# THE NORTHWEST TERRITORIES VIRTUAL HERBARIUM

# PROTOCOLS AND METADATA

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# ABSTRACT

The NWT Virtual Herbarium was initiated to store information, in a digital form, on plants collected or photographed in the NWT. Botanists have been collecting plant specimens in the NWT for the past 150 years. These specimens have been stored with a wealth of information on habitat, site descriptions and, in most cases, with location information. In 2007–2008, almost all the plant specimens available at the Agriculture and Agri-Food Canada herbarium in Ottawa were photographed and the information on each label was entered into a database. The procedures, standards, fields, and update protocols are described.

The NWT Virtual Herbarium can be updated and extended to include any other sets of photographs and label information of vascular plant specimens collected and stored in a recognized institution with botanical expertise. Data on other vascular plants photographed in the NWT that have been verified as correctly identified by a knowledgeable naturalist or botanist can also be added if suitable location information and associated data are provided.

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# INTRODUCTION

Northern studies are very expensive. Most analyses related to long-term changes in northern ecosystems and cumulative impact assessments gain in relevance with large sets of historical data and large geographic coverage. For plant species in the NWT, these large-scale historical data are available at herbaria in North America, the United States, and Europe, especially England (Porsild and Cody, 1980).

Botanists have been collecting plant specimens in the NWT for the past 150 years. These specimens have been stored with a wealth of information on habitat, site descriptions and, in most cases, with location information. Some of that historical information was collected with the help of northern Aboriginal people to ensure that local and traditional knowledge on plant distribution and biology can be preserved.

This historical information is stored in the form of dried, pressed plant specimens with associated data labels in museums, universities, and government departments across North America and other countries, but in particular in Canada, the United States, and England. One institution has received the most specimens of NWT plants: the National Collection of Vascular Plants (Herbarium) at Agriculture and Agri-Food Canada (DAO) in Ottawa. This occurred because William Cody, one of the authors of the sole comprehensive work on vascular plants in the NWT (Porsild and Cody, 1980), worked at DAO for 40 years. Cody himself, and later most botanists working in the NWT, placed

voucher specimens resulting from their studies for permanent storage at DAO. The Canadian Museum of Nature (CAN) also contains many NWT plants.

Currently, no NWT-based institution has the capacity to store botanical specimens relevant to the NWT. Each year, many agencies, firms and botanists send voucher specimens to CAN and DAO for permanent storage and taxonomic verification. These institutions have never been fully funded to transfer all plant label data that they archive into a digital format. Consequently, almost none of this important and expensive information is easily available to NWT researchers, institutions, and communities.

During the past decade, with the advent of Geographic Information Systems (GIS), other jurisdictions such as Yukon, and other organizations such as NatureServe, have invested time and money to retrieve label information from museums. This information now forms an essential part of their own GIS capacity and information systems, which in turn allow for analyses of long-term environmental changes and cumulative impact assessments.

The aim of the Northwest Territories Virtual Herbarium is to store, in digital form, the following:

1. Photographs and label information of all vascular plant specimens collected and stored in a recognized institution with botanical expertise.
2. Other available photographs, location information, and associated data of vascular plants from the NWT.

The NWT Virtual Herbarium will increase the capacity to perform analyses on the distribution of vascular plants in the NWT, to study the timing of introduction of exotic plant species, and to map the distribution of rare vascular plants and compare this to proposed protected areas and developments.

NWT communities, management authorities, researchers, and environmental assessment practitioners will have access to these important data (databases and digital images) in a form that is easily available to them for analysis. The urgent need for current analytical maps of vascular plants in Northern Canada has also been recognized at the national and international levels as well as in the NWT. The database, so far, will be used to:

- Help in the risk analysis of invasive alien plant species in the NWT as part of the Invasive Alien Species Strategy for Canada.
- Provide up-to-date occurrence data on vascular plants for the NWT General Status Ranking Program.
- Provide search effort information for vascular plants and location data that can be used in future COSEWIC reports for plant species that may be at risk in the NWT.
- Provide data and maps for the NWT State of the Environment Report and Canada's Ecosystem Status and Trends Report.
- Provide data for the NWT Protected Areas Strategy – Special Elements analyses.
- Provide maps and data to the Flora of North America project.

- Provide maps and data to the Circumpolar Biodiversity Monitoring Program and the 2010 Arctic Assessment led by the Arctic Council.

# METHODS

Data retrieval follows two procedures:

A. Acquisition of information already digitized by institutions

B. Digitization of herbarium specimens at institutions

## A. Acquisition of information already digitized by institutions

Some institutions have invested in digitizing voucher specimens. These data are searched on the Internet and if available, they are acquired either freely or using a data acquisition agreement. These data are then included in the NWT Virtual Herbarium.

## B. Digitization of herbarium specimens at institutions

Some institutions have not digitized voucher specimens, or have transferred only portions of label information into databases for some specific use, such as publications or analytical projects. Institutions with a large number of NWT plant specimens are prioritized, and if appropriate, time and funds are invested in digitizing NWT specimens for inclusion in the NWT Virtual Herbarium. E. Haber developed the methods used to digitize specimens as follows.

### Method of Data Capture

To facilitate specimen documentation, folders of herbarium specimens are removed from the collections alphabetically and photographed with a digital camera to record all of the data on each sheet (Figure 1). Images were captured

mainly at a resolution of five megapixels. This provided adequate resolution for enlargement and viewing and resulted in a modest size of the digital images (about one megabyte). The autofocus of the digital camera resulted in a slight soft focus effect in the images due to the lack of much 3D relief of the flattened pressed specimens. The sharpness could likely be rectified through the use of manual control over the shutter aperture.

Figure 1. Photographic setup for recording specimens.

Databases for each plant family were subsequently compiled. Images were displayed using Microsoft™ Windows Explorer on a separate monitor linked to a laptop computer that was used to enter data into the spreadsheet.

**Geographic Range**

For the purpose of the NWT Virtual Herbarium, the geographical range includes all terrestrial areas within the boundary of the NWT as defined in 1999 by the creation of Nunavut.

In some institutions, plant specimens collected in the Northwest Territories have not been separated from those collected in Nunavut. This was the case for many plant families stored at DAO. To increase efficiencies in digitization, all specimens filed under NWT at DAO and found from the 102° longitude west to the Yukon border and found from 60° latitude north to the pole, were entered in the database. Consequently, some records of plants in the NWT Virtual Herbarium are actually relevant to Nunavut. Some Yukon records are also present by error.

In other institutions, plant specimens collected before 1905 in Alberta, Saskatchewan, Manitoba, northern Québec, and Nunavut are recorded as NWT collections. These records are not deleted from the NWT Virtual Herbarium. Users of the Herbarium may simply take note of these extra-limital records and ignore these records or use them as they see fit.

A few photos of misfiled plants clearly outside of NWT were accidentally taken; these photos have been numbered and are retained in the NWT Virtual Herbarium for completeness, but no data were entered.

**Database Documentation**

The database consists of 23 fields (columns) of information that capture all of the data provided on herbarium specimen labels and supplementary notes on identification verifications. These fields are:

1. FAMILY – Plant family name
2. FAMILY_IMAGE NO – Plant family name followed by the herbarium code and unique photograph number (e.g. ASTERACEAE_DAO_2008-2274)
3. INSTITUTION – Unique herbarium code for the institution (e.g. DAO) where the original specimen is stored or code for a project if records originated from a photographic survey only. This code can differ from the code in ACC_NO if the later is a photograph of an original specimen from another institution; in this case, see “Other Notes” for details
4. ACC_NO – the unique accession number stamped on each herbarium sheet. This number can also contain the unique herbarium code for each institution, e.g. DAO
5. BINOMIAL – the scientific name of the species as used in the General Status Ranking Program in the NWT
6. COLLECTOR(S) – collector(s) written with last name first for the primary collector
7. DATE_COLL – date collected; written as year/month/day (if lacking then “s.d.” or -, or blank); two zeros replace each of the month or day if these are missing

8. COLL_FIELD NO – collector's unique field number for recording a collection (if lacking then "s.d." or -, or blank);
9. IDENTIFIED_BY – person identifying the specimen
10. LOCALITY – geographic location where the specimen was collected
11. SITE_DESCRIPTION – additional description of the site (substrate, topography, associated species, etc.)
12. ELEVATION – in feet or metres, if given
13. LAT – latitude; primarily as degrees and minutes but occasionally also including seconds; occasionally decimal degrees are provided
14. LONG – longitude; primarily as degrees and minutes but occasionally also including seconds; occasionally decimal degrees are provided
15. LATDEC - latitude; calculated latitude in decimal degrees
16. LONGDEC – longitude; calculated latitude in decimal degrees
17. LOC_ACCURACY –
    - Excellent: location provided with at least 3 decimal minutes (e.g. 61$^{o}$ 21' 22.52")
    - Good (1-2 decimal point): with 1-2 decimal minutes (e.g. 61$^{o}$ 21' 22")
    - Medium (no decimal point): without decimal minutes (e.g. 61$^{o}$ 21')
    - Poor (only degrees): without minutes (e.g. 61$^{o}$)
    - Calculated based on LOCALITY
18. OTHER_NOTES – supplementary information such as the original name under which the species was identified and other annotations and changes in identification

19. FLOWERING – fl = flowering, fr = fruiting, ve = vegetative, ? = cannot determine from image. A legend is provided as a comment under the heading for the “Flowering” column in the database. Specimens in which there were at least some flowers remaining, even if fruits were also present, or if young flower buds were present were categorized as flowering (fl); those in fruit with no flowers were labeled as fruiting (fr) and those specimens that appeared to have no flowers or fruits were labeled as vegetative (ve).
20. CALCULATDEC – Equation to calculate Latitude using the LAT field, the value is then saved in the field LATDEC
21. CALCULONGDEC – Equation to calculate Latitude using the LONG field, the value is then saved in the field LONGDEC
22. Grank – NWT General Status Rank according to current NWT Species report. Only “May be at risk” and “Alien” status were recorded.
23. Edge note - Notes on the distribution of species that “May be at risk”:
    - Arctic = species of typical arctic distribution but rare in the NWT, expect more sites in northern NWT
    - Beringian = species of Beringian distribution, expect more sites in northwestern NWT and mountain
    - Western = species of western distribution, expected more sites in southwestern NWT
    - Southern = species found usually south of the NWT

- Eastern = species found usually in eastern Canada, and rare in the NWT
- Canada = species found in many ecozones in Canada, but rare in the NWT
- G ranks = endemics and species rare in the world. Ranked according the current data from NatureServe

If two species were mounted on one sheet, two line entries were made detailing the species' names and different field collection numbers. Where species on one sheet had originated from two separate locations, two line entries with different coordinates were entered.

**Error Correction**

As required, spelling corrections are made seamlessly. Errors in location coordinates are noted in Other Notes, or corrected seamlessly (see results below). Some entries may have a question mark associated with them. These reflect the uncertainty due to poor legibility of a place name or individual or of the person actually identifying the specimen.

**Uncertainties**

*Species name*: If identification was questionable (i.e. *Genus ?species*), then the species was listed under the likely species where, in every case, it was already filed in the herbarium. A note was made in the "Other Notes" section.

*Dates*: If a specimen was collected over a couple of days, the range or the first date was entered with a note in the “Other Notes” column. Where a specimen was collected over a longer period of time (e.g. week, month, year), a note in the “Other Notes” column.

*Identified by*: It was assumed that specimens collected by W. J. Cody were also identified by W. J. Cody in the same year, unless otherwise noted. This was also assumed for specimens collected by J. A. Calder, A. E. Porsild, J. W. Thieret, and R. W. Reich. For others, where the identifier was not clear, a blank or hyphen was entered. For many specimens, there was a great deal of ambiguity as to whether it was originally identified by the collector or by someone else. The database aims at crediting the correct person in each case (sometimes by recognition of the handwriting), but on many labels this information was lacking. Where there was no indication to the contrary, it was assumed that the collector provided the identification.

*Co-ordinates*: All co-ordinates were placed in the Lat/Long columns, including those in decimal degrees and those indicating seconds. A note was placed in the “Other Notes” column. If the collection was made over a large area, the range was not entered here but in the “Other Notes” section. Where no co-ordinates were given, none were entered.

*Flowering*: The most appropriate state (one only) was selected. If the state was not obvious, a “?” or blank was entered. For some taxa, determining flowering state was particularly difficult. In many species this is actually difficult to determine, from an image, if the plants are in flower or have already produced fruit. Some species have non-showy flower heads where one cannot tell from a photo whether the plants are primarily in flower or have begun to set fruit. This is true even in those species of the aster family where showy ray flowers are present around the periphery of the head. Some heads on a multi-headed inflorescence could be producing fruitlets at the same time as other younger heads are in flower. In members of the mustard family, the racemes on a single plant can have both young flowers near the apex and ripening capsules in the lower portion. Consequently, the data in this supplementary field are generally of limited value for many species in determining accurate seasonal ranges in flowering or fruiting times.

The “Flowering” field was not used in compiling the sedge data because of the cryptic nature of the flowers and the inability to determine the flowering/fruiting status of plants readily except through the use of supplementary magnification, a time-consuming process that could not be accommodated for this project.

**Duplicates**

Many botanists will take more than one specimen from each site. These duplicate or near-duplicate collections were dealt with in one of four manners:

1. Some were cited in the “Other Notes” column of the database. As data were recorded from digital images of NWT specimens made at DAO, reference image numbers that appear to be missing under the spreadsheet column for “Image No” can be found in the “Other Notes” column recording duplicate or near duplicate collections.
2. Duplicate specimens were photographed but recorded simply as referenced in the “Other Notes” column of that first record
3. Some were entered as a full record with no other notes added. Users will find these duplicates by comparing locations, dates, and species names.
4. Some were omitted from the database altogether.

**Reporting**

Each botanist contracted to digitize NWT plant voucher specimens is required to provide information on the number of specimens examined, deviations from the standard protocol, type of errors corrected, notes on taxonomic issues encountered, and any comments or suggestions.

# RESULTS

From 2007 to 2008, almost all NWT specimens available at DAO were digitized. A summary map of all records with available location information is show in figure 2.

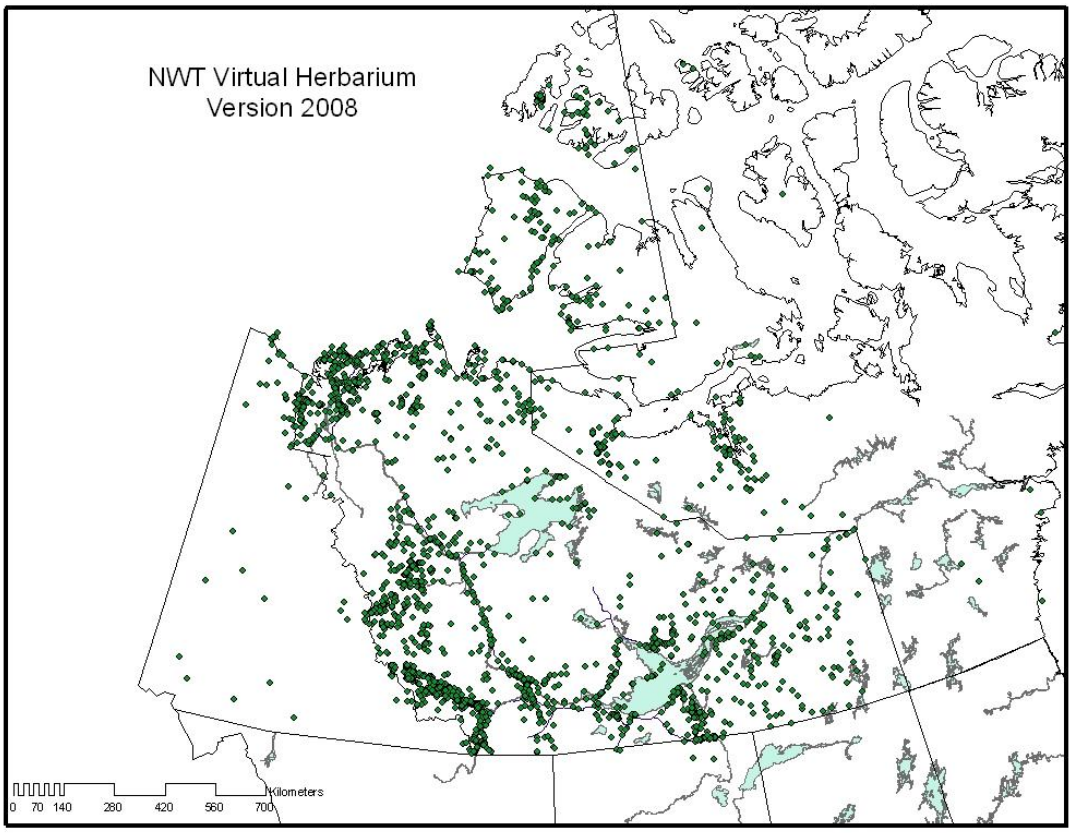


Figure 2. Map of all records available in the NWT Virtual Herbarium of as 20 June 2008. Records are from DAO, with some additional ones from CAN.

## Project Management and Cost Analysis

To increase efficiencies and manageability, the specimens were organized according to plant families; six botanists worked independently to digitize specimens. All botanists had access to DAO. To standardize data entry, each

botanist was given a few hours of instructions by E. Haber, who developed the digitization method.

After a couple of families were completed, a standard cost of $5 per record was estimated as adequate to cover most expenditures, including photography, data entry and botanical verification. The final cost of the project was $113,935.

| **REVENUE** | |
|---|---|
| Environment Canada – Invasive Alien Species Partnership Program | $6,000.00 |
| Environment and Natural Resources, GNWT – Protected Areas Strategy Secretariat | $11,752.00 |
| INAC – Protected Areas Strategy Secretariat | $49,500.00 |
| Environment and Natural Resources, GNWT – Biodiversity Action Plan | $41,883.00 |
| NWT – CIMP (Indian and Northern Affairs, INAC) | $4,800.00 |
| **Total Revenue** | **$113,935.00** |
| **EXPENDITURES** | |
| Photography, database production and botanical identification verification (6 contracts) | 113,935.00 |
| **Total Expenditures** | **$113,935.00** |

**Report Summaries – Basis for Metadata**

The number of records per plant family, the name of the botanist who digitized the specimens and the date of work are given in Appendix 1. Reports from each botanist form the basis for the information included in the Metadata (Appendix 2). Details presented in these reports are presented below for each plant family. S. Carrière edited the information.

**Aceraceae**

No specimens were digitized as of June 2008. Only one species is present in the NWT: Manitoba Maple (*Acer negudo*), alien species. The DAO record consists of a photo of collection in CAN made in Fort Simpson by A. E. and R. T. Porsild, Sept 1928; also collected by Cody and Matte in June 1955.

**Acoraceae, Adoxaceae,**

No additional details for these families were presented in the botanist's reports.

**Amaranthaceae,**

No specimens were digitized as of June 2008. Only one species is present in the NWT: Green Amaranthus (*Amaranthus retroflexus*), alien species. DAO record is from Fort Simpson, 1939.

**Alismataceae, Apiaceae, Apocynaceae, Araceae, Araliaceae, Aspleniaceae,**

No additional details for these families were presented in the botanist's reports.

**Asteraceae**

As the database exists for this family, the first record entered for a locality was not necessarily the earliest collection made at the site for that species but simply the first collection encountered in the specimen folder.

The following species had no collection at DAO: *Anaphalis margaritacea*, *Arnica amplexicaulis*, *A. mollis*, *Cirsium drummondii*, *C. foliosum*, *Erigeron pallens*, *E. purpuratus*, *Lactuca tatarica* (only var. *heterophylla* found for Keewatin, Nunavut), *Packera ogotorukensis. Solidago simplex*, *Symphyotrichum ciliatum*, *S. ericoides*, *S. falcatum*, *S. spathulatum*, *S. yukonense.* Most of these had empty folders indicating that the specimens were on loan.

A number of species names in the aster family database compiled for the database reflect current name usage as given in volume 23 of FNA. These replace names previously used for the General Status of Wild Species in Canada:

- *Taraxacum erythrospemum* was previously called *T. laevigatum*
- *Taraxacum holmenianum* is now recognized in FNA as a distinct Arctic species but was previously recognized as *T. pumilum*, a synonym of *T. phymatocarpum* in Kartesz's 1999 *Synthesis of the North American Flora.* The name *T. holmenianum* was not previously used in the General Status database.
- *Taraxacum hyparcticum* is now also recognized as a distinct species in FNA whereas it was formerly included in *T. phymatocarpum* by Kartesz 1999.
- *Tripleurospermum inodora* is now used in FNA to replace *Tripleurospermum perforata* as recognized by Kartesz 1999.

**Balasaminaceae, Betulaceae, Boraginaceae**

No additional details for these families were presented in the botanist's reports.

**Brassicaceae (DAO)**

The following species had no collection at DAO: *Arabis caldera*, *Cardamine digitata*, *C. microphylla*, [on loan to Missouri Bot. Garden], *C. oligosperma*, *Draba arctogena*, *D. incerta*, *D. norvegica*, *D. ogilviensis* [DAO 1 specimen?], *D. pauciflora*, *D. porsildii*, and *D. praealta* [DAO 3 specimens? The Mackenzie folder, however, was empty indicating that many specimens may be on loan.

**Brassicaceae (CAN), Callitrichaceae, Campanulaceae, Caprifoliaceae**

No additional details for these families were presented in the botanist's reports.

**Caryophyllaceae**

The following species had no collection at DAO either because it was a rare species and no specimens had ever been present in the collection or the specimens were on loan to specialists studying the group: *Cerastium jenisejense*, *C. nigrescens*, *Honckenya peploides*, *Minuartia elegans*, *Silene drummondii*, *S. tayloriae*, *Spergula arvensis*, and *Stellaria longifolia.*

There is also the possibility that some were overlooked due to their inclusion under a synonym missed by the botanist, as was the case for *Honckenya peploides* (=*Arenaria peploides*).

**Ceratophyllaceae**

No additional details for this family were presented in the botanist's reports.

**Chenopodiaceae**

Specimens from the following species were found at DAO and digitized, but are not included in the 2005 list of NWT vascular plants under the General Status Ranking Program (WGGSNS 2006):

- *Chenopodium desiccatum* (Chenopodiaceae, 1 record, coll. 2003, L. Kershaw)
- *Chenopodium leptophyllum* (Chenopodiaceae, 2 records; P. Catling, 2003)
- *Corispermum ? pallassii* (Chenopodiaceae, 1 record) Note that the single (immature) specimen of *Corispermum ? pallassii* was originally identified as *C. hyssopifolium* by W. J. Cody in 1955, revised to *C. nitidum* by C. W. Crompton in 1980; and finally revised to *Corispermum* sp. ~? *pallassii* by S. L. Mosyakin in 1994. That database records this as *C. pallassii* because this is an accepted species; however it may be better described for this purpose as *Corispermum* sp.

DAO does not appear to contain any specimens of *Salicornia maritima* and *Salicornia rubra.* It is possible that specimens of these taxa are on loan to other institutions, or can be found in other collections (e.g. CAN).

**Cistaceae, Cornaceae**

No additional details for these families were presented in the botanist's reports.

**Crassulaceae**

Specimens from the following species were found at DAO and digitized, but are not included in the 2005 list of NWT vascular plants under the General Status Ranking Program (WGGSNS 2006): *Sedum spurium* (Crassulaceae, 1 record, 1987).

There does not appear to be a FNA treatment for Crassulaceae and so the taxonomy of *Rhodiola integrifolia* was somewhat unclear. *Rhodiola rosea* is an accepted name within the General Status list, and it is possible that some of these specimens should be listed as *R. rosea*, especially those identified by J.A. Calder as *Sedum rosea ssp. rosea* (e.g. CRASSULACEAE_DAO_2008_6 and CRASSULACEAE_DAO_2008_13). For consistency with the NWT General Status list, all were placed under *R. integrifolia* but with all taxonomic history explained in the "Other Notes" column.

**Cupressaceae**

No additional details for this family were presented in the botanist's reports.

**Cyperaceae**

In some cases, specimens were on loan to specialists or the folders were simply empty without an indication as to whether they were out on loan or removed for

study by staff at DAO. No specimens were present for *C. adelostoma* or *C. deweyana*, and those for *C. deflexa* were recorded as on loan. The largest number of *Carex* collections in the NWT were those made by Bill Cody (407 collections) and various associates accompanying Bill Cody.

Many species of the sedge family are difficult to distinguish definitively in the field, except perhaps by specialists in the group, and as a consequence, some collections turn out to represent the same species once carefully examined and identified on technical characteristics in the lab. Time restraints precluded the sorting of specimens in an effort to remove all duplicate collections.

The following species of *Carex* reported for the NWT were not represented in the collections at DAO: *Carex micropoda* and *Carex oligosperma*. The collections contained one sheet with a collection of *Carex "trisperma*". The collection by Cody (#15476, made on 26 July 1966 at Mantic Lake – see image no "Cyperaceae_DAO_2007-1882) was originally identified by Cody as "*Carex ? brunnescens*". A.E. Porsild subsequently annotated it as *C. trisperma* in 1967. This specimen was later re-identified by Bernard Boivin (formerly of DAO but now deceased) as *Carex brunnescens*. This was a poor and questionable collection and was not entered into the spreadsheet. *Scirpus atrocinctus* (undetermined for NWT in the General Status Assessment) was not represented in the collections at DAO.

**Diapensiaceae, Droseraceae**

No additional details for these families were presented in the botanist's reports.

**Dryopteridaceae**

Each specimen is recorded on a separate line part way through Dryopteridaceae. In the first part of Dryopteridaceae, some duplicate specimens are entered under Other Notes.

The Dryopteridaceae worksheet begins with number 2 (Dryopteridaceae_DAO_2007-2) because number 1 was entered in error and subsequently deleted. Therefore the number of specimens in that family is one less than the final image number.

On the 2005 list (WGGSNS 2006) of accepted names of vascular plant species occurring in the Northwest Territories, *Gymnocarpium disjunctum* appears and *G. dryopteris* does not. According to *Flora of North America* as well as Cody and Britton's *Ferns and Fern Allies of Canada*, *G. disjunctum* does not occur in NWT and *G. dryopteris* does. As you will see on the spreadsheet, the specimens at DAO also substantiate this (although the nomenclatural changes over the years have resulted in a synonymy which is challenging to sort out). Three specimens of *G.* × *intermedium* (*G. dryopteris* × *jessoense*) have also been included in the spreadsheet.

Many of the specimens in *Gymnocarpium*, as well as in a few other genera, required a critical assessment of the plethora of nomenclatural differences to place them correctly according to the accepted name from *General Status of Wild Species*.

**Elaeagnaceae, Elatinaceae, Empetraceae**

No additional details for this family were presented in the botanist's reports.

**Equisetaceae**

One specimen of *Equisetum* × *arcticum* and four specimens of *E.* × *trachyodon* (= *E. hyemale* × *E. variegatum*) have been recorded.

**Ericaceae**

No specimens were present for three species: *Harrimanella hypnoides* (*Cassiope hypnoides*), moss heather; *Vaccinium caespitosum*, dwarf bilberry; and *Vaccinium membranaceaum*, mountain huckleberry. The latter two species were represented, however, by one photograph of each species from collections present in the national collection of vascular plants (acronym CAN) at the Canadian Museum of Nature, Ottawa.

Out of the total of 1,327 records, 187 records or 14% had no coordinates provided with the specimens. A number of these were for actual place names such as Norman Wells, but the majority was for collections whose localities were indicated by highway mileages along roads such as the Enterprise-Mackenzie River Highway. Many of these were the collections made by Thieret and Reich in 1959. Most coordinates provided only the location to the nearest degree and minute. However, a few records provide degrees, minutes and seconds.

According to the assessment of the *General Status of Wild Species*, three of the 22 NWT species in the Ericaceae "May be at Risk": *Vaccinium*

*caespitosum*; *V. membranaceum*; and *V*. *myrtilloides* (velvet-leaved blueberry). Three are “Sensitive”: *Phyllodoce caerulea* (purple mountain heather); *P. empetriformis* (pink mountain heather); and *P. glanduliflora* (yellow mountain heather). The conservation status of *Kalmia microphylla* (alpine bog laurel) is listed for the NWT under the *General Status of Wild Species* as “Undetermined”. However, a total of 16 collections of this species, formerly treated as *Kalmia polifolia* ssp. *microphylla* or var. *microphylla*, are present in the collections at DAO. B. Boivin annotated these in 1964 as var. *microphylla* or were annotated by Shunguo Liu in 1993 as *K. microphylla*. These annotated specimens are recognized here as likely correctly identified. *Harrimanella hypnoides* is considered as “May be at Risk” but no specimens were present at DAO.

Some uncertainty was experienced in recording the identifier of a collection. In most cases, the identifier was the collector of the specimen, which was usually identified the same year. However, W. J. Cody, former curator of the collections at DAO, would commonly handwrite the name of the plant on herbarium sheet labels of collections made by others and sent for identification to DAO. Cody did not always initial and date such handwritten names as originating with him. Sometimes he would initial and date the handwritten name as having been his own identification when a supplementary field label (usually affixed to the top left corner of the herbarium sheet) would indicate that the collector had originally identified the specimen. No doubt this represents an error due to the processing of many specimens sent in for identification.

The frequency of plant collections of the Ericaceae at DAO, grouped into 10-year time intervals beginning in 1901, are plotted in Figure 3. It is clearly evident that the most active historical periods for botanical surveys in mainland NWT were between the mid 1960s and the mid 1970s. Since the family contains mainly widespread species for which there are numerous collections, for example, *Arctostaphylos rubra* (red bearberry), *Arctostaphylos uva-ursi* (bearberry), *Ledum groenlandicum* (Labrador tea), *Rhododendron lapponicum* (Lapland rosebay), *Vaccinium uliginosum* (alpine bilberry), and *Vaccinium vitis-idaea* (mountain cranberry), it is highly likely that this peak represents the trend, in general, for all collections of vascular plants in the NWT. Recent survey collections may not be adequately represented in this graph.

Staff at DAO are not now as active as in earlier decades in documenting the flora of the northern regions of Canada following the completion of publications on the *Vascular Plants of Continental Northwest Territories* by A. E. Porsild and W. J. Cody in 1979 and the *Flora of the Yukon Territory* by W. J. Cody in 1996. Range expansions and the discovery of new species have continued to be recorded, especially by Bill Cody in his retirement. However, collections may not be sent to DAO as frequently in recent years by consulting firms engaged in northern surveys considering that DAO has not itself been actively involved in sending staff on survey expeditions to the North; similarly, such surveys have not been undertaken by the Canadian Museum of Nature to the extent as was the case in earlier decades. At DAO, Dr. Paul Catling has,

however, been engaged, very recently, in some botanical and other collecting activities in mainland NWT.

The most significant collections from mainland NWT at DAO are those made by Bill Cody over a period of many years. A total of about 500 collections for the Ericaceae alone were made in the NWT by Cody individually or with assistants or colleagues. These were made in the years: 1949, 1950, 1953, 1955, 1957, 1961, 1963, 1965, 1966, 1967, 1970, 1971, and 1972. Judging by the number of collections in the Ericaceae made by Cody, his peak years appear to be 1949 (about 59 collections), 1957 (about 73), 1966 (about 101), and 1967 (about 50). The peak decades for plant collecting in the NWT, as noted in Figure 1, are in good measure due to the abundance of collections made by Cody in the mid-1960s supplemented, especially in the mid-1970s, by Talbot (Nahanni National Park) and Ovenden and Rowe (Eastern Great Slave Lake Region). Major collections were made in documenting the Enterprise-Mackenzie River Highway and the Mackenzie River-Yellowknife Highway by Thieret and Reich in 1959 and 1961. Other collectors were also quite active in mainland areas of the former NWT now lying mainly to the north and east of the current boundaries of the NWT in the Coppermine area (Eedy and Lush in 1976), Bathurst Inlet Region (Scotter and Zoltai in1979), and Bluenose Lake Area (Scotter and Zoltai in 1990).

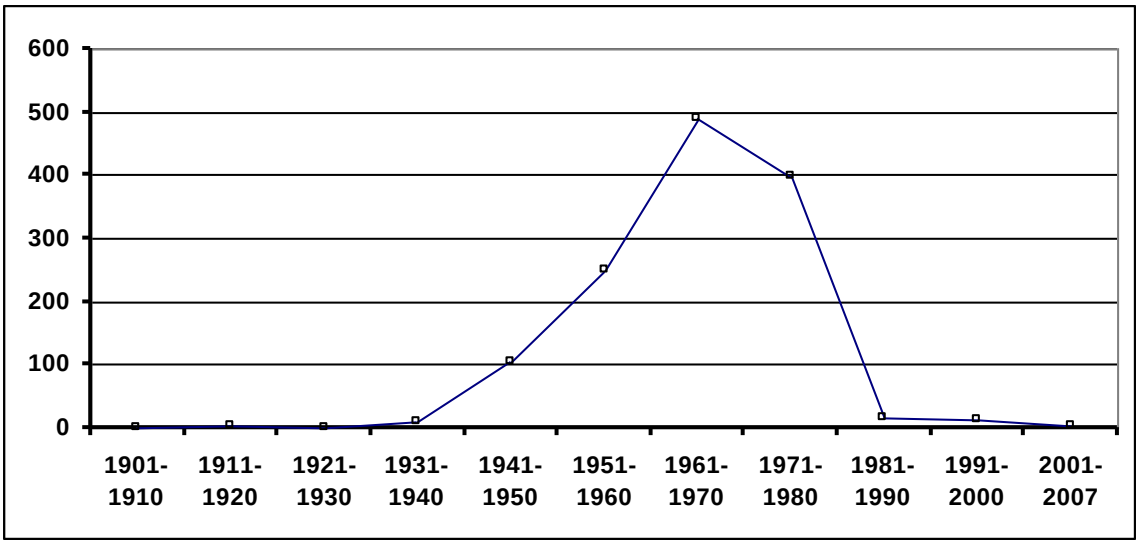


Figure 3. Frequency of vascular plant collections of the heather family (Ericaceae) made in the Northwest Territories recorded by decade time intervals.

**Fabaceae, Fumariaceae, Gentianaceae, Geraniaceae, Grossulariaceae, Haloragaceae, Hippuridaceae, Hydrophyllaceae, Iridaceae, Isoetaceae,**

**Juncaceae**

No additional details for these families were presented in the botanist's reports.

**Juncaginaceae**

There were only three specimens of *Triglochin maritima* at DAO (although the original estimate was 24), but a note on one of the folders indicated that there are some on loan.

**Lamiaceae**

Specimens from the following species were found at DAO and digitized, but are not included in the 2005 list of NWT vascular plants under the General Status Ranking Program (WGGSNS 2006):

- *Galeopsis bifida* (Lamiaceae, 1 record, see below)

The remaining three specimens of *Galeopsis tetrahit* (Lamiaceae) are identified as *Galeopsis tetrahit* var. *bifida*, which appears to be accepted at the species level as *Galeopsis bifida* by some sources. The FNA treatment for this family was not available as of March 2008, therefore the records were kept as *G. tetrahit* to comply with the 2005 list of NWT vascular plants under the General Status Ranking Program (WGGSNS 2006).

DAO does not appear to contain any specimens of *Agastache foeniculum* (Lamiaceae). It is possible that specimens of these taxa are on loan to other institutions, or can be found in other collections (e.g. CAN).

**Lemnaceae, Lentibulariaceae, Liliaceae, Linaceae, Lycopodiaceae**

No additional details for these families were presented in the botanist's reports.

**Malvaceae**

No specimens were digitized as of June 2008. Only one species is present in the NWT. Dwarf Mallow (*Malva neglecta*), alien species. Specimens were collected in 2003 in Yellowknife by P. Catling, and may be present in DAO.

**Menyanthaceae**

No additional details for this family were presented in the botanist's reports.

**Monotropaceae**

There were no Monotropaceae specimens at DAO so the family does not appear in the database.

**Myricaceae, Najadaceae, Nymphaeaceae, Onagraceae**

No additional details for these families were presented in the botanist's reports.

**Ophioglossaceae**

In Ophioglossaceae, there are two records that refer to the same image number. This is because a collection of *Botrychium lunaria* plants included one plant that had been annotated as *B. spathulatum*. This is an important record since it is the only NWT record of *B. spathulatum* at DAO. Therefore the same collection data were entered for *B. spathulatum* as well.

**Orchidaceae, Orobanchaceae**

No additional details for these families were presented in the botanist's reports.

**Papaveraceae**

Specimens from the following species were found at DAO and digitized, but are not included in the 2005 list of NWT vascular plants under the General Status Ranking Program (WGGSNS 2006):

- *Papaver cornwallisensis* (Papaveraceae, 41 records, see below)
- *Papaver gorodkovii* (Papaveraceae, 7 records, determined by D. F. Murray, 1998)

All specimens identified as *Papaver cornwallisensis* had been recently revised by Heidi Solstad (Oslo) in 2003. In the FNA treatment of Papaveraceae, *P. cornwallisensis* is listed as a synonym of *P. radicatum* ssp. *polare* (and therefore would be identified as *P. radicatum* in this database, which does not recognize infraspecific taxa). However, the authors suggest that if recognized at the species level, *P. cornwallisensis* should be used, and so these collections have been recorded as identified by H. Solstad in order to distinguish them.

**Pinaceae, Plantaginaceae, Plumbaginaceae**

No additional details for these families were presented in the botanist's reports.

**Poaceae**

All NWT Poaceae specimens at DAO were photographed (464), but only 18 were databased, since most had already been databased by Agriculture Canada.

**Polemoniaceae, Polygonaceae, Polypodiaceae, Portulacaceae, Potamogetonaceae, Primulaceae, Pteridaceae, Pyrolaceae**

No additional details for these families were presented in the botanist's reports.

**Ranunculaceae**

One specimen of *Delphinium brachycentrum* was recorded; this is known from the *General Status of Wild Species* for the Yukon but not for the Northwest Territories. (The specimen was collected close to the Yukon border.) One specimen of *Ranunculus gmelinii* × *hyperboreus* was also recorded.

**Rosaceae, Rubiaceae, Ruppiaceae**

No additional details for these families were presented in the botanist's reports.

**Salicaceae**

All specimens collected by Christine Boyd *et al.* in 1981 have coordinates that are probably incorrect. About half of them are impossible, having more than 60 minutes or seconds. It is possible that she divided each degree and minute into 100 rather than 60. The location fields are left blank for these records. The coordinates are entered under Other Notes, along with a note "[apparently incorrect]" or "[questioned]".

In the "identified by" column, if the accepted binomial has not been used at all, the name of the person who first used a correct synonym is entered, followed by "(see notes)" where the synonym is noted.

One specimen of "*S. rigida*" was not possible to place definitively under an accepted name, since *S. rigida* is a synonym of more than one accepted name. It was placed under *S. prolixa*, since it appears to be most likely that species; this was so noted under Other Notes.

One specimen of *S. calcicola* was recorded, but is not on the 2005 NWT list. A few specimens of *S. arctica* × *glauca*, *S. arctica* × *polaris*, *S. athabascensis* × *pedicellaris*, *S. brachycarpa* × *glauca*, *S. glauca* hybrid and *S. planifolia* / *pulchra* intermediates were also recorded.

**Santalaceae, Sarraceniaceae**

No additional details for these families were presented in the botanist's reports.

**Saxifragaceae**

In one case (SAXIFRAGACEAE_DAO_2008_824, *Chrysosplenium tetrandrum*, Banks Island), the field label and typed label gave different coordinates and elevations; the field label was assumed to be correct.

Specimens from the following species were found at DAO and digitized, but are not included in the 2005 list of NWT vascular plants under the General Status Ranking Program (WGGSNS 2006):

- *Chrysosplenium iowense* (Saxifragaceae, 1 record, 1960)
- *Mitella pentandra* (Saxifragaceae, 1 record, 2007)

DAO does not appear to contain any specimens of *Saxifraga ferruginea* (Saxifragaceae) or *Saxifraga redovskii* (Saxifragaceae). It is possible that specimens of these taxa are on loan to other institutions, or can be found in other collections (e.g. CAN).

**Scheuchzeriaceae, Scrophulariaceae, Selaginellaceae, Sparganiaceae, Thelypteridaceae, Typhaceae, Urticaceae**

No additional details for these families were presented in the botanist's reports.

**Valerianaceae**

No additional details for this family were presented in the botanist's reports.

**Violaceae**

One specimen of *Viola labradorica* was recorded, but is not in the 2005 NWT list.

**Zanichelliaceae**

No additional details for this family were presented in the botanist's reports.

# DISCUSSION

These next steps are suggested to ensure proper maintenance and update of the NWT Virtual Herbarium.

## 1. Updates

Additional search effort will be required to locate some species from the herbarium of the Canadian Museum of Nature (CAN) or other institutions in order to have locality information for all specimens for all species known to be present in the NWT.

Some of the DAO specimens were on loan and not available for digitizing in 2007-2008. The database can be easily updated once these specimens become available. Each specimen digitized for this project was marked (Figure 4), so unmarked specimens should be easy to locate at DAO.

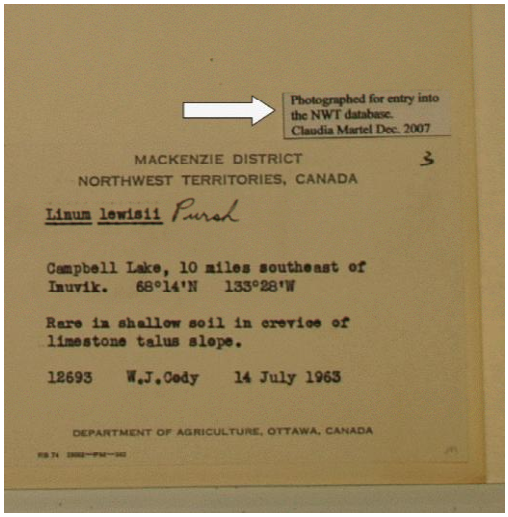


Figure 4. Example of a marker tag left on each DAO specimen digitized from 2007 to 2008 for this project.

Recent surveys for plants in the NWT may result in good quality digital photographs. If the photographed specimens can be or have been correctly identified as to the species level, this kind of data can be integrated into the virtual herbarium.

Plant locations and field notes without good quality photographs should not be integrated into this project. Other methods of recording results, such as reports, should be used.

## 2. Error Correction

Errors on original labels and on database copies of label information are inevitable. Error corrections should be part of the proper maintenance of the NWT Virtual Herbarium.

Errors will be corrected for the following types with the following procedures:

a) Original location error on the label. These errors are detected if the location description and the lat-long information do not match, or if the lat-long information positions the specimens in an impossible location (e.g. middle of ocean, lake without islands, or outside the NWT). These errors should be corrected in the database, a note made in the Other Notes field, and the corrections should be communicated to the DAO Herbarium Curator (see address in Appendix 1) for correction on the original label.

b) Location error in the copying process. These errors are detected if the location description and the lat-long information do not match. These errors can be corrected seamlessly in the database.

c) Other typological errors can be corrected on case-by case basis.

**3. Taxonomic Revisions.**

The database follows the taxonomy used for the 2005 list of NWT vascular plants (WGGSNS 2006) according to the 2005 version of the program General Status of Wild Species in Canada. This program was based on FNA's work if available by December 2005, and on Kartesz (1999) for other families not available on FNA. Exceptions to this occurred during data entry from 2007 to 2008 and are noted in the results.

The taxonomy of vascular plants has been undergoing rapid revisions in the past decade. The NWT Virtual Herbarium will be updated regularly to follow these revisions. The Herbarium's taxonomy will be updated in 2010 to follow the next version of the NWT list of vascular plants, which will be according to the 2010 version of the program General Status of Wild Species in Canada: FNA (prior to December 2010, or Kartesz (1999).

**4. Metadata Updates**

Metadata will be updated when (1) additional specimens (records) or photographs are integrated, or (2) new taxonomy is used. Other changes can be tracked by publishing a new version of this Manuscript Report.

# ACKNOWLEDGEMENTS

The authors would like to thank Dr. Paul Catling, Curator, and Gisèle Mitrow, Collections Manager, at DAO Herbarium & National Vascular Plant Identification Service, Department of Agriculture and Agri-Food Canada, Ottawa. They provided an appreciated welcome and much help to all botanists during their extended visits at DAO. This work could not have been completed without their help and support. We would like to thank Michele Stacey, Wildlife Division, Environment and Natural Resources, GNWT, for organizing the 26,000+ photographs and records for permanent storage and for performing the location conversions into decimal units.

Funds for this project were obtained from Environment and Natural Resources, GNWT, the Protected Areas Strategy, GNWT and Indian and Northern Affairs (INAC), from the Cumulative Impact Monitoring Program, INAC and from the Invasive Alien Species Partnership Program of Environment Canada. We greatly thank them for their support. This funding was essential to the successful completion of this project. The DAO information now in the NWT Virtual Herbarium is providing an important basis for future input from other collections.

## LITERATURE CITED

Flora of North America Editorial Committee, eds. 1993+. Flora of North America North of Mexico. 12+ vols. New York and Oxford. Available at http://hua.huh.harvard.edu/FNA/.

Kartesz, J.T. 1999. A Synonymized Checklist and Atlas with Biological Attributes for the Vascular Flora of the United States, Canada, and Greenland. First Edition. In: Kartesz, J.T. and Meacham, C.A. Synthesis of the North American Flora, Version 1.0. North Carolina Botanical Garden, Chapel Hill, NC. (CD Version).

Porsild, A.E. and Cody, William J. 1980. Vascular plants of continental Northwest Territories, Canada. Ottawa, National Museum of Natural Sciences. 667 pp.

WGGSNS (Working Group on General Status of NWT Species). 2006. NWT Species 2006-2010 – General Status Ranks of Wild Species in the Northwest Territories. Department of Environment and Natural Resources, GNWT. Yellowknife, NT. 111 pp.

**APPENDIX 1.** Name of contract botanist, date and number of records per plant families digitalized from DAO and CAN. As of June 20, 2008.

| Family | Contract botanist | Date | Records in Virtual Herbarium |
|---|---|---|---|
| Aceraceae | | Not done | |
| Acoraceae | OLDHAM | 15/11/2007 | 1 |
| Adoxaceae | BICKERTON | 08/05/2008 | 3 |
| Amaranthaceae | | Not done | |
| Alismataceae | OLDHAM | 15/11/2007 | 21 |
| Apiaceae | MARTEL | 08/05/2008 | 100 |
| Apocynaceae | BICKERTON | 08/05/2008 | 23 |
| Araceae | OLDHAM | 15/11/2007 | 27 |
| Araliaceae | BICKERTON | 08/05/2008 | 19 |
| Aspleniaceae | THOMSON | 31/12/2007 | 1 |
| Asteraceae | HABER | 08/06/2008 | 2551 |
| Balasaminaceae | BICKERTON | 08/05/2008 | 1 |
| Betulaceae | MARTEL | 12/12/2007 | 378 |
| Boraginaceae | LAMOTHE | 06/05/2008 | 134 |
| Brassicaceae (DOA) | HABER | 08/06/2008 | 1239 |
| Brassicaceae (CAN) | OLDHAM | 22/03/2008 | 594 |
| Callitrichaceae | LAMOTHE | 05/05/2008 | 18 |
| Campanulaceae | THOMSON | 05/06/2008 | 154 |
| Caprifoliaceae | LAMOTHE | 06/05/2008 | 201 |
| Caryophyllaceae | HABER | 10/12/2007 | 866 |
| Ceratophyllaceae | MARTEL? | 08/05/2008 | 2 |
| Chenopodiaceae | BICKERTON | 08/05/2008 | 131 |
| Cistaceae | BICKERTON | 08/05/2008 | 7 |
| Cornaceae | MARTEL | 08/05/2008 | 128 |
| Crassulaceae | BICKERTON | 08/05/2008 | 35 |
| Cupressaceae | MARTEL | 08/05/2008 | 157 |
| Cyperaceae | HABER | 06/03/2007 | 2472 |
| Diapensiaceae | BICKERTON | 08/05/2008 | 16 |
| Droseraceae | LAMOTHE | 12/12/2007 | 43 |
| Dryopteridaceae | THOMSON | 31/12/2007 | 403 |
| Elaeagnaceae | MARTEL | 08/05/2008 | 167 |
| Elatinaceae | THOMSON | 05/06/2008 | 1 |
| Empetraceae | BICKERTON | 08/05/2008 | 148 |
| Equisetaceae | THOMSON | 05/06/2008 | 582 |
| Ericaceae | HABER | 12/09/2007 | 1327 |
| Fabaceae | LAMOTHE | 06/05/2008 | 1305 |
| Fumariaceae | BICKERTON | 08/05/2008 | 95 |
| Gentianaceae | MARTEL | 08/05/2008 | 274 |
| Geraniaceae | LAMOTHE | 06/05/2008 | 39 |
| Grossulariaceae | LAMOTHE | 19/06/2008 | 234 |
| Haloragaceae | BICKERTON | 08/05/2008 | 46 |
| Hippuridaceae | BICKERTON | 08/05/2008 | 95 |
| Hydrophyllaceae | LAMOTHE | 06/05/2008 | 24 |
| Iridaceae | OLDHAM | 15/11/2007 | 29 |
| Isoetaceae | THOMSON | 06/05/2008 | 6 |

| | | | |
|---|---|---|---|
| Juncaceae | OLDHAM | 08/05/2008 | 567 |
| Juncaginaceae | THOMSON | 06/05/2008 | 5 |
| Lamiaceae | BICKERTON | 08/05/2008 | 167 |
| Lemnaceae | OLDHAM | 15/11/2007 | 30 |
| Lentibulariaceae | BICKERTON | 08/05/2008 | 199 |
| Liliaceae | OLDHAM | 15/11/2007 | 60 |
| Linaceae | MARTEL | 08/05/2008 | 31 |
| Lycopodiaceae | THOMSON | 31/12/2007 | 262 |
| Malvaceae | | Not done | |
| Menyanthaceae | THOMSON | 06/05/2008 | 39 |
| Monotropaceae | THOMSON | 05/06/2008 | 0 |
| Myricaceae | THOMSON | 06/05/2008 | 73 |
| Najadaceae | THOMSON | 05/06/2008 | 1 |
| Nymphaeaceae | THOMSON | 06/05/2008 | 27 |
| Onagraceae | MARTEL | 11/06/2008 | 374 |
| Ophioglossaceae | THOMSON | 31/12/2007 | 30 |
| Orchidaceae | THOMSON | 08/05/2008 | 582 |
| Orobanchaceae | THOMSON | 05/06/2008 | 35 |
| Papaveraceae | BICKERTON | 08/05/2008 | 122 |
| Pinaceae | MARTEL | 08/05/2008 | 229 |
| Plantaginaceae | THOMSON | 06/05/2008 | 114 |
| Plumbaginaceae | THOMSON | 06/05/2008 | 46 |
| Poaceae | OLDHAM | 08/05/2008 | 18 |
| Polemoniaceae | LAMOTHE | 06/05/2008 | 99 |
| Polygonaceae | MARTEL | 08/05/2008 | 414 |
| Polypodiaceae | THOMSON | 31/12/2007 | 28 |
| Portulacaceae | THOMSON | 06/05/2008 | 25 |
| Potamogetonaceae | OLDHAM | 15/11/2007 | 270 |
| Primulaceae | LAMOTHE | 06/05/2008 | 352 |
| Pteridaceae | THOMSON | 31/12/2007 | 38 |
| Pyrolaceae | THOMSON | 05/06/2008 | 465 |
| Ranunculaceae | THOMSON | 06/05/2008 | 1242 |
| Rosaceae | LAMOTHE | 08/05/2008 | 1867 |
| Rubiaceae | MARTEL | 08/05/2008 | 153 |
| Ruppiaceae | OLDHAM | 15/11/2007 | 3 |
| Salicaceae | THOMSON | 06/05/2008 | 2498 |
| Santalaceae | THOMSON | 06/05/2008 | 105 |
| Sarraceniaceae | THOMSON | 31/12/2007 | 3 |
| Saxifragaceae | BICKERTON | 08/05/2008 | 1095 |
| Scheuchzeriaceae | OLDHAM | 15/11/2007 | 25 |
| Scrophulariaceae | MARTEL | 07/08/2008 | 845 |
| Selaginellaceae | THOMSON | 31/12/2007 | 44 |
| Sparganiaceae | OLDHAM | 15/11/2007 | 97 |
| Thelypteridaceae | THOMSON | 31/12/2007 | 7 |
| Typhaceae | OLDHAM | 15/11/2007 | 22 |
| Urticaceae | THOMSON | 05/06/2008 | 30 |
| Valerianaceae | THOMSON | 05/06/2008 | 32 |
| Violaceae | THOMSON | 05/06/2008 | 87 |
| Zanichelliaceae | OLDHAM | 15/11/2007 | 2 |
| **Grand Total** | | | **26956** |

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**APPENDIX 2.** Metadata for the NWT Virtual Herbarium – version 2008.

Compiled with ESRI ® ArcCatalog ™ ArcView 9.1. Metadata_Standard_Version*:* FGDC-STD-001-1998

*Identification_Information:*

*Citation:*
*Citation_Information:*
*Originator:* ENR, GNWT
*Publication_Date:* 20 June 2008
*Publication_Time:* Unknown
*Title:* NWT DOA PLANTS Corrected June 2008
*Edition:* Version 2008
*Geospatial_Data_Presentation_Form:* tabular digital data
*Series_Information:*
*Series_Name:* NWT Virtual Herbarium
*Issue_Identification:* Version 2008
*Publication_Information:*
*Publication_Place:* Yellowknife
*Publisher:* GNWT
*Online_Linkage:* \\ykenr\ENR Wildlife and Fisheries\NWT Plants\DOA location data\Main DOA Vascular Plants GIS file\NWT DAO PLANTS Corrected June 2008.dbf
*Description:*
*Abstract:* The NWT Virtual Herbarium was initiated to store information, in a digital form, on plants collected or photographed in the NWT. From 2007 to 2008, almost all the plant specimens available at the Agriculture and Agri-Food Canada herbarium in Ottawa were photographed and the information on each label was entered into a database. The procedures, standards, fields, and update protocols are described. The NWT Virtual Herbarium can be updated and extended to include any other set of photographs and label information of all vascular plant specimens ever collected and stored in a recognized institution with botanical expertise and other available photographs, location information and associated data of vascular plants from the NWT.
*Purpose:* The aim of the Northwest Territories Virtual Herbarium is to store, in digital form, photographs and label information of all vascular plant specimens ever collected and stored in a recognized institution with botanical expertise and other available photographs, location information and associated data of vascular plants from the NWT.
*Supplemental_Information:* Carriere et al. 2008. The NWT Virtual Herbarium. Protocols and Metadata. Manuscript Report ____. ENR. GNWT. Yellowknife. NT
*Range_of_Dates/Times:*

*Beginning_Date:* 2008
*Ending_Date:* Present
*Currentness_Reference:* publication date
*Status:*
*Progress:* In work
*Maintenance_and_Update_Frequency:* Continually
*Spatial_Domain:*
*Bounding_Coordinates:*
*West_Bounding_Coordinate:* -138
*East_Bounding_Coordinate:* -102
*North_Bounding_Coordinate:* 90
*South_Bounding_Coordinate:* 60
*Keywords:*
*Theme:*
*Theme_Keyword_Thesaurus:* Vasular Plants
*Theme_Keyword:* Herbarium
*Place:*
*Place_Keyword_Thesaurus:* Canada
*Place_Keyword:* Northwest Territories
*Stratum:*
*Stratum_Keyword_Thesaurus:* Specimens
*Stratum_Keyword:* Photographs
*Stratum_Keyword:* Specimens
*Stratum_Keyword:* Collector
*Stratum_Keyword:* Museum
*Stratum_Keyword:* Location information
*Stratum_Keyword:* Habitat
*Stratum_Keyword:* Field Notes
*Temporal:*
*Temporal_Keyword:* Historical
*Temporal_Keyword:* Current
*Access_Constraints:* No Constraint
*Use_Constraints:* Require Citation.
*Point_of_Contact:*
*Contact_Information:*
*Contact_Person_Primary:*
*Contact_Person:* Dr. Suzanne Carriere
*Contact_Organization:*
Environment and Natural Resources, Gov. of the Northwest Territories
*Contact_Position:* Ecosystem Management Biologist
*Contact_Voice_Telephone:* 867-920-6327
*Contact_Facsimile_Telephone:* 867-873-0293
*Contact_Electronic_Mail_Address:* suzanne_carriere@gov.nt.ca
*Data_Set_Credit:* GWNT. (current). The NWT Virtual Herbarium. (Date Accessed). Version accessed

*Native_Data_Set_Environment:* Microsoft Windows XP Version 5.1 (Build 2600) Service Pack 1; ESRI ArcCatalog 9.1.0.722

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*Spatial_Reference_Information:*
*Horizontal_Coordinate_System_Definition:*
*Local:*
*Local_Description:* Northwest Territories, Canada
*Local_Georeference_Information:* Contains some records outside the NWT: Yukon and Nunavut

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*Entity_and_Attribute_Information:*
*Detailed_Description:*
*Entity_Type:*
*Entity_Type_Label:* NWT Virtual Herbarium Version June 2008
*Attribute:*
*Attribute_Label:* OID
*Attribute_Definition:* Internal feature number.
*Attribute_Definition_Source:* ESRI
*Attribute_Domain_Values:*
*Unrepresentable_Domain:*
Sequential unique whole numbers that are automatically generated.
*Beginning_Date_of_Attribute_Values:* 1850
*Ending_Date_of_Attribute_Values:* Current
*Attribute_Label:* FAMILY
*Attribute_Label:* FAMILY_IMA
*Attribute_Label:* DAO_ACC_NO
*Attribute_Label:* BINOMIAL__
*Attribute_Label:* ITEM_COUNT
*Attribute_Label:* SYNONYM
*Attribute_Label:* COLLECTOR(
*Attribute_Label:* DATE_COLL
*Attribute_Label:* COLL_FIELD
*Attribute_Label:* IDENTIFIED
*Attribute_Label:* IDENTIFI_1
*Attribute_Label:* LOCALITY
*Attribute_Label:* SITE_DESCR
*Attribute_Label:* UTM
*Attribute_Label:* ELEVATION
*Attribute_Label:* FLOWERING
*Attribute_Label:* LAT
*Attribute_Label:* LONG
*Attribute_Label:* LATDEC
*Attribute_Label:* LONGDEC
*Attribute_Label:* LOC_ACCY
*Attribute_Label:* OTHER_NOTE
*Attribute_Label:* FLOWERIN_1

*Attribute_Label:* CALCULLATD
*Attribute_Label:* CALCULLONG
*Attribute_Label:* GSRANK
*Attribute_Label:* PREVIOUS_I
*Attribute_Label:* YEAR_OF_PR

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*Distribution_Information:*
*Contact_Information:*
*Contact_Organization:* ENR, GNWT
*Resource_Description:* Downloadable Data
*Transfer_Size:* 44.139
*Fees:* None

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*Metadata_Reference_Information:*
*Metadata_Date:* 20080626
*Metadata_Review_Date:* 20080626
*Metadata_Future_Review_Date:* 20090620
*Metadata_Contact:*
*Contact_Information:*
*Contact_Organization_Primary:*
*Contact_Organization:* ENR, GNWT
*Contact_Person:* Dr. Suzanne Carrière
*Contact_Address:*
Box 1320
Scotia Centre 5th floor
*Address_Type:* Mailing and physical addresses.
*City:* Yellowknife
*State_or_Province:* Northwest Territories
*Postal_Code:* REQUIRED: X!A 2L9
*Contact_Voice_Telephone:* 867-920-6327
*Contact_Facsimile_Telephone:* 867-873-0293
*Contact_Electronic_Mail_Address:* suzanne_carriere@gov.nt.ca
*Metadata_Standard_Name:* FGDC Content Standards for Digital Geospatial Metadata
*Metadata_Standard_Version:* FGDC-STD-001-1998
*Metadata_Time_Convention:* local time
*Metadata_Extensions:*
*Online_Linkage:* <http://www.esri.com/metadata/esriprof80.html>
*Profile_Name:* ESRI Metadata Profile

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