

Arctic Flora of Canada and Alaska Guide for Contributors

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Canadian Museum of Nature, Ottawa
Version 1.0 – 30 May 2012

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Introduction

The goal of the Arctic Flora of Canada and Alaska project is to produce a comprehensive flora of the arctic ecozone in Canada and northern Alaska. We desire to move the Flora beyond current standards and produce a treatment that is digital, interactive, and which takes full advantage of current (and future) web and database technologies. In other words, our goal is to produce a "new standard". This approach will allow the Flora to incorporate ancillary information and metadata associated with each taxon (e.g., specimen databases, character matrices, specimen photographs, links to BOLD, GenBank, etc.) into a single treatment. At its core the Flora will consist of keys, taxon descriptions, nomenclatural data and detailed, specimen based distribution maps. With the digital format, information will be published on-line as it is generated and ready for release. By being electronic, this flora will function as a living document, able to easily take advantage of the latest taxonomic, distributional, and other related information. It will also allow us to employ emerging software innovations such as fully interactive keys and descriptions.

We aim to complete the digital (on-line) version by late 2015; this digital version will be updated continuously thereafter as new information becomes available. Once the digital version is completed, a hard copy version will be prepared for publication. Subsequent use of the word 'Flora' here does not differentiate between digital and hard-copy versions.

Project Organizational Framework

Project Co-Leaders: Lynn Gillespie, Jeff Saarela (Canadian Museum of Nature, Ottawa)

Project Steering Committee & Editors: Lynn Gillespie, Jeff Saarela, Bruce Ford

Arctic Flora Research Assistant: Paul Sokoloff

Museum Team: Gillespie, Saarela, Sokoloff, Jennifer Doubt, Roger Bull & CMN summer/coop students

Core Research Team: George Argus, Luc Brouillet, Jacques Cayouette, Laurie Consaul, Reidar Elven, Alain Cuerrier, Steffi Ickert-Bond, James Macklin, David Murray, Tyler Smith, Julian Starr.

Authorship

Cite the entire website as:

Gillespie LJ, JM Saarela, and BA Ford (Editors). 2012 onwards. Arctic Flora of Canada and Alaska. <http://arcticplants.myspecies.info/> [accessed on day month year].

Cite a taxonomic treatment as:

[author(s) of treatment], [date content was posted]. [Taxon name]. In Gillespie LJ, JM Saarela, and BA Ford (Editors). 2012 onwards. Arctic Flora of Canada and Alaska. <http://arcticplants.myspecies.info/> [accessed on day month year].

Example:

Saarela, JM. 2012. *Elymus*. In Gillespie LJ, JM Saarela, and BA Ford (Editors). Arctic Flora of Canada and Alaska. 2012 onwards. <http://arcticplants.myspecies.info/> [accessed on 26 Jan 2012]

Recommendation: When citing a page in the flora, click the 'Create Citation' in the Authors and Sources module at the bottom of each page. This archives the content at that moment

in time, and creates a permanent link to the version of the page being cited. The cited version is thus available into the future, despite subsequent changes to the webpage. If citing multiple pages, you can create these citations for each page you visit. Use this or these URLs in your citation. Example: <http://arcticplants.myspecies.info/citations/4>

Geographical Limits of the Flora

The Flora boundary (Fig. 1) follows the limits of the arctic ecozone in Canada and northern Alaska as defined by the Circumpolar Arctic Vegetation Map Team (CAVM 2003; Walker et al. 2005), with a few modifications. Western Alaska and Wapusk are excluded from the Flora region (see below). The Flora region includes the north slope of Alaska, arctic northern Yukon, about one third of the Northwest Territories, most of Nunavut, extreme northeastern Manitoba, northern Quebec, and a small portion of northern Newfoundland and Labrador. Within Hudson Bay, the Sleeper Islands, Belcher Islands, Ottawa Islands, Hopewell Islands and the northern Nastapoka Islands — all part of Nunavut — are part of the Flora region.

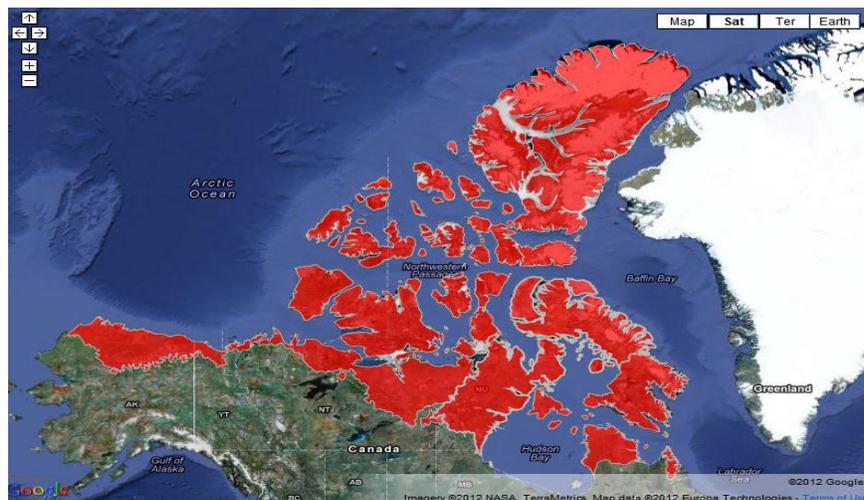


Figure 1. The Arctic Flora of Canada and Alaska region. The geographical boundaries for the Flora follows the limits of the arctic ecozone as defined by the Circumpolar Arctic Vegetation Map Team (CAVM 2003).

The Hudson Bay coastal region (HBC) in Manitoba, Ontario and Quebec. The HBC south of the main boundary line of the Flora is an arctic-boreal borderline region that comprises a complex mix of arctic, boreal, and intermediate vegetation types; determining a "cut-off" line in the region defining what is and is not Arctic is difficult. Portions of the Hudson Bay lowlands have variously been considered to be part of the Canadian Arctic (e.g., Pointe Louis XIV in Quebec, Long Island in Hudson Bay, Nunavut, part of Wapusk National Park in northern Manitoba, and Cape Henrietta Marie in Ontario). The HBC area was not included in the Circumpolar Arctic Vegetation Map, with the exception of a small portion of Wapusk National Park (from Cape Churchill south to the Owl River and inland 10 km from Hudson Bay) that was included without explanation. Additional details on the HBC will be posted on the Flora website.

The HBC will be given special consideration in the Flora. All arctic species (i.e., all species that occur north of the main Flora boundary line) in the HBC will be treated and mapped in the Flora. The HBC will be defined for the purposes of this Flora as including the mainland

coast to 20 km inland and the coastal islands that are south of the main Flora boundary (i.e., all of the Hudson Bay coast in Ontario, most in Manitoba, and the southern one third in Quebec). This arbitrary 20 km zone encompasses all the arctic vegetation communities in the Hudson Bay lowlands and is thus appropriate for mapping arctic species in this region.

Boreal species that are found in the HBC but not within the main Flora boundary will not be treated in the Flora. Authors are encouraged to mention HBC boreal species in taxon discussion sections as they see appropriate.

The following areas are not part of the Flora region:

- **Western Alaska, equivalent to the Western Alaska floristic province of the Panarctic Flora (Elven et al. 2011):** This region is excluded from the Flora because it comprises a distinct Beringian element that is floristically very different from the rest of the North American Arctic.
- **Greenland:** Greenland is excluded primarily because of difficulties in accessing collections (most are in Denmark) and their lack of digitization.
- **An upland region in northern Quebec (Plateau du Lac Nedlouc) surrounding Lake Nedlouc:** This region is transitional between the boreal forest and the arctic tundra and has a strong arctic floristic element. This region is classified as tundra-forest tundra by Payette (1976, 1983), and is considered to be part of the boreal zone (Brandt 2009). It is not included in the Circumpolar Arctic Vegetation Map, and is not part of the Flora region. However, this plateau is an important part of the distribution range of many Arctic taxa, similar to the Hudson Bay Lowland region (above). Therefore the Flora will include distributional and, where pertinent, other data (e.g., ecological, taxonomic, etc.) from the plateau regions for Arctic species that extend into them. Taxa that occur on the Plateau du Lac Nedlouc but not elsewhere in the Flora region will not be treated.

To determine if a specimen is inside or outside the Flora boundary, authors should consult the interactive map of the Flora region that is available on the Flora website:

<http://arcticplants.myspecies.info/content/map-flora-region-north-american-arctic-ecozone>

The map can be viewed on the Flora website, and can also easily be opened in Google Earth to determine the geographical limits of the Flora region at any particular location (to do this, click the link to download the .kml file on the above webpage, then click it and it should open in Google Earth).

Arctic Flora Website — <http://arcticplants.myspecies.info/>

The Arctic Flora project is being built and disseminated online on a Scratchpad (Smith et al. 2009, 2011) website, a Drupal-based content management system. Upon completion, we anticipate that all digital content will be formatted into a text document to produce a standard, hard copy publication.

Because the Flora is being built online using a content management system, Flora data must be compiled in a format that can be converted into machine readable text for the website, and standard text for an eventual hardcopy publication. All data should be compiled in the standardized spreadsheets provided by the Museum team.

Taxa in the flora website are organized in a hierarchical classification displayed on the sites left navigation column. The number in parentheses beside a scientific name indicates the number of included taxa at the next lower rank. At all levels, accepted taxa are listed in blue and 'not accepted' taxa are displayed in red.

When uploaded to the website, information from each of the different worksheets described below is presented in data display blocks (modules) on the page for the accepted taxon to which the data correspond. All accepted taxa (at any rank) will have data display blocks for some or all of the following data types: Taxonomy, Description, Images, Specimens, Specimens map, Distribution, and General Information.

To see how Flora data are displayed on the website, explore the following "in progress" taxon pages:

[*Elymus alaskanus* ssp. *hyperarcticus*](#)

[*Elymus alaskanus* ssp. *alaskanus*](#)

[*Leymus mollis* ssp. *mollis*](#)

[*Leymus mollis* ssp. *villosissimus*](#)

Taxa Included in the Arctic Flora

The Flora will develop comprehensive baseline data for the Arctic ecozone, and will include all vascular plant taxa that have been collected within the Flora boundary. All included taxa must be documented by at least one voucher specimen deposited in a herbarium.

In general the Flora aims to be inclusive rather than exclusive in terms of taxa that are treated. Authors should be liberal in drafting lists of taxa in the groups they are treating. In most cases 'borderline' taxa (those that occur at, or very close to the defined boundary) should be included, particularly those that may be expected to be in the Flora region but are not yet documented. In all cases taxa determined to be 'borderline', including those that are not ultimately treated in the Flora, should be carefully documented so the information is not lost. Authors should comment on included and excluded borderline taxa in the discussion section for their genus, and in the discussion for taxa that are treated.

Collections of taxa with locations that are ambiguous with respect to the southern Flora boundary, and which are not otherwise documented by another specimen from clearly within the Flora boundary, can be discussed with the project leaders to determine if they should be included or excluded.

Only a single infraspecific rank (subspecies or variety) is recommended, however in certain cases it may be justified to use both ranks. It is important that ranks be applied in the same manner throughout the Flora, but use will ultimately depend on the author's taxonomic concepts. As a guide, we suggest authors consider applying species concepts as outlined in Elven et al. (1999). Subspecies, the main category below species, should be major regional entities that are morphologically distinguishable and are typically vicariant (at the geographical [allopatric], eco-geographical or ecological level). The category of variety may be used for entities that are of ecological significance or local occurrence, and sharply morphologically distinguishable.

Established hybrids, especially those that are common and widespread, should be included and fully treated in the Flora with justification for their inclusion explained as part of the

taxon treatment. Infrequently occurring and sterile hybrids should be mentioned in the discussion section of the parent species or the genus, as appropriate.

As a preliminary working checklist of taxa in the Flora region, we are following the *Annotated Checklist of the Panarctic Flora (PAF) Vascular Plants* (Elven et al. 2011). We have extracted all taxa in the PAF list reported as being present in Arctic Canada and northern Alaska, and uploaded these to the website. These data should be used as a guide when authors begin work on their treatments; authors are not required to follow the taxonomy in the PAF Checklist.

Authors are encouraged to develop a list of included taxa in the Flora in their respective groups when they begin work, and this information should be communicated to the Museum team so that an up-to-date taxon list can be maintained on the website. This is especially critical when taxa need to be removed or added from the working list or if there is a difference of taxonomic opinion.

Classifications employed should reflect the latest research (e.g., recognized families and genera should be monophyletic). Order and family level classification will follow APG III (2010) for angiosperms and Smith et al. (2006) for ferns except in instances where newly published evidence supports an alternative classification.

Within families, usage of ranks above and below the level of genus (i.e., sections, subgenera, tribes) will be left to the discretion of the author. Such usage may be appropriate for large genera or families for which good ranking systems exist.

New species and combinations must be published in accordance with the International Code of Nomenclature for algae, fungi and plants, preferably in peer-reviewed publications. The Flora website does not meet the requirements for electronic publication. New names should not be used on the Flora website until valid.

Worksheet Format for Recording Data

All Flora data must be compiled in a spreadsheet format, as fully parsed data are required for uploading data to the website. Parsed data can be converted to free flow text for a hardcopy publication, but it is much more difficult to go from free form text to database format. It is important that all authors work in the same format.

Template spreadsheets have been designed for the different categories of data that will be compiled for the flora. These are defined as separate worksheets within a single spreadsheet file, minimizing the number of separate files that authors and editors will need to maintain. An example of a completed Excel file is available on the Flora website [here](#). Authors should review this example prior constructing spreadsheets for their own taxonomic treatments.

Separate worksheets are defined for:

- (1) Family information;
- (2) Genus information;
- (3) Accepted species information;
- (4) References cited in worksheets 1–3
- (5) Nomenclatural data for all taxa (in "full hierarchy" format);
- (6) Specimens examined;
- (7) Family description;

- (8) Genus description;
- (9) Taxon description (species and infraspecific taxa).

NOTE: "(8) Genus description" and "(9) Taxon description" worksheets are user defined. Authors should use the example worksheet as a template and formulate worksheets that are specific to their group(s).

When uploaded to the project website, all data are organized in a relational database based on the taxon name in the first column of each worksheet. The order of the rows within each worksheet does not matter, and each worksheet can contain information for a single or multiple taxa (e.g., one genus, two or more genera, one family, etc.). Although data must be entered into the pre-defined worksheet fields in the formats described below, authors are free to organize their data within and among worksheets in any manner. Blank worksheets can be copied as many times as may be necessary to organize the information effectively.

The blank worksheet template and a partially completed example template are posted on the Arctic Flora website [here](#).

The pre-defined fields in worksheets 1–6 are outlined below. Names in red are the descriptive field names used in the worksheets. Explanatory information is given in parentheses for a subset of fields. Unless otherwise stated, the format for data entry is free-form text.

General Information for Arctic Taxa (Worksheets 1–4)

Worksheets 1 to 3 record general data (e.g., species diversity, common names, etymology, etc.) about families, genera and species/subspecies, respectively, excluding nomenclatural data and taxonomic descriptions, which have separate worksheets. Regardless of the number of families, genera and species/subspecies an author is treating, he/she can work in single or multiple copies of each of worksheets 1 to 3, whichever is found to be easiest. All references cited in worksheets 1–3 should be listed in full in worksheet 4.

Etymology (optional field) — Authors are encouraged to provide a brief description of the origins of names of their genera and species, and include the references to the origins of this information, if available. A useful reference is Brown (1978).

Common Names — Common names in English and French should be included. Common names should be listed in lower case, as in VASCAN; capitalize only proper names. Include a single common name for families (reference not required). Where there are several common names for a genus or species, provide an 'Accepted Common Name' and references in which the accepted common name is used. List other common names in the 'Other Common Names' field; references are not required for these. VASCAN is an excellent starting point for common names (<http://data.canadensys.net/vascan/search/>), particularly the accepted common name (though this does not necessarily have to be followed). French common names need not be given if they do not exist.

Indigenous names will be included in a separate spreadsheet. All indigenous knowledge will be compiled by Alain Cuerrier and collaborators. Treatment authors do not need to compile indigenous information.

Species diversity — Authors should list the number of species in their genera in (1) the flora region, (2) in the Panarctic Flora according to Elven et al. (2011), and (3) globally. If

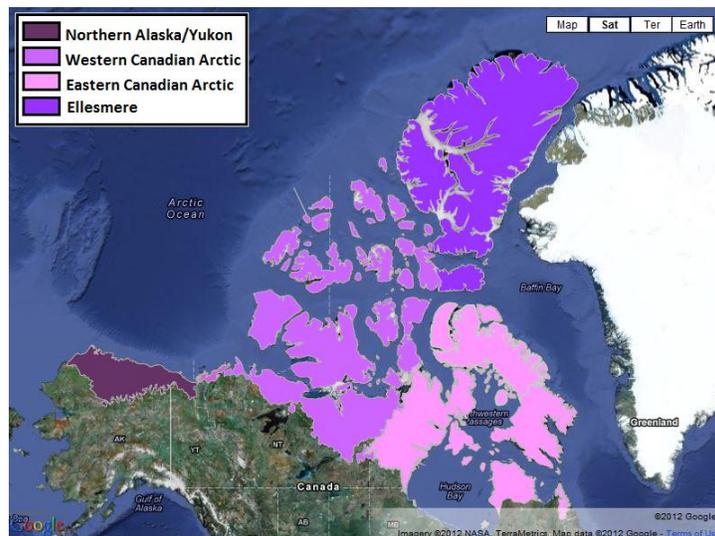
the number of species in a category is difficult to determine (e.g., due to differing generic concepts, etc.), this should be commented on; there are comment fields corresponding to each of these three regions in the worksheet.

General Discussion — Authors should include a discussion for each genus, species and, if applicable, infraspecific taxon, as in FNA & PAF, for example. The discussion should include notes on taxonomic problems, alternative taxonomic treatments, reasons for differing taxonomy in the Flora compared with recent published treatments (e.g., FNA, PAF, recent papers in the primary literature), peculiarities of distribution, ecology, and other useful or interesting information. References must be cited.

Ecology and Phenology — Authors should include information on typical habitat, substrate preference, elevational range, flowering times and fruiting times for each species. We are currently exploring options that would allow authors to describe habitats using standardized terminology. If a taxon is weedy or invasive in all or part of its range, this should be noted in the habitat field. We aim to generate detailed phenological data from the Specimens Examined worksheet; only a brief summary should be included here.

Ecogeographical Distribution — Ecogeographical distribution within the Flora region is described in terms of vegetation zone and floristic region, and for outside the Flora region in terms of Canada terrestrial ecozone ecogeographical (climatic) distribution zone, and geographical region.

- **Vegetation zone:** Select the vegetation zone(s) that comprise the distribution of each taxon in the Flora region Arctic vegetation zones follow the Panarctic Flora (see [section 2.3 Vegetation Zones](#) in the PAF). These regions are referred to as Bioclimate subzones in the Circumpolar Arctic Vegetation map (see [here](#)). This field will be scored when the distribution maps are complete.
- **Floristic regions:** While there have been several attempts to define floristic regions for the North American arctic, none have been entirely successful for the Canadian arctic. We use a modified, but still not perfect, version here, and hope that this Flora project will contribute to developing a better system of Arctic floristic regions for North America. The Arctic floristic regions are based on those defined in the Panarctic Flora (Elven et al. 2011) and the Circumpolar Arctic Vegetation map (CAVM) (which was based on an earlier version of PAF), but are not identical to either in names and/or boundaries.



- The **Northern Alaska/Yukon** floristic region is equivalent to the Northern Alaska floristic province of CAVM, and the Northern Alaska–Yukon Territory as defined in PAF.
 - The **Western Canadian Arctic** floristic region is equivalent to the Central Canada floristic province of CAVM, not the Central Canada floristic region as defined in PAF.
 - The **Eastern Canadian Arctic** floristic region is equivalent to the combined West Hudsonian and Baffin and Labrador floristic provinces of the CAVM.
 - The **Ellesmere** floristic region is equivalent to Ellesmere–North Greenland in the CAVM and Ellesmere Land–Northern Greenland in PAF, excluding Greenland. It includes Axel Heiberg Island, the eastern half of Devon Island and Ellesmere Island.
- **Canada terrestrial eozones:** These follow Ecological Stratification Working Group (1996) and are used to describe the non-Arctic primary distribution of a species (or infraspecific taxon) in Canada. A map of the eozones is available [here](#). This field may be scored from the literature. If taxonomic concepts in the Flora differ from those elsewhere and it is not possible to reliably score extra-Arctic distribution in Canada, this should be mentioned in the comments field. Note that the Arctic

ecozones (i.e., Arctic Cordillera; Northern Arctic; Southern Arctic) are not scored; these are replaced with the more detailed vegetation zones of PAF (above).

- The principal **ecogeographical (climatic) distribution zone** (e.g., arctic, alpine, boreal, other) and **geographical region where a species occurs globally** should be given. For example, a species with its main distribution in boreal parts of Alaska and the Russian Far East, but also crossing the boundary into the low arctic of these areas (and thus in the Flora), would be scored as boreal for the Global distribution zone and Amphi-Beringian for the Global ecogeographical region. For the Global distribution zone only the primary zone where a species most commonly occurs should be scored. If a species is equally frequent in two zones (e.g., arctic and alpine), then both may be scored. For the Global ecogeographical region, one region will usually be sufficient to describe its primary distribution, but in some cases it may be necessary to score two or more regions. For western alpine species a distinction is made between boreal alpine and temperate alpine.
- **Political Distribution** — Political distributions for each species and infraspecific taxon are scored for the Flora region (by province and state), for the circumpolar Arctic (by country and for Russia, main region), for the non-Arctic in Canada and Alaska (by province and state), and for the non-Arctic globally (text description). For each political region defined, enter "Y" in the worksheet cell if the taxon is present, and leave the cell blank if absent. If appropriate (e.g., for rare taxa), include references (text format) and/or voucher specimen data documenting these distributions in the comments field. Scoring distribution outside the Flora region may be based on examination of herbarium material or on works such as Flora of North America, VASCAN, the Panarctic Flora, etc. References should be provided for published works or websites consulted when completing these fields, and if herbarium material is used comment on this. If taxonomic concepts in the Flora differ from those elsewhere and it is not possible to reliably score circumpolar Arctic distribution, note this in the comments field.

Conservation Status — The conservation status of taxa will be given according to NatureServe Conservation Status ranks (www.natureserve.org/explorer/ranking.htm), and, if applicable, ranks under Canadian and U.S. national/federal and provincial/territorial/ state species at risk/endangered species legislation. The Museum team will score conservation status for all taxa when treatments undergo editorial review; authors are also welcome to score these where known.

References — All references cited in a treatment should be listed in full in the References worksheet (worksheet 4). These will be entered or imported into EndNote, then exported from EndNote in a format that can be uploaded to the website. Please use the following format when listing references to facilitate their import into EndNote. References should follow this format:

- Authors: Last name, first initial., middle initial.
- Date: No parentheses
- Article titles: Capitalize only first word and proper nouns
- Publication: Use full journal title
- Doi: include if available.

Example: Elven, R., Al-Shehbaz, I.A. 2008. *Draba simmonsii* (Brassicaceae), a new species of the *D. micropetala* complex from the Canadian Arctic Archipelago. *Novon*: 18: 325-329. doi: 10.3417/2007178

Worksheet 1: Family Information

Worksheet 1 records general information (excluding nomenclatural data) for a single family or multiple families that an author is treating. The accepted name of each family is listed in the first column. If an author is treating two families, there could be two rows of data in worksheet 1, one row corresponding to each of the families. Alternatively, an author could make two copies of worksheet 1, with data for each family in separate worksheets. In this case, each copy of the worksheet would have a single row of data for a family.

- **Family name**
 - **Family.** Accepted family name in flora
- **Common name(s).** A single common name is preferred.
 - **Family common name(s) English**
 - **Family common name(s) French**
- **Number of genera and species in the family.** Provide references for genera and species numbers in the comments fields as necessary.
 - **Genera/species in Flora region.**
 - Example: 5 genera / 10 species
 - **Genera/species in Flora region comments**
 - **Genera/species in Panarctic Flora.** Based on Elven et al. (2011).
 - **Genera/species in Panarctic Flora comments.** If there are differences in taxonomic opinion between the Flora and PAF, comment on this here.
 - **Genera/species in North America (north of Mexico).**
 - Example: 6–8 genera / 25–27 species
 - **Genera/species in North America (north of Mexico) comments**
 - Example: Smith (1994), Tellerman et al. (2002)
 - **Genera/species worldwide**
 - **Genera/species worldwide comments**
- **General discussion**
 - **Family discussion.** Cite references in the text.

Worksheet 2: Genus Information

Worksheet 2 records general information (excluding nomenclatural data) for one genus or multiple genera (all genera within a family, for example). The accepted genus name is listed in the first column in each row.

If an author is treating two genera in one family, and three genera in a second family, worksheet 2 could have five rows, one listing data for each of the genera in the two families. Alternatively, an author could make two copies of worksheet 2, with genus-level data for each family compiled in separate worksheets. In this case, the first copy of worksheet 2 would have two rows (one for each of the two genera in the first family), and the second copy would have three rows (one for each of the three genera in the second family).

- **Genus name**
 - **Genus.** Accepted genus name in flora.
- **Etymology**

- Genus etymology.
- **Common name(s).** Separate multiple common names with commas.
 - Genus accepted common name English
 - Genus accepted common name English references
 - Genus other common names English
 - Genus accepted common name French
 - Genus accepted common names French references
 - Genus other common names French
- **Number of species in the genus.** Provide references for species numbers in the comments fields as necessary.
 - Species in Flora region
 - Species in Flora region comments
 - Species in Panarctic Flora.
 - Species in Panarctic Flora comments If there are differences in taxonomic opinion between the Flora and PAF, comment on this here.
 - Species in North America north of Mexico
 - Species in North America north of Mexico comments
 - Species worldwide
 - Species worldwide comments
- **General discussion**
 - Genus general discussion. Cite references.
- **References.** Provide the full citations for all references cited in the above discussion, so they can be uploaded to the website
 - Genus references

Worksheet 3: Species Information

Worksheet 3 records general information (excluding nomenclatural data) for accepted species and infraspecific taxa within a genus or multiple genera. Each accepted taxon (species, subspecies, variety) is listed in full in the first column. If working on a family with three genera with five species each, an author may choose to compile the descriptive data for all 15 species in a single copy of worksheet 3 (in this case, worksheet 3 would have 15 rows, one for each species). Alternatively, the author could make three copies of worksheet 3, with species data for each genus in a separate worksheet. In this case, each copy of worksheet 3 would have five species.

- **Species.** Complete one row per accepted species, subspecies, and variety; do not include authorities in this field.
 - Species/infraspecific taxon
- **Species common names.** Separate multiple common names by semicolons.
 - Accepted common name English
 - Accepted common name English references
 - Other common names English
 - Accepted common name French
 - Accepted common names French references
 - Other common names French
- **Etymology**
 - Species etymology.

- **Number of infraspecific taxa in the species.** Provide references for species numbers in the comments fields as necessary.
 - **Infraspecific taxa in Flora region**
 - **Infraspecific taxa in Flora region comments**
 - **Infraspecific taxa in Panarctic Flora.**
 - **Infraspecific taxa in Panarctic Flora comments.** If there are differences in taxonomic opinion between the Flora and PAF, comment on this here.
 - **Infraspecific taxa in North America north of Mexico**
 - **Infraspecific taxa in North America north of Mexico comments**
 - **Infraspecific taxa worldwide**
 - **Infraspecific taxa worldwide comments**

- **Discussion**
 - **Discussion**

- **Ecology and phenology**
 - **Habitat**
 - **Substrate (select one from drop down menu)**
 - Acidic
 - Calcareous
 - Other
 - Not substrate specific
 - **Substrate comments**
 - **Geographical origin (select one from drop down menu)**
 - Native
 - Introduced naturalized
 - Other
 - **Geographical origin comments.** If a taxon is introduced, mention where it is introduced from and the means of introduction, if known.
 - **Elevation range.** Obtain data from the Specimens Examined worksheet.
 - **Flowering time.** This field will summarize flowering time data from the Specimens Examined worksheet, and will be scored once that worksheet is finalized. Details on scoring specimens are given below under Worksheet 6.
 - **Fruiting time.** This field will summarize fruiting time data from the Specimens Examined worksheet, and will be scored once that worksheet is finalized. Details on scoring specimens are given below under Worksheet 6.

- **Ecogeographical distribution**
 - **Arctic vegetation zone.** Select one or several. This field will be scored when the distribution maps are complete.
 - Arctic polar desert zone (Zone A)
 - Northern arctic tundra zone (Zone B)
 - Middle arctic tundra zone (Zone C)
 - Southern arctic tundra zone (Zone D)
 - Arctic shrub tundra zone (Zone E)
 - **Arctic vegetation zone comments**
 - **Arctic floristic regions.** Select the floristic region(s) that are part of the primary distribution of each taxon. For a map of the floristic regions, see [here](#). This field will be scored when the distribution maps are complete.
 - Northern Alaska/Yukon
 - Western Canadian Arctic
 - Eastern Canadian Arctic
 - Ellesmere

- Arctic floristic regions comments
- Canada terrestrial ecozone. Select the Canada Terrestrial ecozone(s) (Ecological Stratification Working Group 1996) that are part of the non-Arctic primary distribution of the taxon in Canada. A map of the ecozones is available [here](#).
 - Taiga Plains
 - Taiga Shield
 - Taiga Cordillera
 - Hudson Plains
 - Boreal Plains
 - Boreal Shield
 - Boreal Cordillera
 - Pacific Maritime
 - Montane Cordillera
 - Prairies
 - Atlantic Maritime
 - Mixedwood Plains
- Canada terrestrial ecozone comments
- Global ecogeographical distribution zone. Score the primary distribution zone. If a species is equally frequent in two zones (e.g., arctic and alpine), then both may be scored.
 - Arctic
 - Alpine
 - Boreal
 - Other
- Global ecogeographical distribution zone comments
- Global geographical distribution. Primary distribution; more than one can be selected. These categories are not necessarily mutually exclusive.
 - Circumarctic
 - North American Arctic
 - Circumboreal
 - North American Boreal
 - North American Boreal Cordilleran (western mountains in boreal zone equivalent to the Canadian terrestrial ecozones Boreal Cordillera and Taiga Cordillera and their extension into adjacent Alaska)
 - North American Temperate Cordilleran (western mountains south of boreal zone equivalent to the Canadian terrestrial ecozone Montane Cordillera and its extension into adjacent United States)
 - Amphi-Beringian
 - North American Beringian
 - Amphi-Atlantic
 - Bipolar disjunct
 - Cosmopolitan
 - Other
- Global geographical distribution comments
- **Political distribution**
 - Distribution in Flora region. Select all that apply.
 - Alaska
 - Yukon Territory
 - Northwest Territories
 - Nunavut
 - Manitoba (Hudson Bay coastal region, Wapusk National Park)

- Ontario (Hudson Bay coastal region)
 - Quebec
 - Newfoundland and Labrador
 - **Global Arctic distribution.** Country level distribution; select all that apply.
 - Canada
 - United States (Alaska)
 - Greenland
 - Scandinavia (including Svalbard)
 - European Russia
 - Siberian Russia (Europe border to the Kolyma River)
 - Far East Russia (east of the Kolyma River)
 - **Global Arctic distribution references (references used to score the above field)**
 - **Global Arctic distribution comments**
 - **Non-Arctic distribution in Canada and Alaska.** Select all that apply.
 - Nunavut
 - Northwest Territories
 - Yukon
 - Alaska
 - Newfoundland & Labrador
 - Prince Edward Island
 - Nova Scotia
 - New Brunswick
 - Quebec
 - Ontario
 - Manitoba
 - Saskatchewan
 - Alberta
 - British Columbia
 - Not present outside the Arctic in Canada and Alaska
 - **Non-Arctic distribution in Canada and Alaska references (references used to score the above field)**
 - **Non-Arctic distribution in Canada and Alaska comments**
 - **Global non-Arctic distribution.** Comma-separated list. This field should be scored primarily from the literature. Potential geographic regions to treat include: United States, South America, Europe, Asia (or Eurasia if in both), Africa, Australia. If taxonomic concepts in the Flora differ from those used elsewhere and it is not possible to reliably score non-Arctic global distribution, mention this in the comments field. If the distribution outside the flora area is localized to specific political units that are considered noteworthy, alphabetize the countries and place them in parentheses after their respective continent. If a taxon is not present outside the global Arctic ecozone, state this.
 - Example: Europe (Norway, Sweden); United States (Colorado).
 - **Global non-Arctic distribution references**
 - **Global non-Arctic distribution comments**
- **Illustrations.** References to publications or websites containing good illustrations, including the page number (e.g., Smith 2001:34) or URL.
 - **Illustrations**
- **Chromosome number information.** Cytological data should be included, with reference to the primary publications in which these data were originally reported. Only counts that are properly vouchered should be considered. If possible, vouchers

should be consulted and confirmed as to their identity. Chromosome counts by Löve & Löve should be avoided as most are not vouchered.

- **Chromosome number**
 - **Example:** 2n=62 (Smith 2001; Teller 2007), 2n=68 (Teller 2008)
- **Chromosome number voucher specimen data.** Optional; include citations as appropriate, and indicate if voucher specimen(s) are seen and confirmed.
- **Conservation status.** Species that have been designated as rare, threatened, etc., by provincial, territorial or federal governments should be identified as such. Since there are few such taxa in the Arctic flora, this information will be entered by the Museum Team; authors can complete these fields if desired.
 - **Conservation status: NatureServe Canada**
 - **Conservation status: NatureServe Canada global status last changed/reviewed.** The date the status was last revised.
 - **Conservation status: NatureServe Canada, global (G) comments.** If taxonomic treatments differ between the Flora and NatureServe Canada, include a comment about this.
 - **Example:** The taxon we treat here as *Elymus latiglumis* is reported in NatureServe Explorer as *Elymus alaskanus* ssp. *latiglumis*.
 - **Conservation status: NatureServe Alaska**
 - **Conservation status: NatureServe Alaska status last changed/reviewed.** The date the status was last revised.
 - **Conservation status: NatureServe Alaska, Global (G) comments.** If taxonomic treatments differ between the Flora and NatureServe Alaska, include a comment about this.
 - **Example:** The taxon we treat here as *Elymus latiglumis* is reported in NatureServe Explorer as *Elymus alaskanus* ssp. *latiglumis*.
 - **Conservation status NWT general status rank**
 - Secure
 - Undetermined
 - Sensitive
 - May be at risk
 - Alien
 - **Conservation status NWT general status rank comments**
 - **Conservation status COSEWIC**
 - **Conservation status COSEWIC comments**
 - **Conservation status Canada Species at Risk Act (SARA)**
 - **Conservation status Canada Species at Risk Act (SARA) comments**
 - **Conservation status U.S. Endangered Species Act**
 - **Conservation status U.S. Endangered Species Act comments**
- **Accepted Name in Previous Arctic Flora Treatments.** These data can be found in the Canadian Arctic Flora Taxonomy Database, but authors should confirm these. In instances where it is problematic to determine how a taxon was treated in an earlier work (due to differing taxonomic hypotheses, for example), fields can be left blank.
 - **Elven et al. 2011.** Panarctic Flora.
 - **Porsild and Cody 1980.** Vascular Plants of the Continental Northwest Territories.
 - **Aiken et al. 2007.** Flora of the Canadian Arctic Archipelago.
 - **Porsild 1955.** The Vascular Plants of the Western Canadian Arctic Archipelago.
 - **Porsild 1957.** Illustrated Flora of the Canadian Arctic Archipelago.
 - **Polunin 1940.** Botany of the Canadian Eastern Arctic

- **Cody 2000.** Flora of the Yukon Territory
- **Hultén 1968.** Flora of Alaska and Neighbouring Territories
- **Hultén 1941.** Flora of Alaska and Yukon
- **Wiggins and Thomas 1962.** A Flora of the Alaskan Arctic Slope.
- **Flora of North America.** Flora of North America series.
- **Flora of North America reference.** Include reference to treatment parenthetically so a reader can find it. Feel free to include the URL to the online version as well.

Worksheet 4: References cited in worksheets 1–3

- **References.**

Nomenclature (Worksheet 5)

The Flora project aims to include comprehensive synonymy. At a minimum, authors are required to treat all names that have been used in the major North American Arctic floras (see details in Appendix 1).

The Museum team has compiled a Taxonomy Database – a cross-referenced list of all names and synonyms used in major Arctic floras (over 6000 names), including (in most cases) standardized author abbreviations, protologue data, and complete reference information. Authors should use this database as a list of all names to consider. The complete Taxonomy Database will be available on the Flora website; authors may request from the Museum team a database specific to their taxonomic group including all names to consider in their group.

Authors first need to work out the taxonomy of their group, and make the decisions as to which species are accepted, and which names are synonyms or should be excluded. Authors must verify that the information in the taxonomy database is accurate, and are encouraged to include additional synonyms, as appropriate.

To complete the Nomenclature Worksheet (worksheet 5), authors may cut and paste from the Taxonomy Database. Nomenclatural information must be entered using the predefined categories for Flora data. If authors have nomenclatural data compiled in a different format, the Museum team can help parse these into the appropriate format. Taxa may be entered in any order.

As general guidelines: (1) authors of names should be abbreviated following Brummitt and Powell (1992) (use IPNI to determine standard forms); (2) names of publications should be cited in both full and abbreviated form; and (3) the full citation of the entire work in which nomenclatural information is presented should be provided. Full and abbreviated publication names will be used online, and abbreviations will likely be used in print. "Microcitations" compiled in nomenclatural databases and published in taxonomic works are typically at the level of the taxon rather than the article, journal or book. Full citations have not generally been compiled in taxonomic botany, but are important in digital environments when linking names to the primary literature.

Example:

Taxon

Agropyron violaceum (Hornem.) Lange var. *latiglume* Scribn. & J.G. Sm.

Microcitation

U.S.D.A. Div. Agrostol. Rep. Agrostol. 4. 30. 1897.

Full citation for the work in which the name was published

Lamson-Scribner, F.L. & Smith, J.G. 1897. Native and introduced species of the genera *Hordeum* and *Agropyron*. U.S. Department of Agriculture, Division of Agrostology Bulletin 4: 23-39.

Microcitation data must be parsed into the Nomenclature worksheet into the fields outlined below under Taxon publication information. The Museum team will enter or import full reference information into the Bibliography module on the Flora website and link them dynamically to their corresponding microcitation.

Note that the Taxonomy Database may include species that do not occur in our Flora region since most of the floras used to compile this database were not restricted to the arctic ecozone (e.g., Porsild and Cody 1980, Cody 1996). Authors should identify taxa and names that are not part of the Flora, and these should be excluded from the Flora. Brief comments as to why a name is excluded should be provided; this information will be communicated on the website.

Once a treatment is finished the Taxonomy Database will be updated by the Museum team to indicate whether names are accepted, synonyms, or excluded from the flora.

Worksheet 5: Nomenclatural Data (Accepted Names and Synonyms)

Worksheet 4 records nomenclatural data for taxa at any rank (family, genus, species, subspecies, variety). It includes nomenclatural details for accepted taxa and their synonyms. The Museum Team has compiled much of this information in Taxonomy Database; authors should work from this database, confirming the information as it is entered into treatments.

Because of the large number of synonyms in the Arctic flora, and the complexity inherent in defining interrelationships among accepted names, homotypic synonyms, heterotypic synonyms, basionyms and type specimen information, it is highly recommended that authors make multiple copies of worksheet 5 and complete one worksheet for each accepted taxon name and all of its synonyms. For families or genera with few species and no or few synonyms authors may choose to work in a single worksheet, whereas for genera with multiple species, each with multiple synonyms, authors are recommended to use a separate spreadsheet for each accepted species (or infraspecific taxon). The use of worksheet 5 is best illustrated with examples:

- A copy of worksheet 5 titled "5 - *E. alaskanus hyperarcticus*" in the example spreadsheet (AFCA Data Worksheets Example.xlsx) includes all nomenclatural data for the accepted taxon *Elymus alakanus* ssp. *hyperarcticus*. This worksheet has eight rows of data; of these, seven correspond to names that are synonyms of this taxon and one row contains data for the accepted name. Six names, including the accepted name, are based on the basionym *Agropyron violaceum* var. *hyperarcticum* Polunin and the non-accepted names are coded as homotypic (nomenclatural) synonyms of the accepted taxon name. One taxon, *Agropyron latiglume* var. *pilosiglume* Hultén, is based on a separate type specimen and is

coded as a heterotypic (taxonomic) synonym of the accepted taxon name. For each taxonomic name, data are compiled for usage (accepted or not), basionym, and publication information. For non-accepted names, the associated accepted name and unacceptability reason (e.g., nomenclatural or taxonomic synonym) is given. Type information is compiled only for basionyms. Taxa in a worksheet can be listed in any order.

→ A second copy of worksheet 5 titled "5 – Nomenclatural data for all taxa" in the example spreadsheet (AFCA Data Worksheets Example.xlsx) illustrates how compiling nomenclatural data for multiple species in a single worksheet can very quickly get complicated and confusing. (These data were initially compiled in multiple worksheets.) When compiled into a single worksheet, there are 65 rows of synonymy data corresponding to six accepted taxa at the genus, species and subspecies levels. The accepted taxa in this case are the accepted genera *Leymus* and *Elymus*, accepted species *Elymus alaskanus* and *Elymus violaceus*, accepted subspecies of *E. alaskanus* ssp. *alaskanus* and *E. alaskanus* ssp. *hyperarcticus*, and two *Leymus* taxa (*Leymus mollis* ssp. *villosissimus*, *Leymus innovatus* ssp. *velutinus*).

- **Nomenclature (Scientific Name)**

- **Taxon complete name.** Full name of lowest-level taxon in row including authors. This field will autocomplete based on data in the next six fields.
 - Example: *Agropyron violaceum* var. *latiglume* Scribn. & J.G. Sm.
- **Taxon (family)**
- **Taxon (genus)**
- **Taxon (species)**
- **Taxon (infrataxon)**
- **Rank.** Specify from drop down menu.
 - Family
 - Genus
 - Species
 - Subspecies
 - Variety
- **Authors.** For lowest-level taxon in row; use standard abbreviations.

- **Usage of names**

- **Usage.** Choose one of two choices.
 - Accepted
 - Not Accepted
- **Associated accepted name.** The accepted name for the taxon in the Flora.
- **Unacceptability reason.** There are 15 choices; choose one from drop down menu. These fields are pre-defined in the Scratchpad nomenclature module and we cannot modify them.
 - Synonym
 - Homotypic (nomenclatural) synonym
 - Heterotypic (taxonomic) synonym
 - Basionym. If the basionym is not the accepted name, it should be included as a synonym.
 - Homonym (illegitimate)
 - Superfluous renaming (illegitimate)
 - Rejected name
 - Invalidly published, nomen nudum
 - Invalidly published, other
 - Misapplied

- Pro parte
 - Horticultural
 - Database artefact
 - Orthographic variant (misspelling)
 - Other
- Unacceptability reason comments
- **Basionym**
 - **Basionym.** If a row treats a name that is a basionym, leave the cell blank.
- **Taxon publication (protologue) information.** Most of these data can be obtained from the Taxonomy Database.
 - **Publication name (full)**
 - **Publication name (abbreviated)**
 - **Publication volume page date.** Format: [volume(issue)]: [page]. [date].
→ Example: 4: 12. 1902.
 - **Publication full reference**
 - **Bibliographic citation comments**
- **Type species for family and genera.**
 - **Type species.** Full species name including authors.
→ Example: *Agropyron violaceum* (Hornem.) Lange.
 - **Typification data**
→ Example: Lectotype selected by Smith, Botany 34:652. 2011
 - **Typification full citation.**
→ Example: Smith, A.B. 2011. A lectotype for the genus Abracadabra. Botany 34: 649-653.
- **Type specimen information for species and infraspecific taxa.** Complete for all names that are basionyms.
 - **Type specimen collection data.** Use a colon after the country, and separate all additional information with commas.
→ Example: Canada: Nunavut, Ellesmere Island, Goose Fiord, 76°29'N, 88°40'W, 7 m, 20 July 1901, H. G. Simmons 2888
 - **Holotype.** Location of holotype. Include herbarium acronym and specimen accession number, and/or other identifier if available. If the author has seen the specimen or an image of the specimen, include "!" to indicate this. Include the URL to an online image if available. Use this format for all type specimens below.
→ Example: CAN-123456!, <http://abcd.efgh.ca>
 - **Isotype(s)**
 - **Syntypes**
 - **Lectotype**
 - **Isolectotype(s)**
 - **Epitype**
 - **Isoepitype(s)**
 - **Neotype**
 - **Isonotype(s)**
 - **Typification Data**
→ Example: Lectotype designated by Elven and Al-Shehbaz, Novon 18: 326. 2008.
 - **Typification Full Reference**

→ Example: Elven, R., Al-Shehbaz, I.A. 2008. *Draba simmonsii* (Brassicaceae), a new species of the *D. micropetala* complex from the Canadian Arctic Archipelago. *Novon: A Journal for Botanical Nomenclature* 18: 325-329. doi: 10.3417/2007178

○ Typification Comments

Specimen Citations and Distribution Maps (Worksheet 6)

Specimen Data — The Flora project aims to keep track of all herbarium specimens examined by authors in preparing their treatments, something that most large flora projects in the past have been unable to accomplish. Distribution maps are generated automatically from the specimen data uploaded to the Flora website. It is therefore important that authors provide the Specimens Examined worksheet with up-to-date determinations in a timely fashion so the Museum Team can upload it to the website.

Specimen data are entered into worksheet 6 and will be uploaded into the 'Specimens' module in the Flora website. In general, only data for specimens seen and confirmed by treatment authors (or members of the Arctic Flora Research Team for taxa that are not problematic taxonomically) will be uploaded. The Museum Team will assist authors in compiling the worksheet (e.g., reformatting specimen databases and digitizing specimen images) upon request.

Authors must examine specimens from the following herbaria: ALA, CAN, and DAO. It is strongly recommended that authors examine specimens from additional herbaria including: CAS (*Wiggins & Thomas* collections, Alaska North Slope), MT (northern Quebec), QFA (northern Quebec), US (especially for historical Alaskan material), TRT (Hudson Bay region of Ontario), TRTE (Hudson Bay region of Ontario, Ellesmere Island), UBC (Yukon, N.W.T.), WIN (Hudson Bay region of Manitoba), and WTU (Alaska). How many and which additional herbaria to consult will depend on the distribution and abundance of the taxon treated. Ideally all collections from the Flora area should be examined, but realistically this may not be possible or necessary. At a minimum a sufficient number of collections from across the range should be examined for the distribution to be reliably described and mapped, and for intraspecific variation to be adequately documented.

Authors may make or confirm identifications based on digital images of herbarium specimens where possible (e.g., easily identified taxa with no taxonomic problems). Eventually, we may be able to link specimens cited on the Flora website to their records on the websites of their herbaria of origin, so specimen images can be accessed if they exist.

On-line resources for Arctic collections (many with specimen images) include:

- University of Alaska Museum of the North Herbarium (ALA) - (<http://arctos.database.museum/SpecimenSearch.cfm>)
- Consortium of Pacific Northwest Herbaria - <http://www.pnwherbaria.org> [includes BABY (Yukon), NY, UBC, V, WTU]
- University of Alberta Vascular Plant Herbarium (ALTA) - <http://vascularplant.museums.ualberta.ca/>
- United States National Herbarium, Smithsonian Institution (US) - <http://collections.mnh.si.edu/search/botany/>
- Canadian Museum of Nature (CAN) – forthcoming, anticipated Fall 2012.
- Global Biodiversity Information Facility (GBIF) – <http://www.gbif.org/>

A good place to start when looking for type specimen data online is JSTOR Plant Science: <http://plants.jstor.org>

Digital collection data should be available for the majority of collections examined. Specimen databases in the appropriate format will be provided with loans from (or visits to) CAN, DAO, and ALA (full data for all specimens may not yet be available). For databased specimens from other institutions, authors should request databases for their taxa; the Museum team can assist in formatting these data into Worksheet 6 format. For specimens that are not digitized, authors should take digital photographs of all specimens that they examine and annotate, and provide these to the Museum team for data entry. Alternatively, authors may enter the data directly into worksheet 6 in the prescribed format (this may be more efficient in some instances, particularly when there are only a small number of specimens require digitization).

For each specimen examined authors must enter the correct determination, the identifier, date identified (year), and the reproductive state into the Specimen Examined Worksheet. If the existing determination is correct, authors must indicate in the spreadsheet that they have seen the specimen and agree with the determination. If data are available for specimens that have not been seen by a treatment author, these can be included as long as the identifier and date identified are filled in, which provide some insight into the reliability of the determination. Material determined recently by other experts (for other projects, for example) is particularly desirable for inclusion.

At a minimum for each species, specimens will be mapped for the Flora region, and the adjacent Hudson Bay coastal zone south of the main flora boundary. In addition, authors are encouraged to provide annotated specimen data for adjacent areas, including non-Arctic Alaska, Northwest Territories, Nunavut, Manitoba, Ontario, Quebec, Labrador, Greenland, and elsewhere. All specimen data provided will be mapped, but maps will be considered to be complete only for the Flora region. For specimens that are databased but not georeferenced, the Museum Team will investigate efficient ways to batch georeference large numbers of specimens.

Reproductive State — Authors should provide the reproductive state (flower bud, flower, immature fruit, fruit, vegetative for angiosperms; reproductive and vegetative for monilophytes and lycophytes) for each specimen examined. This will provide invaluable data for determining species phenology, and how phenology may vary with latitude, elevation, and on a regional scale. Simply giving months for flowering and fruiting times, as standard in most floras, is inadequate for an Arctic flora due to the extremely short growing season. Species flowering and fruiting times in the Arctic are typically not restricted to a specific period, but rather may vary considerably with elevation, latitude, and the length and temperature of a particular growing season.

Worksheet 6: Specimens Examined

Specimen data obtained from herbarium databases does not need to be massaged into the format prescribed below by authors; the Museum team will do this so it can be uploaded to the Flora website. However, authors should be sure to include and fill in "Identified by" and "Year identified" columns, and columns scoring reproductive state. All newly entered data should use the format below.

- **Specimen Data** (leave fields blank if data not available or not applicable)
 - **Institution code.** According to the Biodiversity Collections Index: <http://www.biodiversitycollectionsindex.org/static/index.html>
 - **Collection code.** Herbarium acronym according to Index Herbariorum.
 - **Catalog number.** Specimen accession number.

- **Taxonomic name.** Do not include authors; infraspecific taxa should be noted with either ssp., var., or f. (these are the abbreviations required by the Scratchpad website software).
- **Identification qualifier/modifier** (e.g., cf.)
- **Identified by.** This field must always be entered by the author.
- **Year identified.** This field must always be entered by the author.
- **Collector number**
- **Collector(s).** Enter all collectors in a comma-separated list. Include authors last names and initials. Enter last name first followed by initials, and separate collectors with a semi-colon. E.g., Saarela, J.M.; Gillespie, L.J.
- **Date (or earliest date) collected.** Format: 16 Aug 2012 (abbreviate month)
- **Latest date collected** Format: 16 Aug 2012 (abbreviate month)
- **Location node.** The location node for each specimen links to the location name field (below) for each location. Leave this field blank; it will be filled out by the Museum team.
- **Angiosperm reproductive state.** This field (or the following) must always be entered by the author. More than one field can be selected.
 - Reproductive state
 - Flower bud
 - Flower
 - Immature fruit
 - Fruit
- **Monilophyte/lycophyte reproductive state.** This field (or the previous field) must always be entered by the author. More than one field can be selected.
 - Vegetative
 - Reproductive
- **Location Data.** Leave fields blank if data are not available or not applicable.
 - **Location name.** Leave blank; this will be filled out by the Museum team. The location node for each specimen links to the location name for each location. This field and the location node field above must be exactly the same to map the specimen.
 - **Continent.** For collections from North America enter Northern America; this awkward wording is required by the website software.
 - **Country**
 - **Territory/province/state**
 - **Island**
 - **Locality.** The specific location where the specimen was collected.
 - **Geographical Coordinates.** Enter data in the format present on the specimen (degrees minutes seconds; degree decimal minutes; decimal degrees; UTM). Decimal degree minutes (DDM) is required for upload to the website. The Museum team will convert coordinates to DDM as necessary.
 - Latitude (Degrees)
 - Latitude (Minutes)
 - Latitude (Seconds)
 - or-
 - Latitude (Degrees)
 - Latitude (Decimal Minutes)
 - or-
 - Latitude (Decimal Degrees)
 - or-

- **Latitude (Other)** (e.g., UTM coordinates including projection, latitude range)
- **Longitude (Degrees)**
- **Longitude (Minutes)**
- **Longitude (Seconds)**
- or–
- **Longitude (Degrees)**
- **Longitude (Decimal Minutes)**
- or–
- **Longitude (Decimal Degrees)**
- or–
- **Longitude (Other)**
- **Geodetic Datum.** Optional, enter if available.
- **Verbatim Coordinate System.** Specify the coordinate system for coordinates entered: degrees minutes seconds; degree decimal minutes; decimal degrees; UTM.
- **Coordinate Source.** Specify from drop-down menu if coordinate data are primary (obtained from the specimen label) or secondary (georeferenced).
- **Georeference Protocol / Comments.** Optional.
 - Example: Georeferenced with Biogeomancer.
- **Coordinate uncertainty in meters**
- **Elevation or minimum elevation in meters**
- **Maximum elevation in meters**

Descriptions (Worksheets 7–9)

A digital flora requires descriptions in a database or spreadsheet format. This will help authors and editors ensure that descriptions are fully parallel, and will greatly facilitate development of interactive keys in the future. Text descriptions will be generated from data in spreadsheets. Assistance in parsing descriptions can be provided to authors who already have text descriptions developed (e.g., from recent FNA or other flora treatments). Contact the Museum team if help is desired.

At minimum, descriptions must be parallel as follows:

- 1) All family descriptions must be parallel;
- 2) All genus descriptions within a family must be parallel;
- 3) All species descriptions within a genus must be parallel;
- 4) All subspecies descriptions within a species must be parallel.

Descriptions should be of intermediate length, more than simply diagnostic, but less than monographic. A species description should provide a good overall general description of a species (so one has a good impression of what the plant looks like) plus include key characters that distinguish species within a genus.

Family, genus, and species/subspecies descriptions are developed in separate worksheets. Each worksheet records data for one or multiple taxa at a rank.

Worksheet 7: Family Descriptions

A family spreadsheet template will be developed by the Museum team and distributed to authors. Authors will work with the Editorial team if they feel that a modification to the family template is necessary in order to include characters of importance for distinguishing and characterizing their family(ies).

Worksheet 8: Genus Descriptions

- Genus description (spreadsheet format).
- Worksheet will be developed by family authors in conjunction with the Museum team.
- Genus descriptions must be strictly parallel within a family.

Worksheet 9: Species and Subspecies Descriptions

- Worksheets will be developed by family authors in conjunction with the Museum Team (see Appendix 3 for two examples and templates). Description spreadsheets are provided on the Flora website [here](#): one for species of *Salix* (AFCA Salix Example_final.xls) and one for species of *Draba* (AFCA Draba Example _final.xls).
- One worksheet for all species in a genus.
- Species descriptions must be strictly parallel within a genus.
- Subspecies descriptions must be strictly parallel within a species.

Genus and species description worksheets will not be provided, since they will vary considerably among groups. Authors should work closely with the Editorial Team to develop genus and species description worksheets specific to their family (or group of morphologically similar related families) and tailored to their needs. For small families with several monotypic or small genera, one species description worksheet for the family is recommended. This would ensure parallel descriptions across the family, and would also ease the task of generating text descriptions.

Terminology—Terminology used in Flora descriptions will follow Kiger et al's.(2001) *Categorical Glossary for the Flora of North America Project*. Where there is a choice among terms having the same or similar meanings, it is recommended that the more precise term be used. For example, use abaxial/adaxial (e.g., for leaves) rather than lower/upper or dorsal/ventral. For two equally precise terms, the less technical term is generally preferred. For example, use odd-pinnate rather than imparipinnate, clasping rather than amplexicaulous, cross-shaped rather than cruciate, spreading rather than patent, porrect or salient. The exception would be when the technical term is commonly used and understood, e.g., crenate rather than scalloped, serrate rather than sawtoothed. Rarely used highly technical terms should be avoided where possible; if these must be used for precision then a definition should be provided. Authors who wish to use terms not included in the Categorical Glossary will need the approval of the Flora Editorial Team.

Description Spreadsheets—Each column in the description worksheets should contain only a single character. Having characters fully parsed allows the database to be easily searchable; it is much easier to put data together into a text string than to go the other way and parse text into discrete characters after the fact. For all species, states must be given for all characters (i.e., no empty cells!), unless a particular character does not apply (e.g., petal colour if petals are absent).

All character states known for a species in the flora area should be described. Avoid the use of "to" as in "acute to rounded"; instead, provide all states, e.g., "acute, obtuse, or rounded". Also avoid the use of the terms "usually" and "often", e.g., "usually acute", instead give all states, e.g., "acute, rarely obtuse". What is typical or usual is the default condition. Negative character states should be avoided, e.g., "not papillose"; instead, describe the condition, e.g., "smooth".

For size characters, quantitative rather than qualitative states should be given. For example, provide exact numbers or ranges of numbers, rather than using "several", "many", or "numerous". Similarly, give numeric ranges for lengths, rather than using imprecise terms such as "short", "long", "longer than", etc.

Character order will follow *Flora of North America Guide for Contributors* (Flora of North America Editorial Committee 2008) with minor modifications (e.g., pedicel description will be part of the inflorescence paragraph, rather than treated as a separate bolded heading). Refer to Appendix 2 for a character order template. Characters should be ordered in the worksheet in the order they are to appear in the text description.

Two examples of species description spreadsheets are provided in Appendix 3. The first worksheet in each spreadsheet is the description worksheet, the second is the text description generated from the description worksheet (discussed below). Both examples were generated from existing FNA descriptions and do not include all species in the genus (some characters do not vary in the examples, but would across the genus as a whole in the Arctic). For some species character states are missing and cells were filled in with "[need state]" to emphasize that all descriptions should be parallel.

Descriptions for taxa at all ranks should be based on character states found in the Flora area, as much as is possible. In cases where authors have descriptions in hand based on Arctic and extra-Arctic material, these should be modified as much as is possible and appropriate to reflect the range of variation in the Flora region. For each taxon description brief comments should be included in a separate comment field describing in general the origins of the material used in writing the description. This will help users understand how the descriptions were generated. Label this column "Origin of material used for description" (the column must be added manually since the description templates are generated by authors).

Examples:

- The description is based on specimens from within the Flora region.
- The description is based on the few available specimens collected in the Flora region, and material from adjacent boreal regions in the Northwest Territories and Nunavut.
- The description is based on specimens from the global Arctic range of the taxon (North America and Russia).

Major morphological variation in a taxon (family, genus, species, subspecies) outside the Flora region should be described in a comment field; this variation should not be included in the description. Label this column "Morphological variation outside Flora region". References should be included as appropriate (e.g., a reference to an FNA treatment, a taxonomic revision, etc.). Please provide the full citations for these references in your treatment so we can add them to the website bibliography.

Examples:

- In the boreal portion of its range in North America, *Populus balsamifera* grows as a large tree (e.g., Farrar 1995).

- Outside the flora region, plants of *Carex saxatilis* are usually taller, with longer and broader leaves, and more perigynia per spike (Ford and Ball 1992).

In cases where there is potential for ambiguity in interpreting how a character was measured or interpreted in generating descriptions, a brief explanation should be included in the genus or species comments section (worksheets 2 and 3, respectively), as appropriate.

Example:

- Perigynium beak lengths are measured from the apex of the achene to the apex of the beak.

Upon submission, completed description worksheets will be internally reviewed and edited, if necessary, by the Editorial Team. Once accepted the Museum team will generate a text description from the description worksheet (see Appendix 3, worksheet 1–description worksheet; worksheet 2–text description). On the website descriptions will be displayed in 5 paragraphs: Habit (plus all vegetative features except for leaves), Leaves, Inflorescences, Flowers, and Fruit.

Taxonomic Keys

The Flora will initially include standard, text-based dichotomous keys to families, genera, and species. A dichotomous key should be included for each taxon with two or more taxa. Keys to infraspecific taxa (subspecies and varieties) should be included in the key to species. Our long term goal will be to develop interactive keys to families, and to genera and species within families.

Within a couplet the most important key characters should be listed first. Ecology and distribution, if given, should always be listed last, and are not to be used as the main key characters.

Keys should be prepared in a word processor in text format and should be in a bracketed format. When constructing keys, leads of each couplet must be fully parallel. Data in a key must be identical and/or consistent with data in descriptions. Identify leads in couplets numerically as 1 and 1, 2 and 2, etc. Leads with fewer subordinate couplets always come first. If necessary, a taxon may be keyed out more than once. In such cases, indicate the number of times the taxon occurs in the key parenthetically after the species name.

When a species is keyed out, or the number of a next lead is listed, insert the boldfaced species name or next lead number in the key, preceded by five periods and one space (see Example). Keys will be formatted further by the Museum team prior to posting on the web.

Example: Key to species of the *Draba micropetala* complex (adapted from Elven & Al-Shehbaz 2008)

1. Fruits densely pubescent with (2 to)5- to 12-rayed trichomes; stigma considerably wider than style; petals white; cauline leaves 2, 1, or absent **D. oblongata**
1. Fruits moderately to sparsely pubescent with a mixture of simple and 2-rayed trichomes; stigma about as wide as style; petals pale yellow or pale reddish yellow; cauline leaves absent **2**

2. Petals narrowly obovate, (3.5–)3.8–5.5(–5.8) × (2.5–)2.8–4(–4.6) mm, with non-parallel sides; sepals (2.5–)2.8–3.5(–3.8) mm; fruits lanceolate; subapical abaxial leaf surface with predominantly simple and some dendritic trichomes ***D. simmonsii***
2. Petals narrowly spatulate to oblanceolate, 2–3 × 0.7–1.5 mm, with parallel sides; sepals 1.8– 2.5 mm; fruits obovate-oblong, elliptic, or elliptic-ovate; subapical abaxial leaf surface with forked, stellate, and some simple trichomes **3**
3. Leaf apices obtuse or rounded, with predominantly cruciform trichomes; infructescence rachis somewhat flexuous, elongating; petals pale yellow; fruits elliptic to elliptic-ovate ***D. micropetala***
3. Leaf apices subacute, with simple or forked trichomes; infructescence rachis straight, not elongating; petals pale reddish yellow; fruits obovate-oblong ***D. pauciflora***

Illustrations

Illustrations are expensive but extremely helpful for identification. Ideally the Flora will contain full or partial illustrations for all taxa. Our ability to commission new illustrations for the Flora will depend on available funding. If new illustrations for some or all taxa are not possible, we will explore obtaining permission to use existing, high-quality illustrations (e.g., from the Flora of North America or other copyright holders). There is also a possibility of using images that are in the public domain. Using illustrations produced by multiple artists is not ideal for a single-volume, owing to differences in style, but we view this approach as being better than no illustrations.

Images

Authors are encouraged to provide high quality (and preferably vouchered) images of Arctic plants for the Flora website. Images can be submitted for taxa that authors are treating, or other taxa in the flora treated by others. We aim to include images that show taxa in different habitats throughout their Arctic ranges, particularly in the Flora region. Images of diagnostic characters (e.g., from herbarium specimens) are also welcome. Images should be sent to the Museum team for uploading to the website.

For each image, metadata should be included as follows: brief description of the photo including the scientific name of the taxon, the name of the person who identified the taxon in the image (particularly if the image is not vouchered or if the voucher specimen data are not available on the website); photographer, copyright holder, voucher information (collectors, collector number and herbarium to facilitate linking with the complete record, which should be included a specimen record), location including geographic coordinates if available (be as precise as possible, particularly if image is not vouchered or the voucher specimen data is not available on the Flora website). The [Audubon Core](#) metadata standard will be used.

Example:

- Close-up image of *Gentianella propinqua* in habitat. Photo: Jeffery M. Saarela © Canadian Museum of Nature. Voucher specimen: Canada, Northwest Territories, Victoria Island, Minto Inlet, 71°29' 19.1"N, 117°21'36.7"W, Gillespie, L.J., Saarela, J.M., Doubt, J., Bull, R.D. and Sokoloff, P.C. 9619 (CAN596175). Identified by L.J. Gillespie, 2011.

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Appendix 1 – Taxa to be treated in the Arctic Flora

The Museum team has compiled into a list (referred to as the Taxonomy Database) of some 6000 names that have been applied to taxa within or adjacent to the Arctic Flora region, and cross referenced these among 14 different floristic treatments. Authors must account for all names in this list that apply to the groups they are treating. Names that are accepted names for or synonyms of taxa that do not occur in the Flora region should be communicated to the Museum team so these can be removed from the working species list. Names that are synonyms or accepted names for taxa in the Arctic Flora region should be recorded in worksheet 5.

For a majority of the names in this list we have downloaded "microcitation" protologue data and links to their protologues in the Biodiversity Heritage Library, using the Tropicos name matcher tool.¹ We are working to clean up these data to ensure consistency in standard form for authors and publications, format for citing protologue information, and we are correcting errors as we find them. We are also working to figure out the full citations for these names, so that individual authors do not have to spend much effort on this time consuming work. It is much more efficient for a few workers to gather this information from a master list than for multiple authors to spend time trying to locate the same references. Authors should consult and use these data when they being work on their treatments. We will eventually provide these data on the Flora website. Contact the Museum Team for a list of names to be considered for your treatment(s).

The taxonomic name list is based on the following Arctic floras and several recent papers summarizing new floristic information for Northwest Territories and Nunavut. Relevant names that are not in this list should be treated, as appropriate, particularly those that are very recent. The Editorial team will cross check names in completed treatments with names in this list to ensure all are accounted for.

All taxonomic names used in the following resources should be accounted for in the Arctic Flora:

- Aiken, S.G., Dallwitz, M.J., Consaul, L.L., McJannet, C.L., Boles, R.L., Argus, G.W., Gillett, J.M., Scott, P.J., Elven, R., LeBlanc, M.C., Gillespie, L.J., Brysting, A.K., Solstad, H. & Harris, J.G. (2007) *Flora of the Canadian Arctic Archipelago: Descriptions, Illustrations, Identification, and Information Retrieval [CD-ROM]*. NRC Research Press, National Research Council of Canada, Ottawa. <http://nature.ca/en/research-collections/our-research/areas-expertise/botany/flora-canadian-arctic-archipelago>
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¹ See <http://tropicosdev.blogspot.com/2011/02/name-matching.html> and <http://www.tropicos.org/NameMatching.aspx>

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- Welsh, S. (1974) *Anderson's Flora of Alaska and Adjacent Parts of Canada*. Brigham Young University Press, Provo, 724 pp.
- Wiggins, I.L. & Thomas, J.H. (1962) *A flora of the Alaskan Arctic Slope*. University of Toronto Press, 425 pp.
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Appendix 2 – Order of characters in descriptions

Characters in the description worksheets should follow the order below, modified from *Flora of North America Guide for Contributors* (Flora of North America Editorial Committee 2008).

Growth Form, persistence, habit, nutrition. **Roots** and/or other belowground parts. **Stems** general; trunks; bark; wood; branches, shoots; twigs; buds.

Leaves general arrangement; stipules; petiole; leaf blade; lobes; higher-order axes and petiolules; leaflets; modified leaflets.

Inflorescences general position, type; peduncle; branches (i.e., description of higher-order axes); bracts; pedicels.

Flowers general (including sexuality); receptacle and hypanthia; perianth (tepals) or calyx (sepals) and/or corolla (petals); glands and/or discs; androecia (at flowering); gynoecia (at flowering).

Fruits general type; aggregation of or division within fruit; fruit or mericarp structure; accessory structures; multiple fruit structure. **Seeds** external structures, internal anatomy; germination, abortion; endosperm; embryos.

For a particular structure or organ system, describe parts in the following order:

presence, number, position/insertion, arrangement, orientation, connation, adnation

Describe features of a whole organ in the following order:

colour, odor, symmetry, architecture, venation, shape, dimensions (length, width, thickness), texture, base, margins, peripheral region, central area, apex, surface, vestiture, internal parts, exudates

Appendix 3 – Description worksheet examples

Two examples of species description spreadsheets are provided on the Flora website [here](#): one for species of *Salix* (AFCA Salix Example.xls), the other for *Draba* (AFCA Draba Example.xls),

The first worksheet in each spreadsheet is the description worksheet, the second is the text description generated from the description worksheet (discussed below). Both examples were generated from existing FNA descriptions and do not include all species in the genus (some characters do not vary in the examples, but would across the genus as a whole in the Arctic). For some species character states are missing and cells were filled in with “[need state]” to emphasize that all descriptions should be parallel.

The two example *Salix* descriptions below were generated dynamically from these spreadsheets (using fairly complicated formulas in Excel). Descriptions will be posted on the website species pages in this format.

Salix

Salix arctica

Habit: Shrubs 0.03–0.25 m, not clonal or forming clones by layering. **Stems** erect, decumbent, or trailing; branches yellow-brown, gray-brown, or red-brown, strongly glaucous or not, glabrous; branchlets yellow-brown, red-brown, or violet, strongly glaucous or not, densely villous or pilose (usually appearing unkempt), sometimes glabrous.

Leaves: stipules absent, rudimentary, or foliaceous; petiole 2–35 mm, longer than subtended bud, [need state]; largest medial blade hypostomatous or hemiamphistomatous, narrowly to broadly elliptic, subcircular, circular, oblanceolate, obovate, or broadly obovate, 10–85 mm x 5.5–60 mm, 1–3.6(–4.9) times as long as wide, base cuneate, convex, or rounded, margins slightly revolute or flat, entire, apex acuminate, acute, convex, or rounded, abaxial surface pilose, adaxial surface slightly glossy or dull, glabrous, pilose or long-silky on margin; proximal blade margins entire; juvenile blade abaxial surface glabrous or sparsely villous.

Inflorescences: **Staminate catkins** 14–65 mm x 5–18 mm; flowering branchlet 2–36 mm long. **Pistillate catkins** densely to moderately densely flowered, slender, stout, or subglobose, 20–145 mm x 8–22 mm; flowering branchlet 2–40 mm long; floral bract brown or black, 1.6–3.7 mm long, apex broadly rounded, convex, or retuse, margin entire, sinuate, or 2-fid, abaxial surface hairy, hairs straight.

Flowers: **Staminate flowers** abaxial nectary present, (0–)0.3–0.8 mm long, adaxial nectary narrowly oblong, oblong, or square, 0.5–1.2 mm long, nectaries distinct; filaments distinct, [need state]; anthers ellipsoid, 0.3–0.9 mm long. **Pistillate flowers** abaxial nectary absent, adaxial nectary oblong, ovate, or narrowly oblong, 0.4–1.8 mm long, much longer than stipe, [need state], [need state]; stipe 0.2–1.6 mm; ovary obclavate or pyriform, villous, [need state], beak abruptly to gradually tapering to or slightly bulged below styles; ovules 12–15 per ovary; styles connate to distinct 1/2 their lengths, 0.6–2.2 mm long; stigmas slenderly cylindrical, 0.35–0.56–0.88(–1.13) mm long.

Fruits: capsules 4–9 mm long.

Salix arctophila

Habit: Shrubs 0.03–0.15 m, forming clones by layering. **Stems** prostrate, long-trailing; branches yellow-brown, red-brown, or green-brown, not glaucous, glabrous; branchlets yellow-green or yellow-brown to red-brown, sometimes weakly glaucous, glabrous.

Leaves: stipules rudimentary, absent, or foliaceous (early stipules), foliaceous or rudimentary (late stipules); petiole (3–)7.8–15 mm, [need state], [need state]; largest medial blade hypostomatous or hemiamphistomatous, elliptic, obovate, broadly elliptic, broadly obovate, subcircular, or oblanceolate, 15–31–60 mm x 6.5–16–35 mm, 1.2–3–4.3 times as long as wide, base cuneate, convex, or rounded, margins slightly revolute, inconspicuously crenulate or entire, apex usually acute or convex, sometimes rounded, abaxial surface glabrous, adaxial surface slightly or highly glossy, glabrous; proximal blade margins entire or serrulate; juvenile blade abaxial surface glabrous.

Inflorescences: **Staminate catkins** 19–54 mm x 7–16 mm; flowering branchlet 4–20 mm long. **Pistillate catkins** densely to moderately densely flowered, slender, stout, or subglobose, 30–79(–130 in fruit) mm x 10–20 mm; flowering branchlet 8–57 mm long; floral bract brown, black, or bicolor, 0.8–2.4 mm long, apex rounded or acute, margin entire, abaxial surface densely hairy, hairs straight.

Flowers: **Staminate flowers** abaxial nectary absent, [need length] long, adaxial nectary oblong, square, narrowly oblong, or ovate, 0.4–1 mm long, nectaries [need state]; filaments distinct or connate less than 1/2 their lengths, glabrous or hairy on proximal 1/2; anthers ellipsoid or long-cylindrical, 0.5–0.7 mm long. **Pistillate flowers** abaxial nectary absent, adaxial nectary oblong or narrowly oblong, 0.5–0.9 mm long, shorter than stipe, [need state], [need state]; stipe 0.8–1.4 mm; ovary pyriform or obclavate, pubescent or short-silky, crinkled, often refractive, ribbonlike, beak gradually tapering to styles; ovules 8–16 per ovary; styles connate or distinct 1/2 their lengths, 0.6–1.4 mm long; stigmas slenderly or broadly cylindrical, 0.24–0.47–0.72 mm long.

Fruits: capsules 5–9 mm long.