b). The petals are also spotted in *S. tricuspidata* but not in *S. cernua*, *S. cespitosa*, *S. flagellaris* subsp. *platysepala*, *S. hyperborea*, *S. oppositifolia*, and *S. rivularis* (Aiken et al. 2007; Brouillet and Elvander 2009b).

**Saxifraga cespitosa** Linnaeus

*Figure 17C, D*

**Materials examined.** CANADA – Nunavut • Ellesmere Island, CFS Alert; 82°26′39″N, 61°57′18″W; 159 m a.s.l.; 26 Jul. 2019; habitat: mesic, with till and rocks as substrates, dominated by *Juncus biglumis*, moss, and lichen; QFA0635005.

**Identification.** Plants 2.5–7.0 cm high; herbaceous; caespitose (cushion shape). Taproots and rhizomes present. Stems 1.5–6.0 cm long; erect or ascending; hairy, with glandular hairs. Leaves basal and cauline; heterophyllous; alternate; petiolate (basal leaves) or sessile (cauline leaves). Petioles 2–15 mm long; hairy, with glandular hairs. Basal leaf blades 3–7 mm long, 3–6 mm wide; oblanceolate or obtuse-linear; bases cuneate; lobed, with 3 linear or lanceolate, obtuse lobes; reddish-purple; abaxial surface sparsely hairy, with glandular hairs; adaxial surface glabrous; margins ciliate. Cauline leaf blades 3–6 mm long, 1 mm wide; linear or elliptic; abaxial
and adaxial surfaces both sparsely hairy, with glandular hairs; margins ciliate. Inflorescence a solitary flower or a cyme, with 2 or 3 flowers. Pedicels hairy. Sepals 5; 4.0–5.5 mm long, 0.5–2.5 mm wide; ovate or lanceolate; purplish green or reddish-purple; surface hairy, with glandular hairs; margins ciliate; apices obtuse or rounded. Petals 5; 3.0–5.8 mm long, 1.2–2.5 mm wide; oblong to obovate; unlobed; pale yellow. Androecium with 9–10 stamens and 0.3–0.8 mm long anthers. Gynoecium with 2 styles.

Characteristics allowing to distinguish *S. cespitosa* from the other *Saxifraga* species present on Ellesmere Island can be found under *S. cernua*.

*Saxifraga flagellaris* Willdenow subsp. *platysepala* (Trautvetter) A.E. Porsild

Figure 17E

**Materials examined.** CANADA – Nunavut • Ellesmere
Identification. Plants 1.5–6.0 cm high; herbaceous; not caespitose. Fibrous roots and stolons present. Stolons 25–80 mm long; filiform; red; hairy, with glandular hairs; leafless; terminating in a tiny rosette attached to the substrate by adventitious roots. Stems 1.0–5.5 cm long; erect; hairy, with glandular hairs. Leaves basal and cauline; heterophyllous; alternate; sub sessile (basal leaves) or sessile (cauline leaves). Basal leaf blades 3–8 mm long, 2.0–4.5 mm wide; obovate or obtuse, unlobed; red or green; abaxial and adaxial surfaces both glabrous; margins ciliate, with long stiff glandular hairs; apices obtuse. Cauline leaf blades 4–6 mm long, 1–2 mm wide; abaxial surface sparsely hairy, with glandular hairs; adaxial surface glabrous; margins ciliate; apices rounded or obtuse. Inflorescence a solitary flower. Sepals 5; 3–6 mm long, 1.5–2.5 mm wide; ovate; green to purple; surface hairy, with glandular hairs; margins ciliate; apices obtuse. Petals 5; 4–10 mm long, 2.5–6.0 mm wide; obovate; unlobed; yellow. Androecium with 9–10 stamens and 0.3–0.7 mm long anthers. Gynoecium with 2 styles. Fruit not seen at Alert.

Among the three Saxifraga species present on Ellesmere Island with entire basal leaves and yellow petals (S. aizoides, S. flagellaris subsp. platysepala, and S. hirculus; GBIF 2020; Saarela et al. 2020), S. flagellaris subsp. platysepala differs from the two others by having red, long stolons and unspotted petals (Saarela et al. 2020). S. aizoides and S. hirculus usually do not have stolons (but if present, the stolons are very short and green), but can have petals with orange spots (Saarela et al. 2020).

Saxifraga oppositifolia Linnaeus subsp. oppositifolia

Materials examined. CANADA – Nunavut • Ellesmere Island, CFS Alert; 82°27′17″N, 062°35′55″W; 166 m a.s.l.; 30 Jul. 2019; habitat: xeric in a slope; QFA0635002.

Identification. Plants 1.5–6.0 cm high; herbaceous; not caespitose (cushion shape). Taproots and rhizomes present. Stems 1–6 cm long; prostrate, decumbent, or ascending; hairy, with non-glandular hairs. Leaves cauline; sometimes overlapping or imbricate; decussate; sub sessile. Cauline leaf blades 2–5 mm long, 1.0–4.5 mm wide; obovate or oblanceolate; bases cuneate; unlobed; green; abaxial and adaxial surfaces both glabrous; margins ciliate, with non-glandular hairs; apices rounded, obtuse, or truncate. Inflorescence a solitary flower. Sepals 5; 2.5–5.0 mm long, 1.6–2.5 mm wide; ovate; purple; surface glabrous or hairy, with non-glandular hairs; margins ciliate; apices obtuse. Petals 5; 4–8 mm long, 3–5 mm wide; obovate; unlobed; purple, pink, or white. Androecium with 9 or 10 stamens and 0.2–0.6 mm long anthers. Gynoecium with 2 styles. Fruit a capsule.

Saxifraga oppositifolia differs from all other Saxifraga species present on Ellesmere Island by having purple or pink petals (Aiken et al. 2007; Saarela et al. 2020).

Discussion

The total of 58 species recorded during this survey (including 15 Arctic endemics) is a representative number of taxa for a polar desert ecosystem (Aleksandrova 1980; Bay 1992). This is also within the range of vascular plant species richness found in other areas on or near Ellesmere Island. For example, from south to north, 85 species were found at Alexandra Fiord (Muc et al. 1989), 40 in the central part of Ellesmere Island (Lévesque 1997), 75 at Sverdrup Pass (Bergeron and Svoboda 1989), and Sverdrup Pass (Bergeron and Svoboda 1989), 151 at Quttinirpaq National Park (Parks Canada 1994), and 36 at Ward Hunt Island (Vincent et al. 2011). Part of the variation among surveys likely reflects the size of the surveyed area, as well as environmental conditions and landscape heterogeneity (e.g., topography, hydrology, substrate, and microclimate; Ravolainen et al. 2020; Taylor et al. 2020).

Among the 14 families recorded, the Poaceae (18 species) accounted for 32% of the inventoried vascular plant species. The predominance of this family is higher than in other High Arctic ecosystems, notably Ward Hunt
Island (11% with 4 Poaceae species; Vincent et al. 2011), North of Greenland (20% with 19 Poaceae species; Bay 1997), Svalbard (14% with 25 Poaceae species; Svalbard Flora 2020), and Cape Chelyuskin in Russia (22% with 10 Poaceae species; Matveeva and Chernov 1976). Poaceae are early successional species in some Arctic ecosystems and they are most abundant within the first 20 years of colonization of a new environment, including bare soils and enriched or disturbed areas (Forbes and Jefferies 1999; Forbes et al. 2001; Cray and Pollard 2015). This relatively high diversity in Poaceae for a polar desert ecosystem may reflect perturbations related to land use, soil contamination, and operation of heavy vehicles on the soft ground during snowmelt in early summer near CFS Alert.

We recorded four species that were new for the Alert region, but that had been already reported on Ellesmere Island by other collectors (distance and direction from nearest previous records are indicated in parentheses): *Draba pacuiciflora* (Grant Land Mountain, ca. 40 km W; Kershaw s.n. (DAO06935)), *Festuca edlundiae* (Tanquary Fiord, ca. 300 km WSW; Aiken 94–016E (CAN10012792)), *Festuca hyperborea* (Lake Hazen, ca. 140 km WSW; Sokoloff & McMullin 951 (CAN10064714)), and ×*Pucciphippsia vacillans* (Craig Harbour, ca. 790 km SSW; Malte s.n. (ALTA-VP33562)). For *Festuca edlundiae*, this record at Alert corresponds to an extension of the known northern distribution limit in the Canadian Arctic from 82°25′N to 82°31′N (GBIF 2020). Similarly, the record of the hybrid ×*Pucciphippsia vacillans* extends its known northern distribution limit from 76°12′N to 82°31′N in the Canadian Arctic (GBIF 2020). *Draba pacuiciflora* and *Festuca hyperborea* have been found previously at the same latitude or higher on Ellesmere Island (GBIF 2020).

*Draba pacuiciflora* and *Festuca hyperborea* are rare and were found only in a few plots (one and five plots, respectively), which may explain why they had not been found previously. ×*Pucciphippsia vacillans* was more abundant (found in 20 plots), but they may have been mistaken for *Hippsia* sp. in the past. *Festuca edlundiae* was relatively recently separated from other known *Festuca* species (Aiken et al. 1995), and the re-identification of existing specimens from Alert may uncover more records of this species.

Despite our intensive systematic search, we did not find 21 species that had been previously recorded within the study area (GBIF.org 2020). It is possible they were located in microhabitats that we missed while focusing more on systematic than opportunistic sampling.

*Taraxacum holmenianum* (Harington 50 (CAN10085233)) was previously recorded from Alert as *T. phymatocarpum* (Aiken et al. 2007); this specimen was re-determined as *T. holmenianum* by J.M. Saarela (Canadian Museum of Nature).

*Draba alpina*, *D. cinerea*, *D. fladnizensis*, and *D. nivalis* were all previously recorded for Alert by Bruggemann and Calder (1953). However, we were not able to access these records for confirmation in any online database or at the National Collection of Vascular Plants (DAO). *Draba lactea* and *D. oblongata* were not reported in the initial paper of Bruggemann and Calder (1953); they were since re-identified at DAO (D. lactea: Bruggemann s.n. (DAO08985) and (DAO08986)). However, we were not able to verify sheets of *D. oblongata* R. Brown ex de Candolle (Bruggemann s.n. (DAO10096) and (DAO10097); Harington s.n. (ALTA-VP9754)), reported in Aiken et al. (2007). *Draba simmonsii* was reported from the station by Elven and Al-Shebbaz (2008) as a paratype of this newly described High Arctic taxon. This specimen was previously determined as *D. alpina* (MacDonald 37 (CAN10056945)). We did not encounter *D. simmonsii* in 2018–2019.

Neither *Cerastium alpinum* Linnaeus (Bruggemann and Calder 1953) nor *C. beeringianum* (Harington 81 (CAN10046052)) were encountered during our 2019–2019 field seasons. *Cerastium alpinum* and *C. arcticum* were previously differentiated within a *C. alpinum–C. arcticum* complex or lumped into a widely defined *C. alpinum* (Hultén 1956; Böcher 1977; Brysting and Elven 2000). The identification of all three species is particularly problematic in the Arctic because they overlap in most characters and a combination of characters is required to differentiate them unambiguously (Brysting and Elven 2000). *Silene soorensensis* was previously recorded at Alert by Bruggemann and Calder (1953), MacDonald (MacDonald 23 (CAN10047218)), and Harington (Harington 112 (CAN10047213)). We did not encounter this taxon ourselves but accept the two species records at CAN based on examination of online specimen images.

*Carex nardina* Fries was not encountered in our 2018–2019 field seasons, but it was previously recorded twice at Alert (Bruggemann and Calder 1953; Harington 32 (CAN10038316)).

*Luzula confusa* Lindeberg was likewise not collected during our 2018–2019 field season, but it was recorded by Harington during his study at Alert (Harington 173 (CAN10041687); Harington s.n. (ALTA-VP4715)).

*Papaver radicatum* Rottboll was recorded by Bruggemann and Calder (1953) and subsequent workers at the station, following earlier floristic treatments of the Canadian Arctic (Polunin 1940; Porsild 1957). Later works by Solstad (2009) and Solstad and Elven (unpublished data) on this circumpolar genus suggest that *P. radicatum* is a strictly northern European species and that there are five *Papaver* species present in the Canadian Arctic Flora. These previous collections of *P. radicatum* have since been re-identified to *P. cornwallisense* (Harington 118 (CAN10052454), Harington 167 (CAN10052470), John son 09 (CAN10052474), Johnson 104 (CAN10052472)) and *P. lapponicum* (Johnson 15 (CAN10052488), Johnson 89 (CAN10052487), MacDonald 32 (CAN10052490), and Pilon s.n. (CAN10052493)). We did not encounter either of these two species during our 2018–2019 fieldwork.

*Pod hartzii* Gandoger subsp. *vrangelica* var. *vivipara* Polunin was recorded by Bruggemann and Calder (1953)
but not recollected by us. Bruggemann and Calder (1953) also recorded *Puccinellia pumila* (Vasey) Hitchcock at the station, which we suspect had been misidentified, since this species is usually found at much lower latitudes and is not currently recorded on Ellesmere Island (GBIF 2020). However, we were not able to verify the current status of this collection as most of the collections deposited by P.F. Bruggemann do not appear on the database of the National Collection of Vascular Plants (CBIF 2020), and we were unable to visit this herbarium.

*Ranunculus subrigidus* was recorded by Bruggemann and Calder (1953) and MacDonald (MacDonald 26 (CAN10052073)). *Potentilla hystericata* Malte was also recorded by Bruggemann and Calder (1953) and MacDonald (MacDonald 48 (CAN10063302)). We did not record either species.

*Micranthes nivalis* was collected twice by MacDonald at Alert (MacDonald 43 (CAN10061875); MacDonald 45 (CAN210853)) but not recollected by us. Likewise, we did not encounter *Saxifraga hyperborea* R. Brown (previously identified as *Saxifraga rivularis* Linnaeus in Harington 168 (CAN10089195)) in 2018–2019.

Based on this analysis of the floristic inventories from the last 70 years and by the exclusion of *Papaver radicatum* and *Puccinellia pumila*, we conclude that 77 vascular plant species are currently present in our study area at Alert.

An interesting observation is that we found *Poa praetensis* subsp. *colpodea* on a perching site used by birds of prey and on an arctic fox den. These faunal sites are productive vegetation patches due to the regular deposits of urine, faeces, casts, and prey remains, which release nutrients (Aiken et al. 2007; Gharajehdaghipour et al. 2016).

Our survey provides new information that contributes to biodiversity monitoring efforts and conservation management of vascular plants at Alert. In addition to being exposed to climatic warming (CAFF 2013), the vegetation at Alert may have already experienced direct anthropogenic disturbance, including habitat degradation from off-road use of military vehicles and soil contamination, due to past waste management issues. Introduction of new plant species through the transportation of personnel and heavy equipment at Alert may also provide opportunity for plant dissemination, although our survey revealed no obvious case of establishment of a non-native species. A better understanding of the above threats may be important regarding the imperiled *Festuca viviparodea* subsp. *viviparodea*, which has a scattered distribution and low occurrence in Nunavut (NatureServe 2020; GBIF 2020), and other arctic endemic species with restricted distribution (e.g., *Draba pauciflora*, *Festuca edlundiae*, and *Pucciphippsia vacillans*). In this context, identifying areas of highest conservation concerns is essential. The status of several Arctic species is currently not assessed and precise information on distribution and population trends is often lacking (CAFF 2013). Long-term monitoring of plant communities and regular surveillance for the establishment of non-native species are thus critical to assess the effects of climatic changes and anthropogenic impacts on High Arctic ecosystems. The relative accessibility of Alert to scientists offers invaluable opportunities to better understand High Arctic biodiversity and its ongoing changes.

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**Authors’ Contributions**

ED, DB, FV and AT contributed to the study design; ED, DB, SL and MP collected the data; ED, SP, MD, PCS, AS, and LS identified the specimens, with the aid of SL and JL; ED, SL, AS, and JL deposited the voucher specimens at the Herbarium; ED, SL, MD, and AT provided plant pictures; ED and MP arranged the figure plates; ED, SL, SP, PCS, JL, and DB wrote the text; and all authors reviewed and contributed to the final text.

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Supplemental Data

Darwin Core Archive of voucher specimens collected during the 2018–2019 opportunistic and systematic inventory at Canadian Forces Station Alert, Ellesmere Island, Nunavut, Canada.

Appendix

We created a habitat map of the study area consisting of five classes for vegetation habitat types (barren ground, xeric, xeric-mesic, mesic, and wetland) and one class for water/snow. The following six steps were used. 1) We acquired a 40-cm resolution pan-sharpened multispectral satellite picture of the study area (Fig. 1). 2) The water bodies were removed from the satellite picture to reduce the computational expense of the following image processing steps. 3) We grouped the picture pixels into clusters of similar contiguous pixels (hereafter called superpixels), for which the spectral information was averaged. Through visual assessment, we found that a superpixel size of ≥50 pixels (≥8 m²) and compactness (i.e., shape parameter) of 0.08 were the parameter values best suited to obtain homogeneous superpixels (i.e., containing mostly pixels of the same habitat class) that fit the shape boundaries on the satellite picture. Superpixels represent more meaningful ecological entities than individual pixels (Fisher 1997) and reduce the small-scale heterogeneity that can cause misclassifications (Zhang et al. 2015). 4) We transformed the superpixel spectral values with the Soil-Adjusted Vegetation Index (SAVI; Huete 1988), which is a very similar to the Normalized Difference Vegetation Index (NDVI), but allows reduction of soil reflectance when vegetation cover is low (<40%) and bare soil is abundant (Lam and Remmel 2010). SAVI values usually range from −1.5 to 1.5, with lower values depicting bare ground and higher values indicating higher ground coverage by vegetation (Lam and Remmel 2010). 5) We classified the SAVI-transformed clusters in six classes (including five classes for vegetation habitat types and one class for water/snow) using an unsupervised maximum likelihood algorithm (Borra et al. 2019). The chosen number of classes reflected a visual evaluation of dendrograms produced during the classification process, which showed the distance between each pair of sequentially merged classes. GRASS GIS 7.6 (GRASS Development Team 2019) was used to perform step 2 and ArcGIS 10.6.1 (ESRI 2018) for all other steps. 6) The classified map was ground-truthed (detailed not shown here) prior to the field surveys described in this paper.