

FRST 200 Term Project - Herbarium Assignment

INSTRUCTIONS FOR PREPARING YOUR HERBARIUM

The following background text are excerpts from the Kew Botanical Gardens website. Located in the UK, Kew is one of the world's oldest and historically important scientific botanical institutions. You can read the full version online for additional information and to see images of herbarium specimens/ how to prepare them: <http://apps.kew.org/herbcat/gotoWhatIsHerbarium.do>

What is a herbarium?

A herbarium is a collection of preserved plants stored, catalogued, and arranged systematically for study by professionals and amateurs from many walks of life. A collection like this is a vital reference when you need to identify a plant and also serves to fix forever the identity of thousands of plant names. A herbarium is a cross between a museum of priceless artefacts and a warehouse of birth certificates for plants; and acts as a source of information about plants - where they are found, what chemicals they have in them, when they flower, what they look like. Preserved plant specimens can be used to provide samples of DNA and to validate scientific observations. A herbarium is therefore of immense practical use and of fundamental importance to science.

Individual plants or parts of plants, are preserved in various ways, stored and cared for over time so that current and future generations can identify plants, study biodiversity and use the collection in support of conservation, ecology and sustainable development. Herbaria that organize their specimens systematically, by family, genus and species, serve as a working hypothesis of a classification of all plants. Specimens from related species are found close to one another thus facilitating their comparison.

How are the plants collected?

Traditionally plants have been pressed between sheets of newspaper (to absorb the moisture). A special plant press, designed for the purpose, is used and the plants dried, under a low heat, using purpose-built stoves or by leaving the press in the sun (possible in hot, dry climates). These techniques are still used today and Kew botanists have developed presses and stoves that both allow the plants to dry as quickly as possible (conserving as much of their original colour and features as possible) and are highly portable (since they need to be used in remote places). Pressing and drying the plants as soon after collection as possible also helps to preserve their original colour and shape. Historically, a regular chore during expeditions was to change the newspaper in the presses to dry the specimens more quickly. Today, many botanists will use large sheets of blotting paper, cardboard and corrugated sheets of aluminium in between the specimens to ensure they dry quickly.

How are the plants stored and preserved?

Once the specimens are identified, they are mounted on hard paper or card. In the literature, you will see these mounted collections being referred to as specimens, exsiccatae or herbarium sheets. To mount the specimens successfully, the technicians follow painstaking methods that have evolved over centuries. They aim to preserve the specimen carefully whilst exposing to view all possible aspects of a plant: its flowers – with all their petals; their fruit; seeds; the hairs on both upper and lower surfaces of the leaf and so on. Mounted, identified specimens are stored in cupboards of an appropriate size. The collections are organised carefully within these cupboards.

Why do we label the specimens?

There are two reasons for having a label on each and every specimen in the collection.

- To distinguish between one collection and another – just as in a museum every object is identified by a unique number or barcode. Curators of a herbarium collection and scientists communicating with one another around the globe need some unambiguous way of referring to each individual specimen.
- To record additional important information about the plant as it was when collected. This is especially important for trees — where the herbarium specimen is only a small portion of the plant.

How do we uniquely label specimens?

Many specimens of the same plant species might have been collected in different places, at different times and by different people and so we need some other way of referring unambiguously to the individual specimen. Each specimen is labelled using two pieces of information: the name of the person(s) that collected the plant and that person's collection number.

At the start of their career, each botanist collects their first plant - this is known as number 1. They then move on to make collection number 2 and so forth. Active collectors will collect many thousands of plants during their lifetime, thus specimen R.Harley 50594 is the 50594th specimen collected by Ray Harley. This number is unique: Harley will have no other collection sharing this number. This simple procedure allows scientists to publish scientific papers and books referring to the specimens they have seen and to know that they are communicating effectively with one another about the plants studied.

What other information is recorded on the label?

A plant in the reference collection is most useful when we know exactly where it was collected (in modern collections this is recorded using GPS equipment) and a description of its habitat (ecology), appearance when alive (especially important since flower colour for example will be lost when the plant is dried) and other information, such as the uses to which it may be put locally or insects that were seen visiting the flowers.

Careful labelling of plant samples is important and modern plant collectors record a wealth of useful information on the specimen label. A label typically includes the plant family, a first attempt to identify it, any popular (common) names used locally, plus its position and locality, and the date of collection. The latter gives biologists studying reproductive behaviour vital clues to the times of the year a plant can be expected to be in flower and fruit. Features of the plant that cannot be collected (the height of a tree, the presence of latex) or that get lost upon pressing (colours and odours) are also annotated, as they can help identify the specimen later on.

Where are the herbaria in BC?

The UBC Herbarium is the largest in western Canada and houses over 500,000 plant specimens. Royal BC Museum has a botany collection consisting of more than 215,000 dried plant specimens and their collection is one of the largest reference collections for BC plants in the world. The BC Conservation and Data Centre (CDC) also catalogs plants, compiles lists of species, and maps their distributions. This scientific information is available for scientists, researchers and managers to monitor species, help conserve the province's biodiversity, and inform policy makers.

FRST 200 HERBARIUM ASSIGNMENT

The primary purpose of the herbarium assignment is to give you the opportunity to **observe plants** – to observe plants in their habitat, to observe their structural differences, and to observe their status and condition. It is frequently too easy to be superficial about looking at plants and miss their diversity, for the important differences are often small in size, obscured by other tissues, or not easily immediately perceived. This assignment is also an exercise in **data acquisition**, for a good herbarium when combined with other collections can provide a wealth of information on habitat, species range, phenology, genetic diversity, abundance and spread. Finally, this assignment will give you **experience in identifying plant species** using books, identification keys and related tools. Being a good plant collector takes training and practice, and makes use of many skills – observation, attention to detail, accuracy, and patience. These are definitely valued skills that are necessary in the workforce today!

The herbarium is due at the end of term. You should hand your collection and report in on the last day of Term 1 classes.

WHAT AND WHERE TO COLLECT

Start collecting now!! (You will learn to identify your specimens later). Each student is required to prepare a herbarium collection of five flowering plant species. We suggest collecting at least ten plants and choosing the best five for your assignment. Collections of flowering plants should be undertaken before winter dieback begins. A complete herbarium specimen has flowers and/or fruits, the full stem, all leaves (which may vary from the base to the top), and (if practical) a small, clean sample of roots. Flowers/fruits (the reproductive structures), in particular, are critical to getting a positive and definitive identification, so prioritize collecting early while reproductive structures are still abundant. At this time of year, most plants are more likely to be in fruit than in flower but you might be lucky and get some flowers.

Plants you must collect: one specimen from the Asteraceae (daisy family – goldenrods, dandelions, daisy-like flowers, thistles), two specimens from the Poaceae (grass family) or Cyperaceae (sedge family) or Juncaeae (rush family). The other two are up to you but with some exceptions...

Plants to avoid: No trees and no conifers (pines, spruces, yews, junipers, etc.). No ferns, horsetails, seaweed or other non-flowering plants. Also, no crop plants, ornamentals, or garden plants. These will be given a mark of zero.

We prefer *invasive* and/or weedy plants because they are easy to collect but often not so easy to identify and can be significant problems in conservation biology and forest regeneration through their competitive effects on native plants. Also, by emphasizing weeds, we don't run the risk of sending you off to collect rare native plants by mistake! Weedy plants can easily be found along road and railway right-of-ways, back alleys, the Arbutus corridor, in sidewalk cracks, drainage ditches, vacant lots, abandoned farm fields, etc. If you're unsure about whether a plant is a weed or native to the site, that's not a problem – we'll accept it either way.

MAJOR DON'TS: Do not collect from city, provincial and national parks or ecological reserves (it is illegal!). This includes all of Pacific Spirit Park and Stanley Park. **Do not bring specimens into Canada from any other country** - it is illegal and unsafe to transport plant materials across international borders without an import permit and phytosanitary certificate. This policy exists for a good reason - to prevent the spread of harmful plant insects and diseases, as well as to reduce introductions of non-native invasive plants.

HOW TO COLLECT

If you do not have a plant press handy, specimens should be collected and kept in plastic bags until ready for pressing. This will greatly aid in keeping your plant specimens fresh until you can get them into a press. In dry weather, including a small amount of wet paper towel or damp moss in the bag with the specimens can keep them from drying out. It is a good idea to use a separate bag for each plant you collect. Why? If the leaves or flowers or fruits fall off, you can be certain which specimen they belong to. A small sheet of paper or label written in pencil (pen ink can run) with the sample location or some other identifier should be included in each specimen bag.

Plant collecting is best done in dry weather conditions, although in many areas of the province the field seasons are anything but dry. Plants collected in wet weather have a relatively higher content of water and will take proportionally longer to dry in the press. Also, if stored too long in plastic bags or not handled properly, the specimens can quickly become black, moldy, smelly and/or discolored. Aquatic plants are especially prone to becoming mushy and generally unpleasant. For all specimens, the faster the drying, the better the plant is preserved.

A good plant specimen needs all those plant parts that are necessary for proper identification. Herbaceous plants should include at least part of the stem, leaves, fruit, flowers and, if you can, part of the root system. Special attention should be made to collect a specimen that best represents as many of the plant features as possible so you can identify it.

Grasses, sedges, and rushes often require that at least part of the root system be included. Shrub specimens should include twigs, leaves, flowers or catkins and a description of the whole plant. When collecting all but the larger plants, care should be taken in keeping the plant intact. This will avoid losing parts of the plant that may be important for identification.

With each specimen, the site and other collection data (see below) should be recorded in a notebook right at the time of the collection. Don't rely on your memory! The details will soon get confused and mixed up if you try to just memorize the information at each collection site.

WHAT INFORMATION TO RECORD WHILE COLLECTING

Take a notebook with you while you are out collecting. You must take the time to write down some critical information while you are out collecting. Why? This will make your life a lot easier when it comes time to make your collection labels. Information that you need to record includes:

1. the date
2. the collection number (the first plant you collect is #1, the second is #2, etc.)
3. your location, including the closest city (and road intersection if you're in a city), and your approximate elevation
4. a description of the habitat where you found the specimen, which might include soil type and moisture, amount of shade, degree of disturbance, and a description of surrounding vegetation (this can be quite basic, such as "dry, rocky soil with substantial shading by a coniferous overstory"). You can also include a photograph of the plant taken in its habitat with each specimen justification.
5. identifying characteristics and notes that aren't captured by the specimen alone. For example, plant height if it is a meter-high shrub and you just chopped off the top 10 cm. Also, if the specimen you collect does not have a complete set of characteristics (flowers *and* fruits) but surrounding ones do, record what your specimen is lacking.
6. a description of those plant features which may change during pressing. Flower colour and smell are good examples since these often fades. Photos for flowers can be useful here too.

PRESSING AND MOUNTING SPECIMENS

Plants should be pressed and dried between sheets of newspaper according to the instructions given below. **Moldy specimens are unacceptable.** Pressed specimens may be mounted in photographic albums (with or without plastic cover sheets), or on pieces of stiff paper or poster board (no larger than 11"×16").

HOW TO PRESS

Each specimen is laid in a folded sheet of newspaper and arranged so that it will fit on an 11"×16" sheet of paper. Long specimens may have to be folded or cut in order to fit them into the press. Carefully arrange your plant specimen so it will give the maximum amount of information possible. This means making sure you don't have important parts folded over or covering each other. You should show:

- clear and direct views of flowers or fruit
- top and bottom surfaces of leaves
- roots, if possible (no soil attached!)

Data collected with the specimen (especially the collection number) can be written along the margin of the newspaper to prevent loss of data. To avoid confusion, only one species (one type of plant) should be pressed within a newspaper folder. In other words, use separate sheets and folders for different plant samples. Don't try to stuff all your plants into one sheet of newspaper!

It may not be practical to press bulky or squishy fruits, in which case they can be removed carefully and dried in small paper bags or envelopes and later attached to the sheet for the main specimen. The collection number is recorded on the outside of the bag or envelope.

There are proper plant presses, but unfortunately we do not have enough for the whole class. To make a homemade press, get some heavy books (textbooks, phonebooks) or bricks and lots of newspaper. Try to find or make a number of cardboard sheets too (cutting up old boxes work well). Lay a cardboard sheet on the bottom, then a specimen in its newspaper folder, then another cardboard separator, then another specimen, and so on until all the material to be pressed is in. If you have wet material, you can add some extra newspaper sheets and paper towels to absorb the water. If you have bulky material (thick stems or root bulbs) you may either have to carefully cut these in half or added folded paper/paper towel next to the bulky bit to support it while the plant is drying. Recommendation: press bulky plants and aquatic plants separately.

Place the heavy books (or bricks) on top of your stack of cardboard separators and newspaper folders with plants in them. Make sure that the pressure is fairly even across your pile. The press should be opened and inspected daily and the dried specimens removed. During the inspection of the press material, if you note that any of the folders are damp or wet they should be replaced with dry newspaper. This is especially true for aquatic plants! There is **less chance of mildew or mold occurring when plants are cared for and dried quickly**. In good weather, the press can be placed in a sunny, dry, well-ventilated location during the day and brought in for the night. During poor weather or at night, the press can be placed near a stove or heater, taking care not to cause a fire or scorch the specimens. It is important that air flow freely around the press and through the corrugations in the cardboard (it might help to use a fan on the side of your specimen stack).

STORING

Once dried, keep your specimens horizontal (gravity causes loose bits to fall out!). Dried specimens in their labeled newspaper folders should be kept in a cardboard box (preferably one with a lid to keep out dust, rodents and insects) and stored in a cool, dry place.

HOW TO MOUNT

Each specimen will be laid on its own piece of mounting paper. You can use photographic albums (with a sticky adhesive) or stiff paper like posterboard or construction paper. Carefully remove the plant from its newspaper folder and place it on the mounting sheet. You should arrange the plant to look as natural as possible and show all the parts mentioned above (top and bottom surface of leaves, flowers etc.). You also need to leave space at the bottom right hand corner for the label.

If you are not using sticky photographic album sheets, plants can be mounted by tacking them down in a few places with white glue or tiny pieces of tape. Don't use staples. Definitely don't glob glue everywhere! The ultimate goal is to attach the plant to the sheet securely using as few contact points as possible.

If you had to fold your specimen, make sure the roots (or lowest area) are at the bottom of the page. If you had to cut your specimen, you should arrange it so that pieces are side by side and in order. If there are more than two pieces, you need to have small letters written on the sheet indicating where the attachment points are (even if you think it is obvious).

If you had to take fruits off to dry them **OR** if pieces fall off your specimen, like leaves or flowers, collect them and place into a small envelope. The envelope should be glued to the sheet with flap side out so you can get the plant pieces in and out of the envelope. Usually, small envelopes will be off to the side so that they do not interfere with the main plant specimen or the label.

HOW TO MAKE HERBARIUM LABELS

Labels on each specimen must include:

- a collection number (this should correspond to a Table of Contents sheet you will add at the beginning of your herbarium)
- the species name including the Latin name (with authorities), common name (optional), and family name (Latin)
- the collection date, geographic location and habitat info as per what you wrote down while you were collecting (feel free to add the biogeoclimatic zone, latitude and longitude according to Google Earth, etc. if you feel inspired)
- include other data you might have recorded about the plant itself that might not be obvious from the dried specimen (colour of flowers, size of fruit, smell, pollinators that visited flowers etc).
- the name of the person who collected the specimen. **This should be you.**

Labels should be thoroughly attached with glue to your herbarium sheet. Place them at the lower right hand corner flush with the edges of the mounting paper. Make sure they are not on top of your mounted plant specimen! You will need to carefully arrange things so there is space for both the plant and the label.

HANDING IN YOUR HERBARIUM COLLECTION

The herbarium is due at the end of term. You should hand your collection and report in on the last day of Term 1 classes.

Along with your five beautifully mounted and annotated plant specimens, please include the following two items:

1. A covering sheet called 'Table of Contents' (list of your specimens in order of collection number and include Latin names), your name and your student number.
2. An addendum (document at the end) that is **your justification** for each plant identification using key features for each specimen. You should have five justifications (maximum one page each, so five pages total). This should include general growth form, leaf features, and reproductive features. You can also include any descriptive information that helped you to know what the species was and photos you may have taken. **It is not acceptable to copy this information off books, websites or other materials.** The description must be in your own words, and include only the characteristics that you observed in the field, can see on your specimen, and that you understand. If you have worked with a friend on this project, you must both provide differently worded justifications (don't copy each other's paragraphs!). Do not note characteristics that are absent from your specimen – if you did not see flowers (on your collected plant or any other one of the same species nearby), don't justify your identification with this information.
3. Extra: If you wish to include a photo of your plant, add it to the addendum along with each justification. This may be helpful for us to check your plant identification.

GRADING

The preparation of a good herbarium collection takes time and care.

Grading will reflect this and is as follows:

- **20 points for specimen and mounting quality**
- 30 points for accurate identifications (typically two points each for family, genus and species). Grasses are difficult, so if you're only able to identify the specimen to tribe (a kind of "sub-family"), we'll be happy.
- 20 points for correct labeling, including location, habitat description, sample # and date
- 20 points for complete descriptions of identifying features justifying your identification
- 10 points for the Table of Contents (including Latin names and collection numbers) and general organization of your collection.

If you have any questions about this assignment, see the course instructors or TAs.

THINGS TO REMEMBER

You must have specimens of at least two different grass or sedge or rush species, and one aster (daisy family). **Plants to avoid:** No trees and no conifers (pines, spruces, yews, junipers, etc.). No ferns, horsetails, seaweed or other non-flowering plants. Also, no crop plants, ornamentals, or garden plants. These will be given a mark of zero.

It helps to collect more than five plants so you can **pick your best specimens** for the assignment.