

DENVER BOTANIC GARDENS
KATHRYN KALMBACH HERBARIUM
PROCESSING PROTOCOL
Updated on October 18, 2016

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INTRODUCTION

Background

Specimens enter this processing workflow after they have been collected from the field, pressed and dried, identified and frozen. Kathryn Kalmbach Herbarium (KHD) processes collections from oldest to newest and in batches, by collector.

Because we are working through hundreds of specimens at any given time, it is extremely important to follow the processing workflow, maintain the existing organization, and take a few extra seconds to check for accuracy.

Most importantly, if you have *any* questions, don't be afraid to ask!

Essential Herbarium Specimen Components

Voucher

Vouchers, or specimens, (Figure 1) are made by collectors wishing to document the presence of an individual or a population from a particular species, at a particular location, at a particular point in time.

A good collection will contain enough quality plant material for researchers to identify, dissect, and study for hundreds of years.

Plants, just like animals, have nuanced anatomical features, which botanists need to study our specimens for hundreds of years. An ideal specimen will contain as many anatomical features as possible, in a range of developmental stages. An ideal finished herbarium specimen will highlight all of these features.

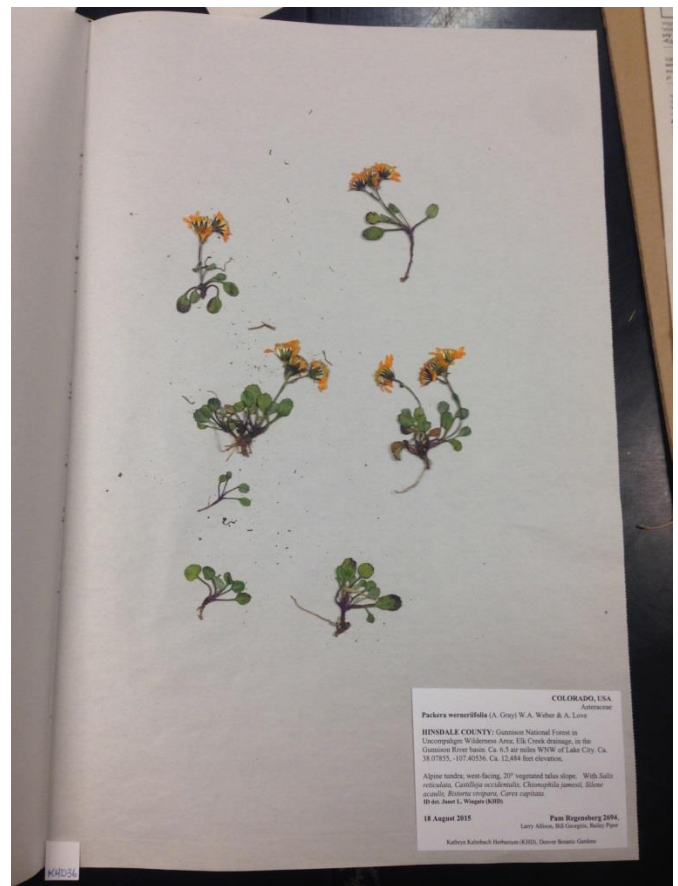


Figure 1. A standard voucher and label

Label

Each voucher is accompanied by a label (Figures 1 and 2), which contains very detailed information including the collector's name and number, the specimen's taxonomy, location and date of collection, habitat, description, and other observations from the collector. **The label is always glued to the mounting paper's bottom righthand corner.**

		COLORADO, USA Boraginaceae	
		<i>Lappula marginata</i> Gürke Det: Don Hazlett, 18 May 2015	
		MORGAN: Wildcat ranch, West of Rd 10, 1/4 mile N of Rd JJ, @ 13.5 miles NNE of Weldona. 40.5141, -103.9568. Ca. 1470m elevation. With <i>Bouteloua gracilis</i> , <i>Gutierrezia sarothrae</i> .	
		Shortgrass prairie below sandstone rock outcrop, south slope, sandy loam soil. Pale blue, five petaled actinomorphic blooms. Flower.	
		18 May 2015	Bruce Bosley, 15-33 Pamela Regensberg; Don Hazlett
		Kathryn <u>Kalmbach</u> Herbarium (KHD), Denver Botanic Gardens	
STATE, U.S.A.			
Species name Author	FAM CODE		
COUNTY: Gross and specific location info. UTM NAD 83, Zone 13, Easting, Northing or Lat/long. Associated species. Habitat description. Elevation.			
Day Month Year	Collector name #		
Affiliation			

Figure 2. Sample labels

The label is a physical analog of the electronic record on SEINet, our database.

Barcode

Each voucher receives a unique barcode (KHDXXXXXXXXX) sticker that corresponds to its electronic record on SEINet. **The barcode is always placed on the mounting paper's bottom lefthand corner.**

Adhesives

KHD uses a combination of Missouri-type archival glue and linen strips (Figure 3) to mount specimens and labels.



Figure 3. Strips of linen tape can be cut to a variety of sizes

Optional Herbarium Specimen Components

Annotations

Annotation labels may also be present, if the collector, a researcher, or other associates added more information about the specimen or make any amendments to the original information.

Annotations may be added during initial processing or afterwards.

Ideally, the annotation labels are placed directly above the original label.

Packets

Smaller packets are containers for extra plant material of particular research value (ie inflorescences, seeds, fruits) or loose fragments of a specimen.

Larger packets are used to hold specimens that are particularly small and/or difficult to mount. They may also be used as an alternative to gluing down a specimen with key anatomical features on both sides.

Packets are placed anywhere on the mounting paper, but ideally in a location that will not touch the voucher nor the label when the packet is opened.

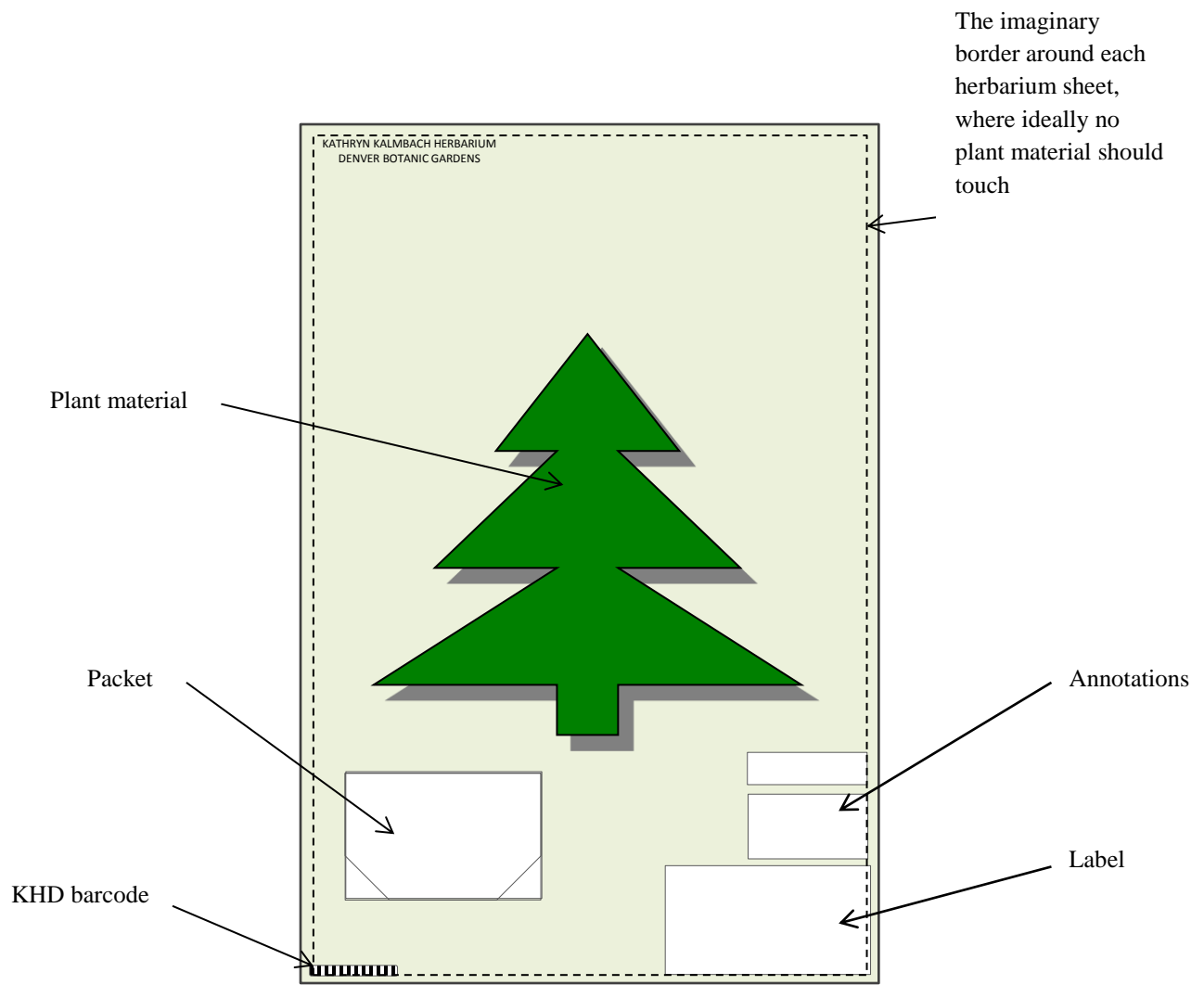


Figure 4. Schematic example of a herbarium specimen

LABEL PASTING

Supplies:

- Unprocessed voucher
- Mounting paper

Steps:

1. Remove a folder from the processing cabinet A. Inside each folder, you will find stacks of newsprint, each containing a voucher and the corresponding label.
2. **CHECK:** The numbers on the newsprint, the label, and the annotations (if any) must match before you continue (Figure 5). If not, put specimen aside for staff review.

These numbers correspond to the entry in the collector's field notebook and is unique to this specimen. If they don't match, there has been some an error in data entry or sorting.

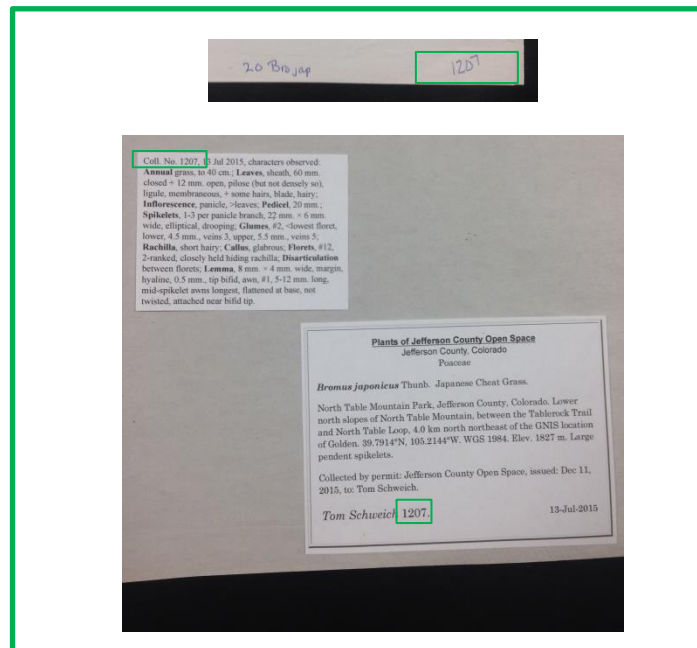


Figure 5. An example of matching newsprint, label, and annotation

3. **CHECK:** Refer to the “Field identification of the 50 most common plant families in temperate regions” cheat sheets in the protocols binder. To the best of your knowledge, confirm that the family on the voucher label fits the cheat sheet description. If something does not seem correct, put the specimen aside for staff review.
4. Apply a very fine line of glue along the top edge of the label. Line up and place along the bottom righthand corner of the mounting paper. Smooth the glue with your finger. There should be no buckling or puckering of the paper. Repeat for any annotations.

5. **CHECK:** If the voucher belongs to the Poaceae or Salicaceae families, or the genus *Carex* (family Cyperaceae), place in the “FOR JAN TO ID” cubbies in cabinet B.
Jan will provide a second determination of the species ID for these tricky groups and return back to the processing workflow.

ARRANGEMENT

The effort and thought put into arranging a specimen for mounting makes all the difference. The main goal of arrangement is **to display the specimen and data as best as possible, and enable maximum observation to be made in the future. It is a balance between aesthetics and scientific usefulness, and each specimen should be thought of as a work of art.**

Supplies:

- Voucher with matching label and/or annotation
- Mounting paper

Steps:

1. Remove dirt or debris as best as possible, without damaging any plant material.
2. Arrange the voucher on the mounting paper following the guidelines in Appendix ii.
3. If a packet is used for any reason, remember to incorporate it into your arrangement.
4. If there is enough plant material to make a quality second specimen, place the remaining material back into the original newsprint and put it to the side for staff review.

Extra collection material can potentially be used as a gift or exchange with our sibling herbaria.

MOUNTING

When you are satisfied with your arrangement, you are ready to mount!

The goal of mounting is **to preserve the specimen so that it will remain intact and useful for hundreds of years. The specimen should be firmly secured to the sheet but not completely attached, to allow for the removal of portions for future study.**

Cardinal rules:

- Do not discard any plant material without permission
- Be careful not to mix up labels
- Put the specimen aside and ask questions when you are not sure
- Wash your hands before and after mounting

Supplies (Figure 6):

- Arranged specimens
- Stack of cardboard
- Archival quality white glue
- Gummed linen tape
- Scissors
- Shallow container of water (for wetting linen tape)
- Various microspatulas and microscrapers
- Small paintbrush
- Wooden blocks (for creating a stack of drying specimens, Figure 7)
- Weights (to secure stubborn, squishy, or flimsy plant material while the adhesive dries)

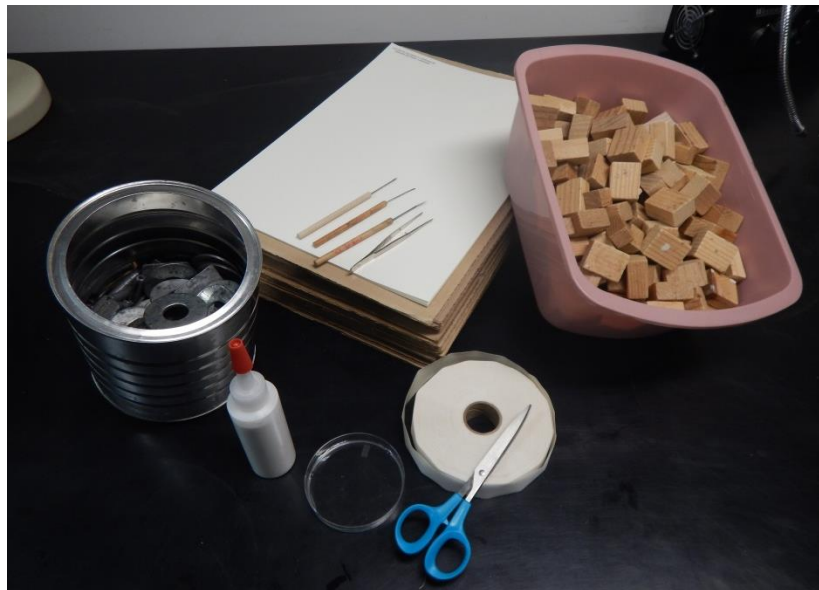


Figure 6. Mounting supplies

Steps:

1. Lay out arranged specimen on top of a sheet of cardboard.
2. **Think before you do anything!** Each voucher will require a unique approach. Some are exclusively fit for strapping, others may only need glue, but most will use a combination of the two adhesives.

Strapping with linen strips is preferable because specimens can be more easily removed from the sheet, if need be.

Glue should be used at your discretion to attach rootballs, proportionally heavy and unweidly portions of the plant, or in areas that simply cannot be effectively strapped down, such as a wide clump of plant material.

3. Adhere the specimen to the mounting paper using any or all of the following techniques, in the order you have determined to be best. Refer to Appendix iv.

If strapping: Cut a linen strip of the appropriate length and width. Wet by dipping in the dish of water, or use a paintbrush. Strap across, firmly tacking each end to the paper, preferably keeping strap parallel to the top edge of paper. Use weights to firmly tack down the ends, if necessary. (Figure 7)

4. If a packet accompanies the voucher, carefully open and remove all material from the packet. Apply a very thin layer of glue to the packet's back surface and mount. Smooth out and then put all plant material back into the packet.
5. When finished, place a wooden block at each corner of the cardboard and add to your drying stack. Washers may stay while the glue and tape dries, if necessary. (Figure 7).



Figure 7. A stack of mounted drying specimens

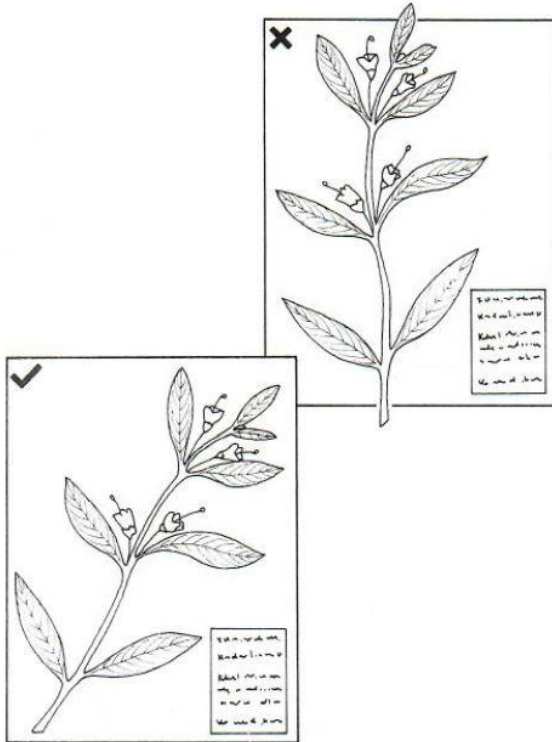
6. Allow specimens to dry completely before putting away. If you glue bridge method (Appendix iv, Figure , pay particular attention to these specimens, as the bridges will take several hours to dry.
7. When the specimens are dry, carefully tear down the stack and place 10-15 mounted specimens in a folder. Place folders of mounted specimens in processing cabinet B, under “To be databased”.

APPENDIX

- i. Arrangement guidelines
- ii. Mounting guidelines
- iii. Good examples
- iv. “Field identification of the 50 most common plant families in temperate regions”

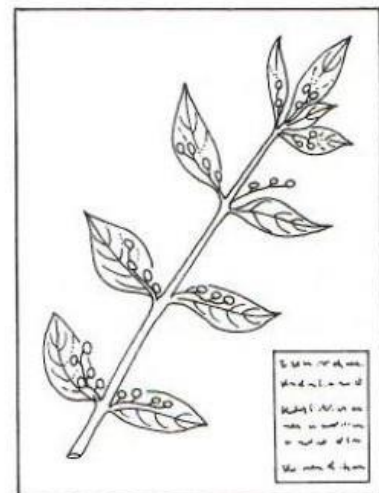
Arrangement guidelines

The following images and guidelines on specimen arrangement have been adapted from Diane Bridson and Leonard Forman’s *The Herbarium Handbook*.



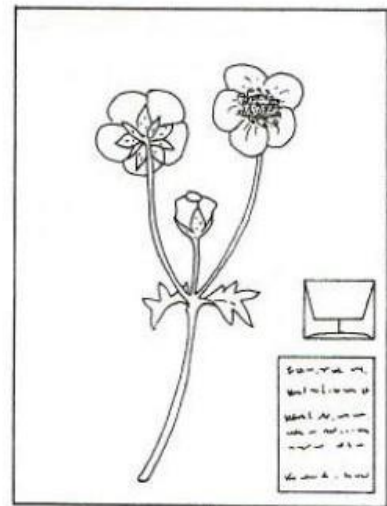
Arrange large specimens diagonally to avoid removing any pieces or obscuring the label.

Choose the best side to display as many anatomical features as possible.

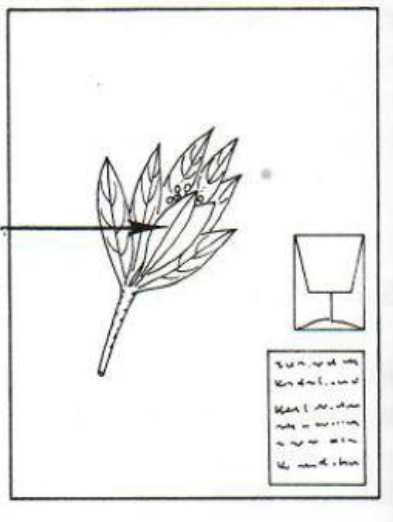




Display both sides of leaves. If necessary, remove one leaf and place in a packet.



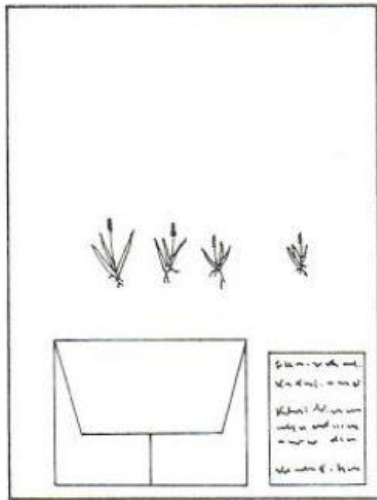
Display both sides of the inflorescence whenever possible.



Expose hidden flowers and fruits by removing leaves and placing in a capsule.

For over-sized specimens:

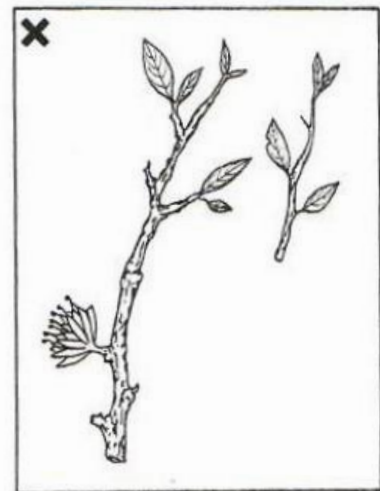
1. Trim just the stem if possible.
2. Trim leaves only if plenty of good whole leaves are left.
3. Remove a whole leaf and place in a packet.



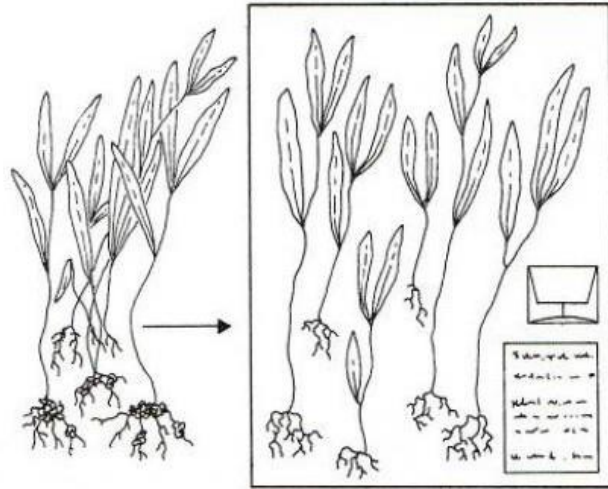
For tiny plants:

1. If there are many, spread out a few and place the rest in a packet.
2. If there are few, place all in a packet.

Avoid placing bulky or delicate items along the left side of the sheet. They can be crushed in the folder in the herbarium.

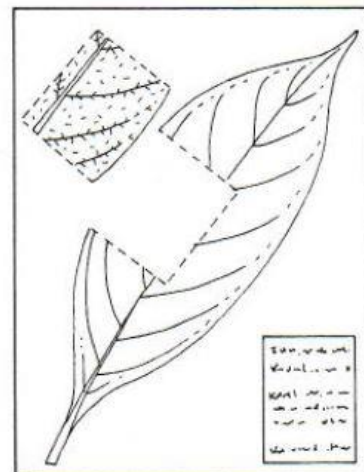


Carefully remove excess soil from the roots.
Separate clumps of plants if necessary.

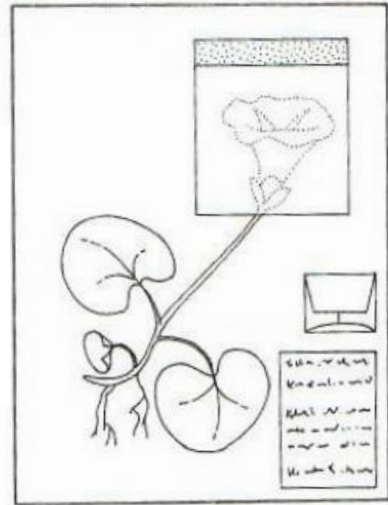


Trim lumpy specimens with forwardly projecting pieces, which could cause damage to adjacent sheets in the herbarium.

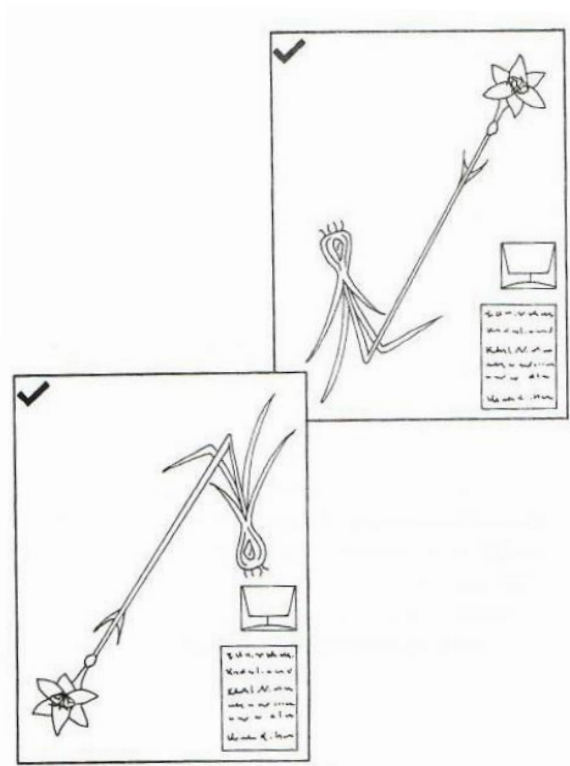
For single large leaves, remove one part and turn, or place in a packet.



Do not directly attach single large inflorescences. Instead, protect it with a 'window' of translucent paper. Secure the window by a single outer edge, so it can be folded back for close study of the flower and its attachment to the rest of the specimen.

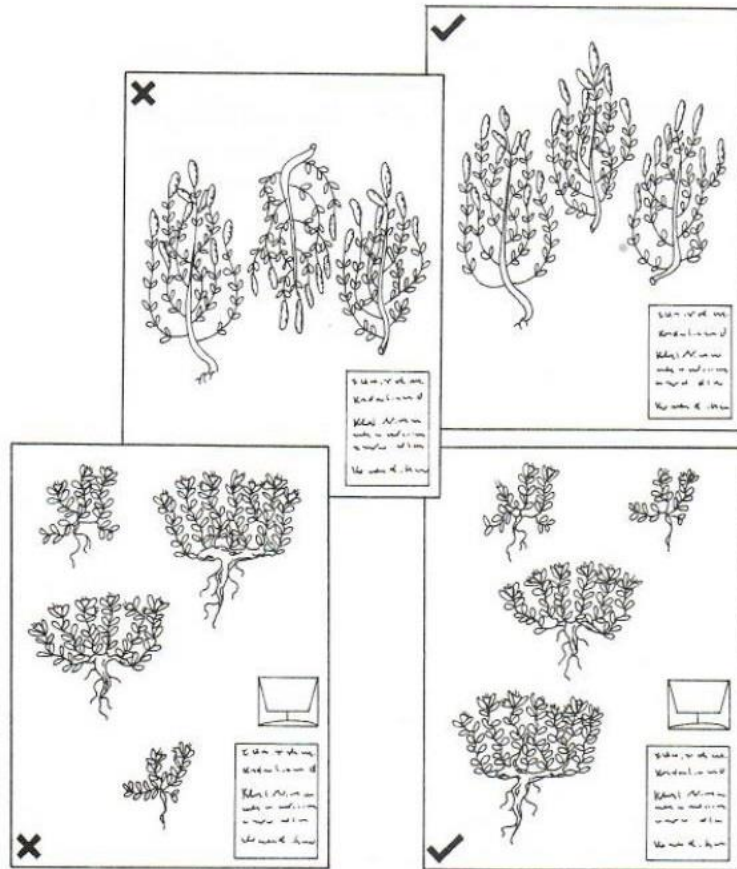


Overly-tall specimens can be folded to fit the sheet. Apex pointing up or down is acceptable.



When arranging multiple plants on one sheet:

1. Keep them all aligned the right way up.
2. Place the largest and heaviest specimens at the bottom, to prevent the sheet from becoming top-heavy and bending when handled.



Oftentimes, a collector will deposit duplicates or excess material to the herbarium. When selecting which pieces to mount, **do your best to represent the greatest range of anatomical variation in the duplicates.**

Examples of variation that can occur within a single species include:

- Overall size
- Developmental stages (ie. Juvenile foilage vs adult foilage, flower buds vs flowers vs young fruits vs mature fruits)
- Branching pattern
- Ranges of leaf shape
- Size of leaves
- Leaf arrangements
- Unisexual flowers – if the flowers are unisexual, represent both male and female

Mounting guidelines

KHD uses a combination of three methods to mount plant specimens:

Strapping

KHD prefers this method because specimens can be easily removed from the sheet if necessary. It is also easier to manipulate or wiggle a specimen on the sheet, for better observation.

Cut and apply a wettened linen strip of the appropriate length and width. Use weights to firmly tack down strips' ends, if necessary. (Figure x)

The strip should be long enough to wrap securely around the plant material and attach firmly to the sheet. The strip's width will vary depending upon the plant's bulk; use thinner strips across finer specimen parts and thicker strips for extra strength.



Figure 8. Applying a linen strip

When strapping, remember the following:

- Use thinner strips for fine plant parts and thicker straps for extra strength on bulky parts
- DO NOT strap over any important anatomical features (see Appendix i), especially nodes and any points of attachment (ie inflorescence to stem, leaf to stem, root to stem)

- DO NOT strap over an inflorescence. Exceptions to this include long, large and or/delicate inflorescences, such as those found on a grass

Standard gluing

The specimen is securely attached to the sheet wherever glue is applied, making this method best for root balls, bases, or other heavy pieces.

Apply glue sparingly on the plant's backside, only where necessary (Figure 9). Flip rightside up and press down firmly. Use weights to apply consistent pressure where necessary (Figure 9).



Figure 9. Using glue and weights to securely attach thicker plant material

Remember the following:

- Use glue sparingly. Keep the appearance of the specimen as neat and natural as possible
- Avoid gluing down inflorescences whenever possible. Exceptions to this include when there are many flowers, or the flowers are compound such as in the Asteraceae family
- DO NOT glue leaves down
- DO NOT glue nodes
- Be careful to not set weights on glue as it will tear the paper or pull the plant off the paper when the weight is removed

Bridge gluing method

Using a fine-nozzled glue bottle, carefully apply a “bridge” of glue over plant parts. This technique works best for a fine plant part, especially when it cannot be strapped down without damaging or overlapping other nearby plant parts. (Figure 10).



Figure 10. Using the Archer method to secure a fine part in a tricky spot. A washer holds down flimsy, flyaway pieces while the glue dries

When using the bridge glue method, remember the following:

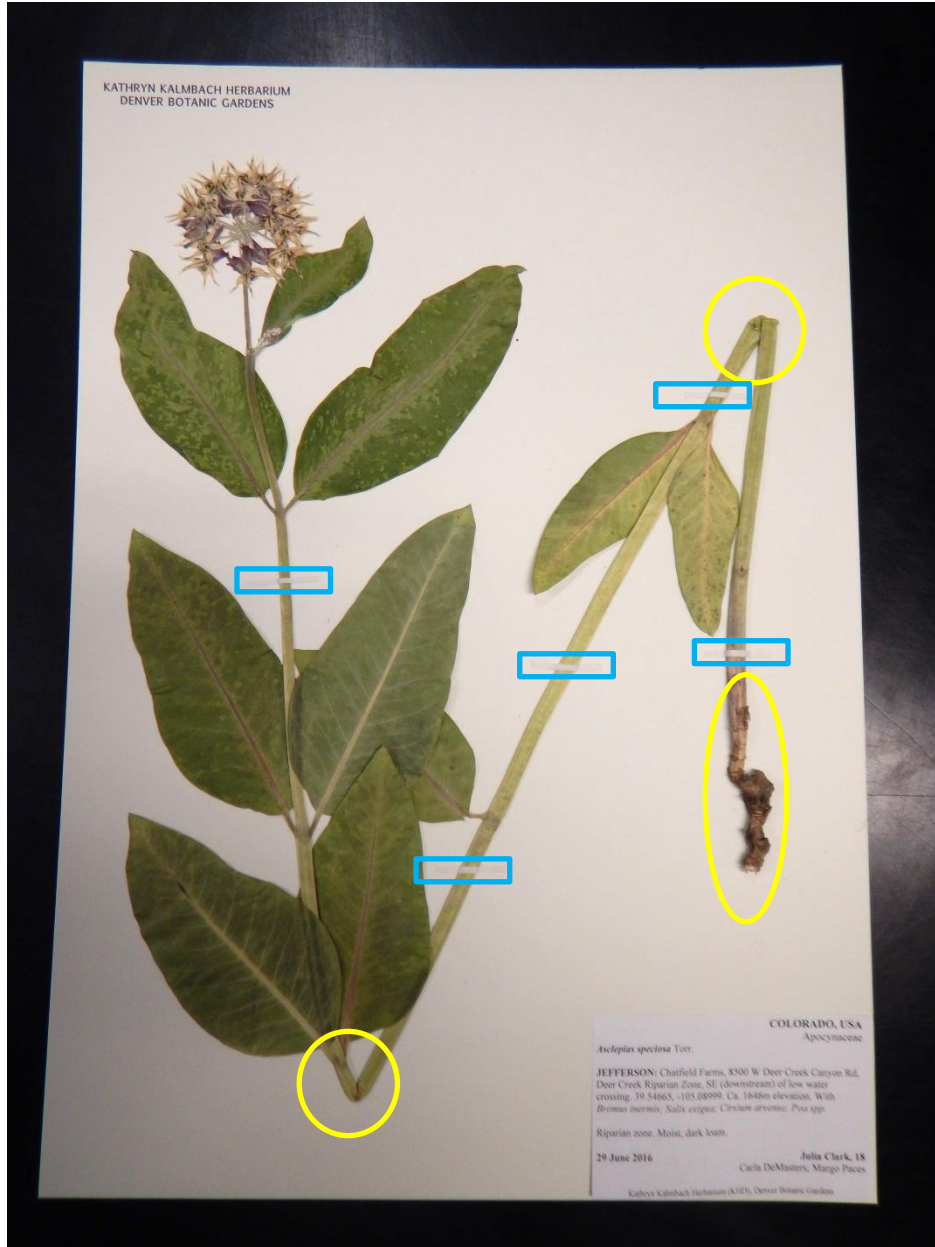
- Only use on fine pieces of the plant
- DO NOT bridge over a node

Good examples

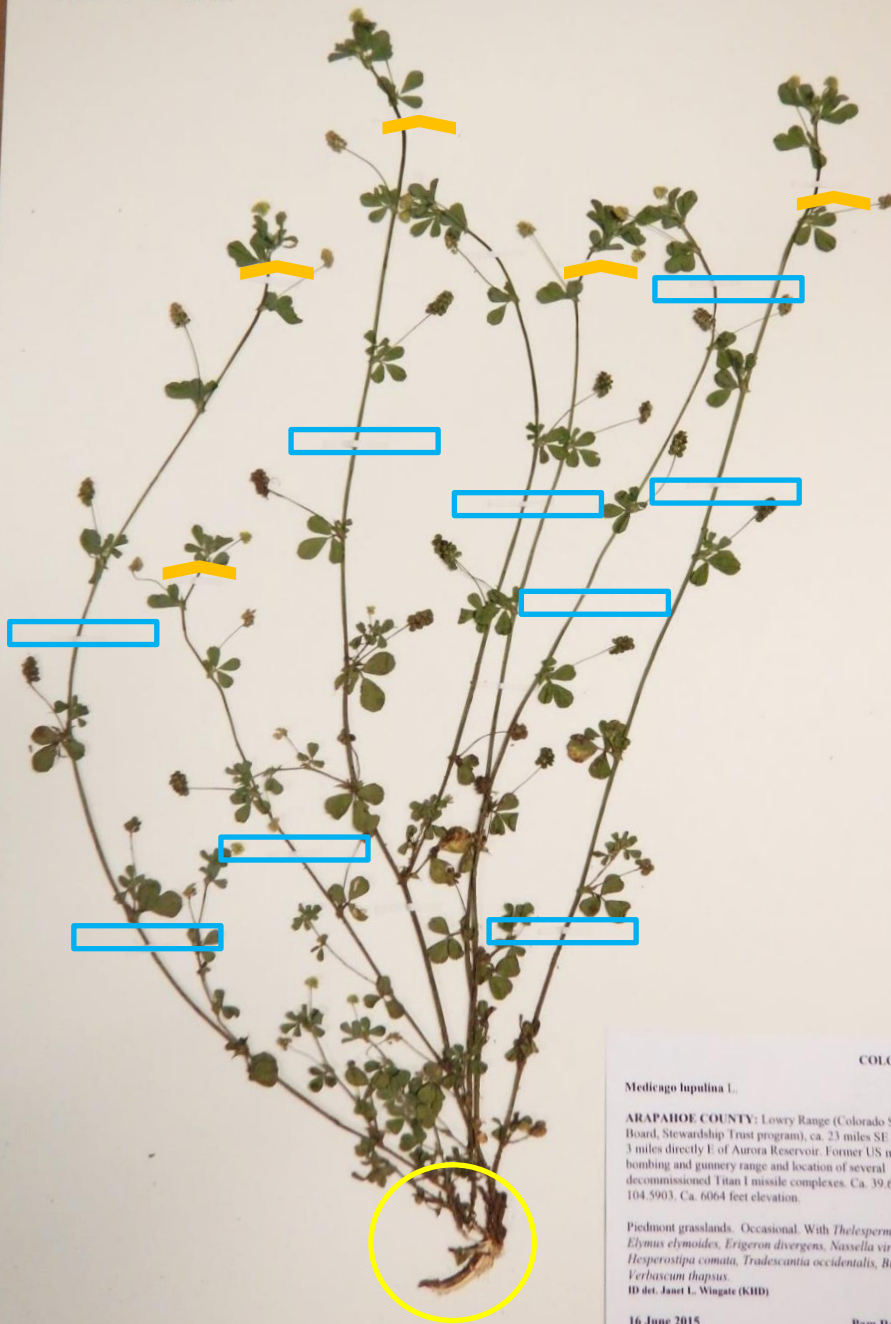
Yellow ellipse = glue

Blue rectangle = linen strip

Orange chevron = Glue bridge



KATHRYN KALMBACH HERBARIUM
DENVER BOTANIC GARDENS



COLORADO, USA
Fabaceae

Medicago lupulina L.

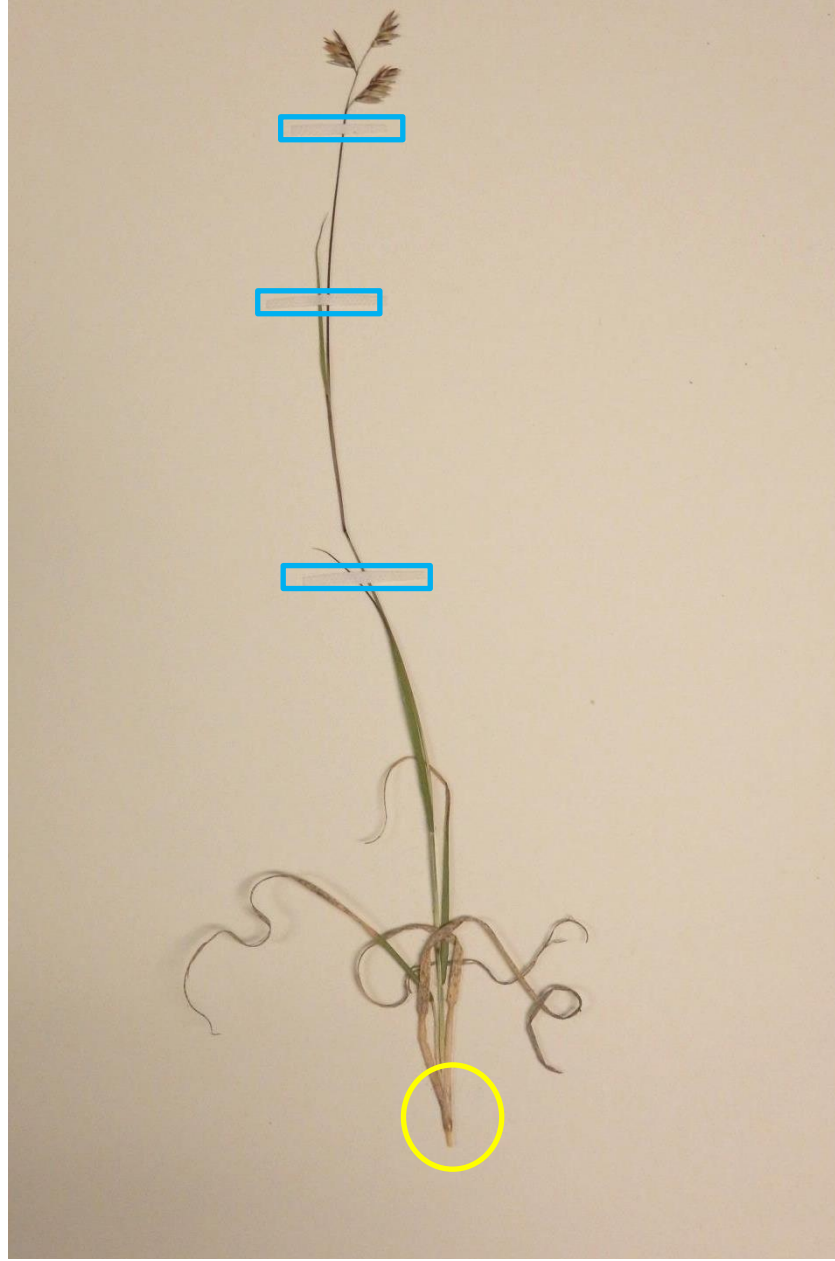
ARAPAHOE COUNTY: Lowry Range (Colorado State Land Board, Stewardship Trust program), ca. 23 miles SE of Denver and 3 miles directly E of Aurora Reservoir. Former US military bombing and gunnery range and location of several decommissioned Titan I missile complexes. Ca. 39.60488, -104.5903, Ca. 6064 feet elevation.

Piedmont grasslands. Occasional. With *Thelesperma filifolium*, *Elymus clymoides*, *Erigeron divergens*, *Nassella viridula*, *Hesperostipa comata*, *Tradescantia occidentalis*, *Bromus tectorum*, *Verbascum thapsus*.
ID det. Janet L. Wingate (KHD)

16 June 2015

Pam Regensberg 2038,
Janet L. Wingate, Bailey Piper, Rick Levy

V KALMBACH HERBARIUM
ER BOTANIC GARDENS



Works Cited

The Herbarium Handbook. 3rd ed. Eds. Diane Bridson and Leonard Forman. Kew: Royal Botanic Gardens, 1999. Print.