
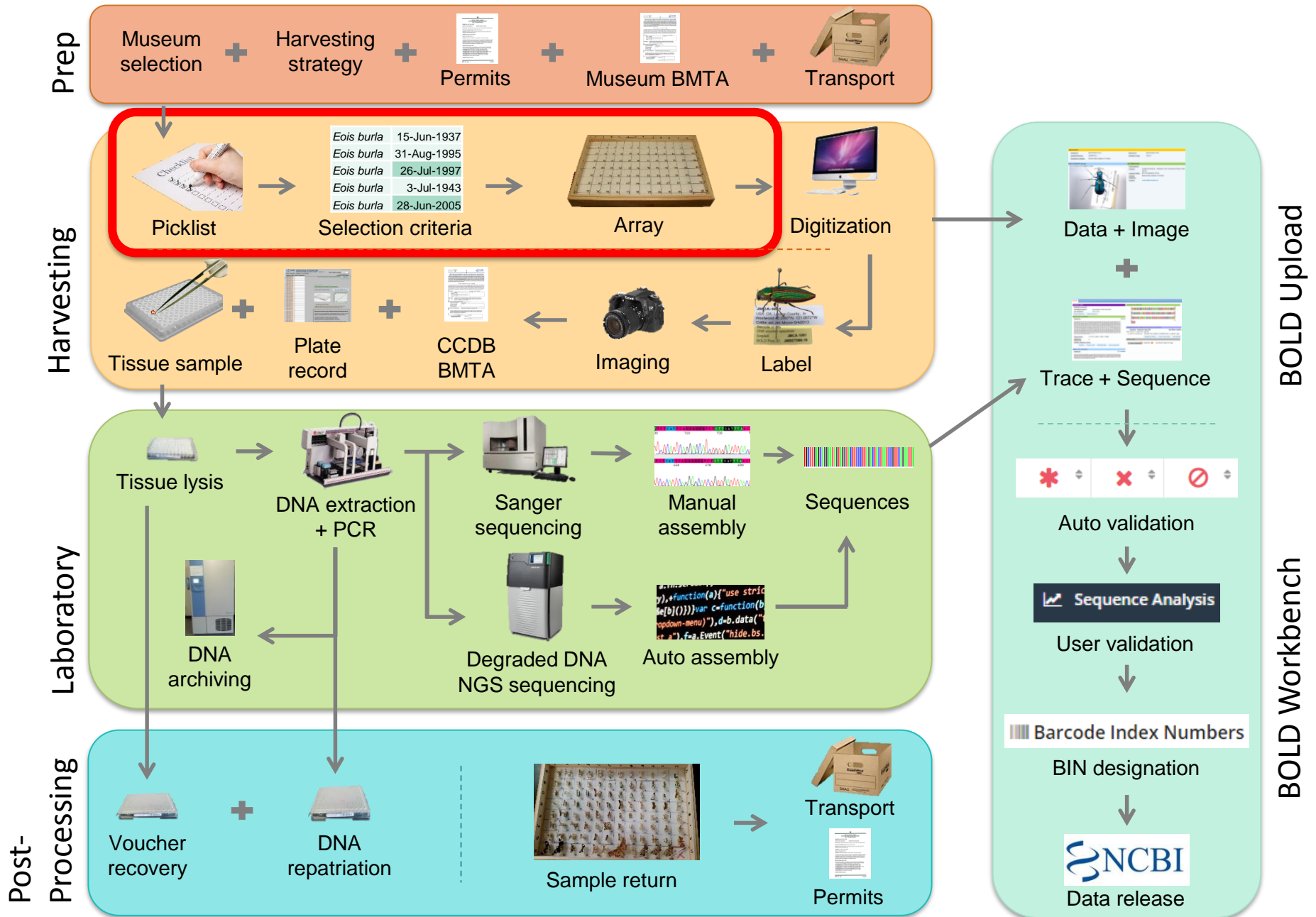




**9:45 - 10:30 – Valerie Levesque-Beaudin**  
**Sample Harvesting in Natural History Collections**

 Centre for  
**Biodiversity**  
Genomics

DNA Barcoding Natural History Collections





# Recap

## Decisions Made Prior to Visit

- The natural history collection you will be visiting
- The taxonomic group that you will be sampling
- If you are borrowing specimens or sampling on site
- If you require any permits

**PARKS CANADA AGENCY  
RESEARCH AND COLLECTION PERMIT  
(NOT TRANSFERABLE)**

PERMIT No.: NRP-2015-19000      EXPIRY DATE: 2018-08-30

START DATE: 2015-08-01

Project Title: DNA Barcode-based Assessment of Canadian Arthropod Diversity

Principal Investigator Name: Holzer, Paul D.N. (Dr.)

Address: Biodiversity Institute of Ontario University of Guelph 50 Stone Rd E.  
Guelph, Ontario Canada N1G 2W1

Telephone: (519) 824-4120 x5025

Email: pholzer@uoguelph.ca



Affiliation: Biodiversity Institute of Ontario (BIO), University of Guelph

It is hereby authorized to conduct the research project entitled "DNA Barcode-based Assessment of Canadian Arthropod Diversity", Research and Collection Permit Application Number 22705, in Protected Areas Establishment and Conservation Directorate, subject to the terms and conditions set out below and/or attached to and forming part of the Research and Collection Permit.

**Members of Research Team:**

Jeremy deBorja (BIO) [deborja@uoguelph.ca](mailto:deborja@uoguelph.ca) (519) 824-4120 x52258 Kate Perez (BIO) [kperez@uoguelph.ca](mailto:kperez@uoguelph.ca) (519) 824-4120 x50228 Crystal Sobel (BIO) [csobel@uoguelph.ca](mailto:csobel@uoguelph.ca) (519) 824-4120 x53002 Jayne Torres (BIO) [jtorres@uoguelph.ca](mailto:jtorres@uoguelph.ca) (519) 824-4120 x53003 Jody McKeown (BIO) [jmckeown@uoguelph.ca](mailto:jmckeown@uoguelph.ca) (519) 824-4120 x50229 Renee Labrecque (BIO) [rlabrecq@uoguelph.ca](mailto:rlabrecq@uoguelph.ca) (519) 824-4120 x53000 Valerie Levesque-Boudin (BIO) [vlevesq@uoguelph.ca](mailto:vlevesq@uoguelph.ca) (519) 824-4120 x53000 Gergely Dapporto (BIO) [gldapporto@uoguelph.ca](mailto:gldapporto@uoguelph.ca) (519) 824-4120 x50164 Minna Young (BIO) [myoung@uoguelph.ca](mailto:myoung@uoguelph.ca) (519) 824-4120 x51600 Angela Teller (BIO) [ateller@uoguelph.ca](mailto:ateller@uoguelph.ca) (519) 824-4120 x53000

**Additional PI's Involved:**

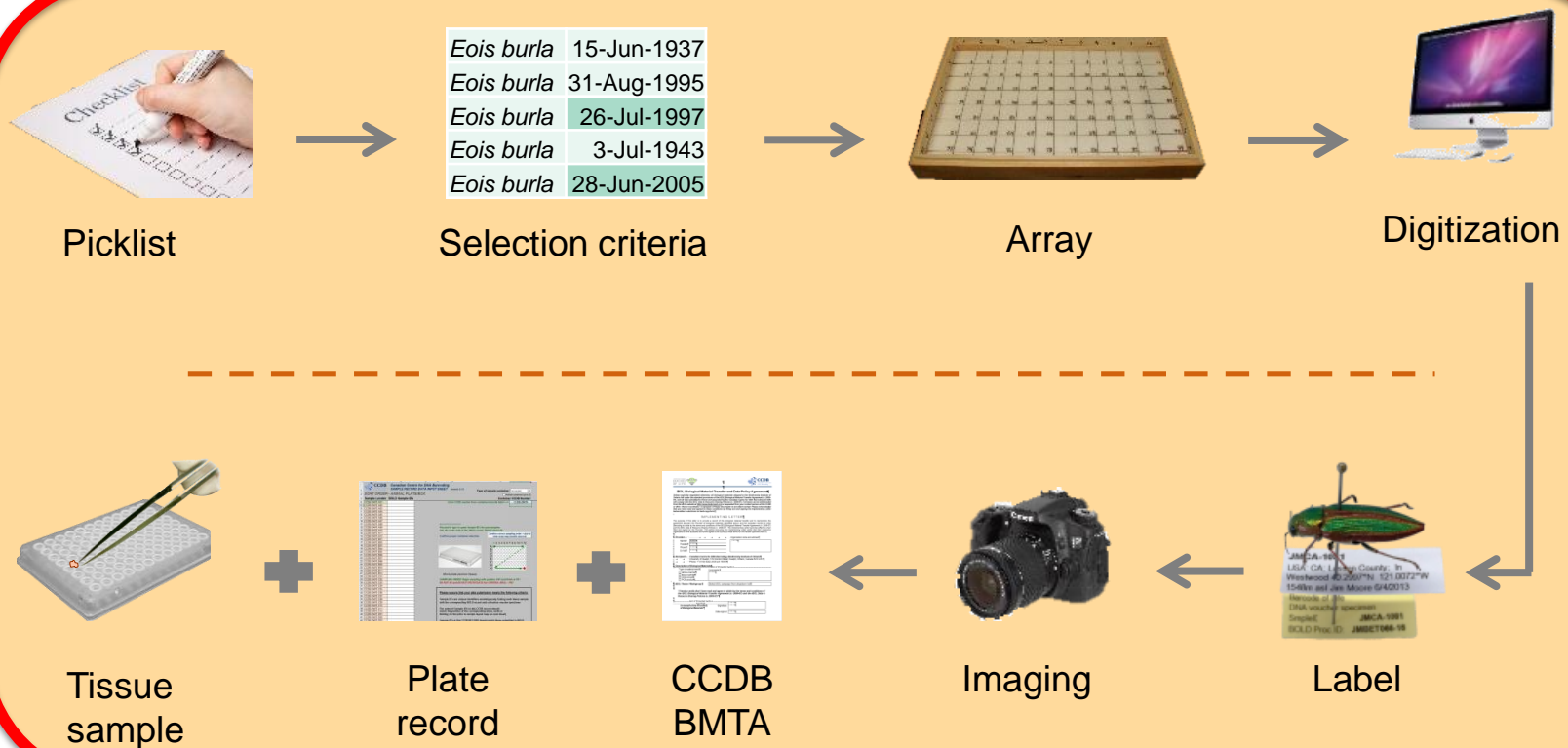
 



# Sampling on Site

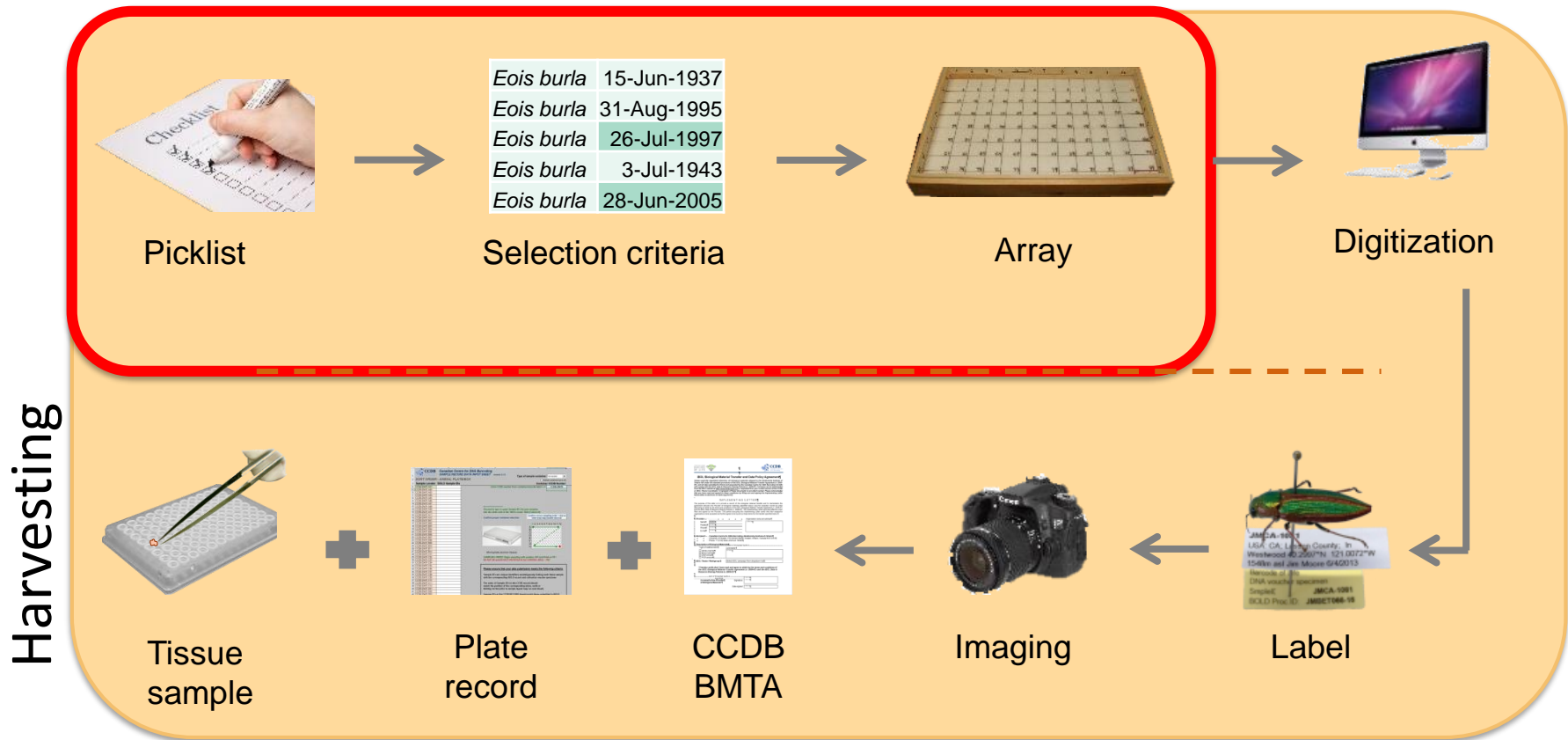
- Usually the case for plants and vertebrates
  - All steps done at the museum

Harvesting

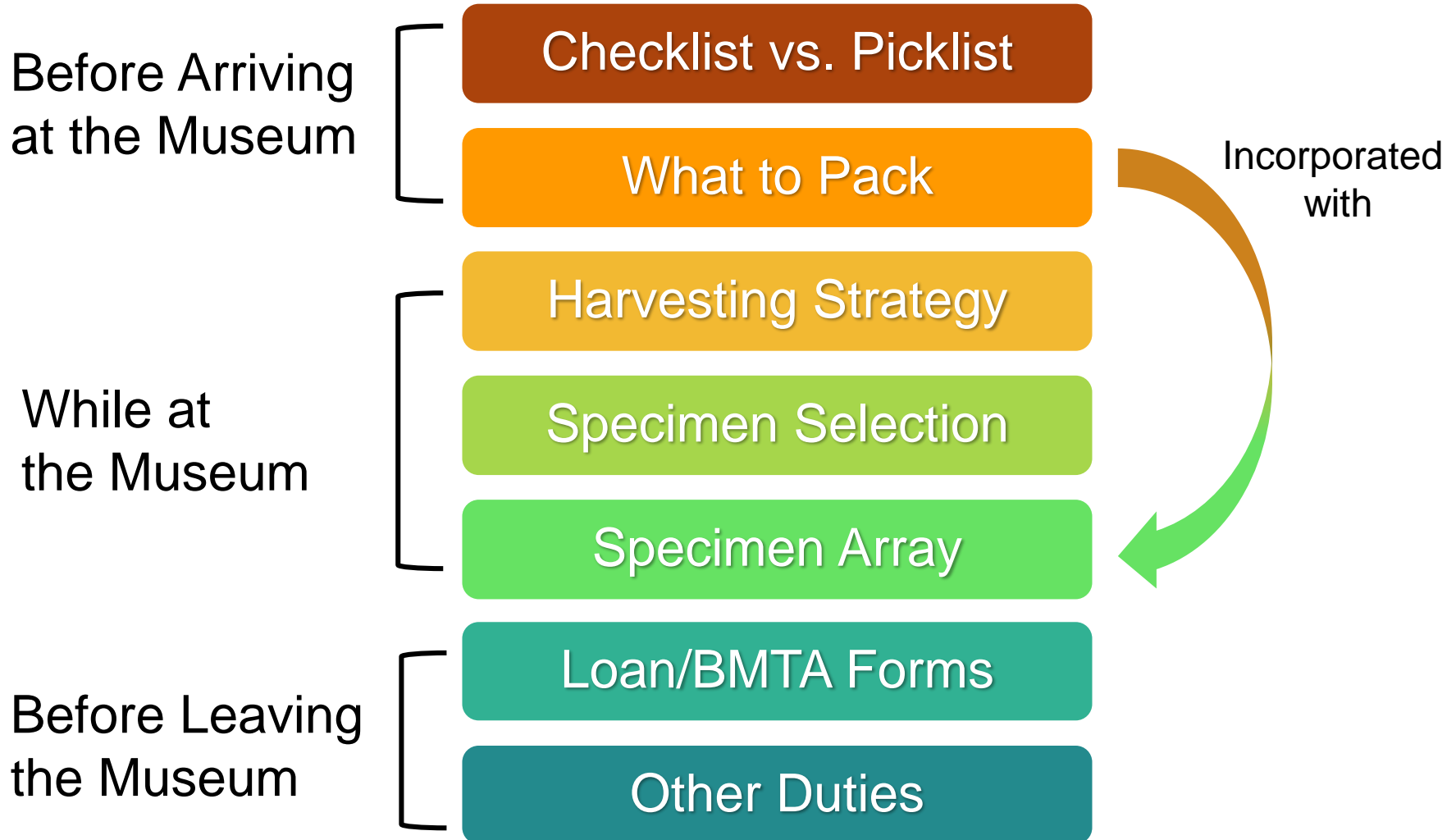


# Borrowing Specimens

- Depending on the collection, usually fine for invertebrates
  - Only the first three steps done at the museum



# Sample Harvesting



# Before Arriving at the Museum

Checklist vs. Picklist

What to Pack

# Checklist vs. Picklist

## Checklist vs. Hitlist

**Checklist:** A complete species list for a given taxa (e.g. Beetles of Canada)

\* **NOTE:** For several groups no checklists are available

- Use when looking to barcode species not yet sequenced from the checklist

**Hitlist:** A list of specific target species, e.g. 100 specific pest species OR if you are lacking a checklist

- Use when targeting a specific list of species



# Checklist vs. Picklist

## Standard Checklist

- Example of checklist

### **Checklist of beetles (Coleoptera) of Canada and Alaska. Second edition**

Yves Bousquet<sup>1</sup>, Patrice Bouchard<sup>1</sup>, Anthony E. Davies<sup>1</sup>, Derek S. Sikes<sup>2</sup>

<sup>1</sup> *Agriculture and Agri-Food Canada, Canadian National Collection of Insects, Arachnids and Nematodes, Ottawa, Ontario, Canada K1A 0C6* <sup>2</sup> *University of Alaska Museum, 907 Yukon Drive, Fairbanks, AK 99775-6960, USA*

Corresponding author: *Patrice Bouchard* (Patrice.Bouchard@agr.gc.ca)

# Checklist vs. Picklist

## Standard Checklist

- Example of checklist spreadsheet

suborder	superfamily	family	subfamily	tribe	subtribe	genus	subgenus	specific epithet	Full Name
Archostemata		Cupedidae	Priacminae			Priacma		serrata	Priacma serrata
Archostemata		Cupedidae	Cupedinae			Cupes		capitatus	Cupes capitatus
Archostemata		Cupedidae	Cupedinae			Tenomerga		cinerea	Tenomerga cinerea
Archostemata		Micromalthidae				Micromalthus		debilis	Micromalthus debilis
Adephaga		Gyrinidae	Gyrininae	Enhydrusini	Dineutina	Dineutus		assimilis	Dineutus assimilis
Adephaga		Gyrinidae	Gyrininae	Enhydrusini	Dineutina	Dineutus		discolor	Dineutus discolor
Adephaga		Gyrinidae	Gyrininae	Enhydrusini	Dineutina	Dineutus		hornii	Dineutus hornii
Adephaga		Gyrinidae	Gyrininae	Enhydrusini	Dineutina	Dineutus		nigrior	Dineutus nigrior
Adephaga		Gyrinidae	Gyrininae	Gyrinini	Gyrinina	Gyrinus	Gyrinulus	cavatus	Gyrinus cavatus
Adephaga		Gyrinidae	Gyrininae	Gyrinini	Gyrinina	Gyrinus	Gyrinulus	minutus	Gyrinus minutus
Adephaga		Gyrinidae	Gyrininae	Gyrinini	Gyrinina	Gyrinus	Gyrinus	aeneolus	Gyrinus aeneolus
Adephaga		Gyrinidae	Gyrininae	Gyrinini	Gyrinina	Gyrinus	Gyrinus	aeratus	Gyrinus aeratus
Adephaga		Gyrinidae	Gyrininae	Gyrinini	Gyrinina	Gyrinus	Gyrinus	affinis	Gyrinus affinis
Adephaga		Gyrinidae	Gyrininae	Gyrinini	Gyrinina	Gyrinus	Gyrinus	aquiris	Gyrinus aquiris
Adephaga		Gyrinidae	Gyrininae	Gyrinini	Gyrinina	Gyrinus	Gyrinus	bifarius	Gyrinus bifarius
Adephaga		Gyrinidae	Gyrininae	Gyrinini	Gyrinina	Gyrinus	Gyrinus	confinis	Gyrinus confinis
Adephaga		Gyrinidae	Gyrininae	Gyrinini	Gyrinina	Gyrinus	Gyrinus	consobrinus	Gyrinus consobrinus
Adephaga		Gyrinidae	Gyrininae	Gyrinini	Gyrinina	Gyrinus	Gyrinus	dichrous	Gyrinus dichrous
Adephaga		Gyrinidae	Gyrininae	Gyrinini	Gyrinina	Gyrinus	Gyrinus	dubius	Gyrinus dubius
Adephaga		Gyrinidae	Gyrininae	Gyrinini	Gyrinina	Gyrinus	Gyrinus	fraternus	Gyrinus fraternus
Adephaga		Gyrinidae	Gyrininae	Gyrinini	Gyrinina	Gyrinus	Gyrinus	gehringi	Gyrinus gehringi
Adephaga		Gyrinidae	Gyrininae	Gyrinini	Gyrinina	Gyrinus	Gyrinus	gibber	Gyrinus gibber
Adephaga		Gyrinidae	Gyrininae	Gyrinini	Gyrinina	Gyrinus	Gyrinus	hoppingi	Gyrinus hoppingi

# Checklist vs. Picklist

## Bold Checklist

- Create your own
- OR upload a known checklist




Checklist Management

Create New Checklist

My Checklists

Show 25 entries

Search:

Access	Kingdom	Code	Title	Details	Last Updated	Terminal Nodes	Updates	Reports
 		CL-IFAM	Insect Families of the World	Taxonomy: Insecta	2016-10-27	1118	<div>Update</div>	<div>Re</div>

Showing 1 to 1 of 1 entries

First

Previous

1













Next

Last

Other Checklists

Show 25 entries

Search:

Access	Kingdom	Code	Title	Details	Last Updated	Terminal Nodes	Manager	Reports
 		CL-0325	Western European Atlantic coast Mollusca	Geography: continent	2017-02-27	323	Sofia Duarte	<div>Rej</div>
 		CL-0479	Western European Atlantic coast Crustacea	Geography: continent, Europe	2017-02-27	546	Sofia Duarte	<div>Rej</div>
 		CL-0511	Western European Atlantic coast Annelida	Geography: continent, Europe	2017-02-27	505	Sofia Duarte	<div>Rej</div>
 		CL-123	Bivalvia of Portugal	Geography: Portugal Taxonomy: Bivalvea	2016-06-08	51	Pedro Sendas	<div>Rej</div>

(more details at 14:15)

# Checklist vs. Picklist

## Bold Checklist

- View online

<div>Disagreement Report</div> <div>HitList Report</div> <div>Progress Report</div>							
Show 25 entries		Search: <input type="text"/>					
Phylum	Class	Order	Family	Subfamily	Genus	Species	Species Reference
Arthropoda	Insecta	Coleoptera	Elateridae	Cardiophorinae	<i>Cardiophorus</i>	<i>Cardiophorus convexulus</i>	LeConte, 1853
Arthropoda	Insecta	Coleoptera	Anthribidae	Anthribinae	<i>Eusphyrus</i>	<i>Eusphyrus walshii</i>	LeConte, 1876
Arthropoda	Insecta	Coleoptera	Anthribidae	Choraginae	<i>Choragus</i>	<i>Choragus sayi</i>	LeConte, 1876
Arthropoda	Insecta	Coleoptera	Curculionidae	Lixinae	<i>Lixus</i>	<i>Lixus punctinatus</i>	LeConte, 1876
Arthropoda	Insecta	Coleoptera	Curculionidae	Baridinae	<i>Calandrinus</i>	<i>Calandrinus grandicollis</i>	LeConte, 1876
Arthropoda	Insecta	Coleoptera	Curculionidae	Molytinae	<i>Microhyus</i>	<i>Microhyus setiger</i>	LeConte, 1876
Arthropoda	Insecta	Coleoptera	Curculionidae	Lixinae	<i>Lixus</i>	<i>Lixus parvus</i>	LeConte, 1876
Arthropoda	Insecta	Coleoptera	Curculionidae	Cryptorhynchinae	<i>Cryptorhynchus</i>	<i>Cryptorhynchus tristis</i>	LeConte, 1876
Arthropoda	Insecta	Coleoptera	Curculionidae	Curculioninae	<i>Proctorus</i>	<i>Proctorus armatus</i>	LeConte, 1876
Arthropoda	Insecta	Coleoptera	Mycteridae	Mycterinae	<i>Mycterus</i>	<i>Mycterus concolor</i>	LeConte, 1853
Arthropoda	Insecta	Coleoptera	Carabidae	Harpalinae	<i>Amara</i>	<i>Amara conflata</i>	LeConte, 1855
Arthropoda	Insecta	Coleoptera	Latridiidae	Corticariinae	<i>Corticaria</i>	<i>Corticaria dentigera</i>	LeConte, 1855
Arthropoda	Insecta	Coleoptera	Carabidae	Harpalinae	<i>Amara</i>	<i>Amara farcta</i>	LeConte, 1855
Arthropoda	Insecta	Coleoptera	Elateridae	Negastriinae	<i>Oedostethus</i>	<i>Oedostethus femoralis</i>	LeConte, 1853
Arthropoda	Insecta	Coleoptera	Leiodidae	Leiodinae	<i>Colenis</i>	<i>Colenis impunctata</i>	LeConte, 1853
Arthropoda	Insecta	Coleoptera	Scarabaeidae	Cetoniinae	<i>Cremastocheilus</i>	<i>Cremastocheilus knockii</i>	LeConte, 1853
Arthropoda	Insecta	Coleoptera	Histeridae	Dendrophilinae	<i>Bacanius</i>	<i>Bacanius tantillus</i>	LeConte, 1853
Arthropoda	Insecta	Coleoptera	Staphylinidae	Staphylininae	<i>Thinopinus</i>	<i>Thinopinus pictus</i>	LeConte, 1852

# Checklist vs. Picklist

## Bold Checklist

### Progress report

- Show current coverage (# and %) on BOLD by hierarchy level

Progress Report Results					<a href="#">Download Progress</a>
Progress Report provides results of the comparison between checklist <b>CL-NALEP</b> and all data on BOLD.					
Summary of Results					
Taxon Level	Total	%Sampled	%Sequenced	%Barcoded	
Subspecies	2911	12.71%	11.44%	10.00%	
Species	12763	88.77%	81.86%	78.09%	
Subgenus	79	0.00%	0.00%	0.00%	
Genus	2504	95.41%	93.41%	91.93%	
Subtribe	70	5.71%	5.71%	5.71%	
Tribe	247	29.15%	29.15%	29.15%	
Subfamily	237	78.06%	78.06%	78.06%	
Family	92	95.65%	95.65%	95.65%	
Superfamily	34	2.94%	2.94%	2.94%	
Order	1	100.00%	100.00%	100.00%	



# Checklist vs. Picklist

## Bold Checklist

**Hitlist:** show species lacking sequences

- Displayed online or download in spreadsheet format

Checklist Hitlist Report for CL-NALEP

Hitlist Results

Report for checklist: **CL-NALEP** based on what is currently missing from the BOLD database

> Minimum number of specimens for hit list: 1

Needs Specimens (4036)

Taxa	Kingdom
<i>Acentria ephemerella ephemerella</i> (s.str.)	Animals
<i>Achalarus albociliatus albociliatus</i> (s.str.)	Animals
<i>Acleris implexana ferrumixtana</i>	Animals
<i>Acleris implexana implexana</i> (s.str.)	Animals
<i>Acleris schalleriana viburnana</i>	Animals
<i>Acossus populi angrezi</i>	Animals
<i>Acossus populi orc</i>	Animals
<i>Acossus populi populi</i> (s.str.)	Animals
<i>Acrolophus griseus griseus</i> (s.str.)	Animals
<i>Acrolophus laticapitanus clarkel</i>	Animals
<i>Acrolophus laticapitanus heinrichi</i>	Animals
<i>Acrolophus laticapitanus laticapitanus</i> (s.str.)	Animals

Download Hitlist



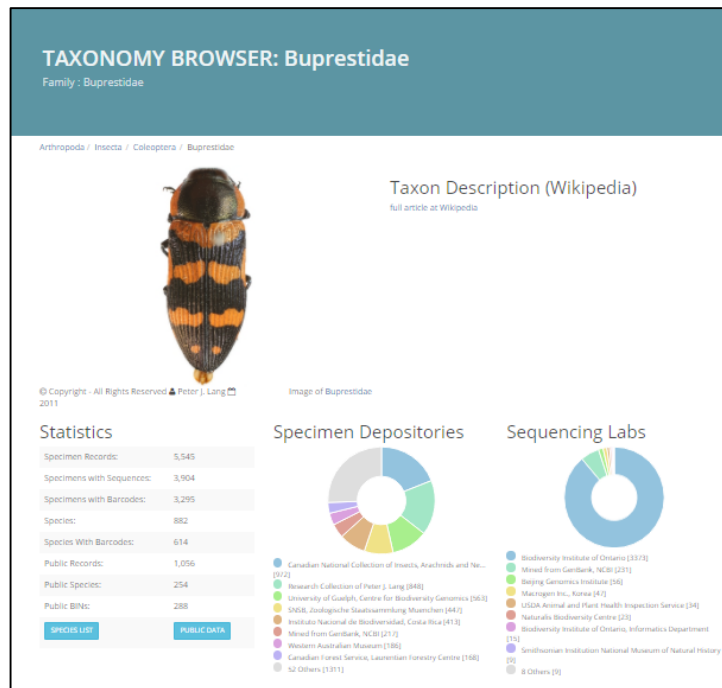
	A	B	C
1	Minimum number of specimens for hit list: 1		
2	Needs Specimens (4036)		
3	Taxa	Kingdom	
4	<i>Acentria ephemerella ephemerella</i> (s.str.)	Animals	
5	<i>Achalarus albociliatus albociliatus</i> (s.str.)	Animals	
6	<i>Acleris implexana ferrumixtana</i>	Animals	
7	<i>Acleris implexana implexana</i> (s.str.)	Animals	
8	<i>Acleris schalleriana viburnana</i>	Animals	
9	<i>Acossus populi angrezi</i>	Animals	
10	<i>Acossus populi orc</i>	Animals	
11	<i>Acossus populi populi</i> (s.str.)	Animals	
12	<i>Acrolophus griseus griseus</i> (s.str.)	Animals	
13	<i>Acrolophus laticapitanus clarkel</i>	Animals	
14	<i>Acrolophus laticapitanus heinrichi</i>	Animals	
15	<i>Acrolophus laticapitanus laticapitanus</i> (s.str.)	Animals	
16	<i>Acrolophus laticapitanus leopardus</i>	Animals	
17	<i>Acrolophus laticapitanus occidens</i>	Animals	
18	<i>Acrolophus macrogaster bipectinicornus</i>	Animals	
19	<i>Acrolophus macrogaster laminicornus</i>	Animals	
20	<i>Acrolophus macrogaster macrogaster</i> (s.str.)	Animals	
21	<i>Acrolophus macrogaster unipectinicornus</i>	Animals	
22	<i>Acrolophus sinclairi nelsoni</i>	Animals	
23	<i>Acrolophus sinclairi sinclairi</i> (s.str.)	Animals	
24	<i>Acronicta americana americana</i> (s.str.)	Animals	
25	<i>Acronicta americana eldora</i>	Animals	
26	<i>Acronicta americana obscura</i>	Animals	
27	<i>Acronicta brumosa brumosa</i> (s.str.)	Animals	

# Checklist vs. Picklist

## Hitlist

### Specific taxon

- e.g. existing coverage of the family Buprestidae (Coleoptera)



### Statistics

Specimen Records:	5,545
Specimens with Sequences:	3,910
Specimens with Barcodes:	3,301
Species:	882
Species With Barcodes:	614
Public Records:	1,058
Public Species:	254
Public BINs:	288

[SPECIES LIST](#)

[PUBLIC DATA](#)

# Checklist vs. Picklist

## Hitlist

### Specific taxon

- Display the species list and transfer to spreadsheet format
  - Select those that failed (0)
  - AND select those not on the list

Species	Specimens	Sequences	Barcodes >500bp
Aaaba fossicollis	1 ♂	1	1
Acmaeodera acuta	5 ♂	3	1
Acmaeodera amabilis	2 ♂	2	2
Acmaeodera amplicollis	5 ♂	5	2
Acmaeodera angelica	4 ♂	0	0
Acmaeodera connexa	4 ♂	3	3
Acmaeodera crinita	1 ♂	1	1
Acmaeodera cylindrica	1 ♂	0	0
Acmaeodera dagetti	5 ♂	4	1
Acmaeodera decipiens	3 ♂	3	3
Acmaeodera degener	2 ♂	0	0
Acmaeodera digna	1 ♂	1	1
Acmaeodera elevata	2 ♂	0	0
Acmaeodera fascigera	1 ♂	1	1



Species	Specimens	Sequences	Barcodes >500bp
Aaaba fossicollis	1	1	1
Acmaeodera acuta	5	3	1
Acmaeodera amabilis	2	2	2
Acmaeodera amplicollis	5	5	2
Acmaeodera angelica	4	0	0
Acmaeodera connexa	4	3	3
Acmaeodera crinita	1	1	1
Acmaeodera cylindrica	1	0	0
Acmaeodera dagetti	5	4	1
Acmaeodera decipiens	3	3	3
Acmaeodera degener	2	0	0
Acmaeodera digna	1	1	1
Acmaeodera elevata	2	0	0
Acmaeodera fascigera	1	1	1
Acmaeodera flavomarginata	4	4	4
Acmaeodera flavosticta	3	3	3
Acmaeodera gibbula	5	5	0
Acmaeodera haemorrhhoa	1	1	1
Acmaeodera idahoensis	5	4	2

## What to Pack

- ## Specimen Array



# While at the Museum

Harvesting Strategy

Specimen Selection

Specimen Array



# Harvesting Strategy

## Set up your workstation

- Location depends on the collection/logistics
  - e.g. central workstation
  - e.g. mobile workstation



# Harvesting Strategy

## Pulling specimens

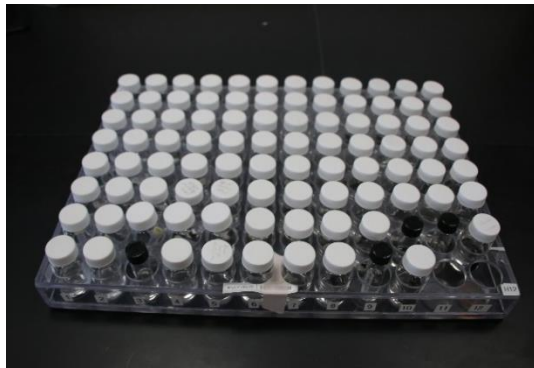
- Systematically by medium



e.g. most insects



e.g. dragonflies



e.g. spiders

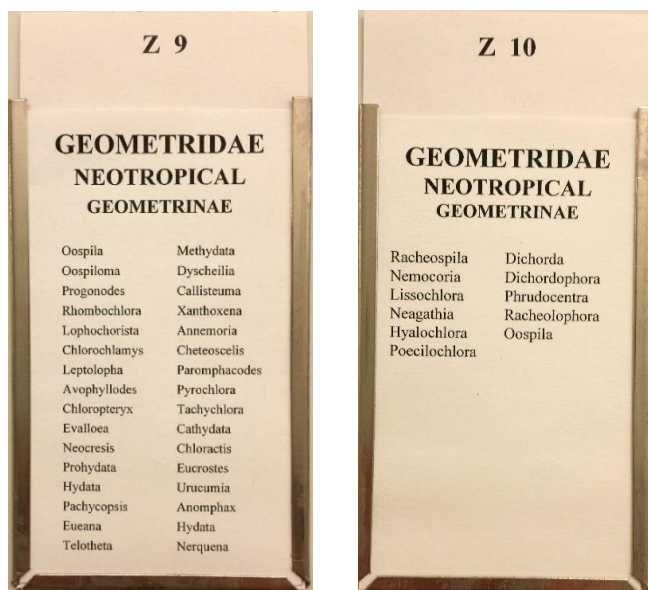


e.g. plants, fungi

# Harvesting Strategy

## Pulling specimens

- Systematically by cabinet
- By picklist order



**Faster to pull specimens and put away!**

# Harvesting Strategy

## Vertebrates

- Usually a separate genetic resource collection detached from vouchers
- Usually frozen samples, sample selection via database

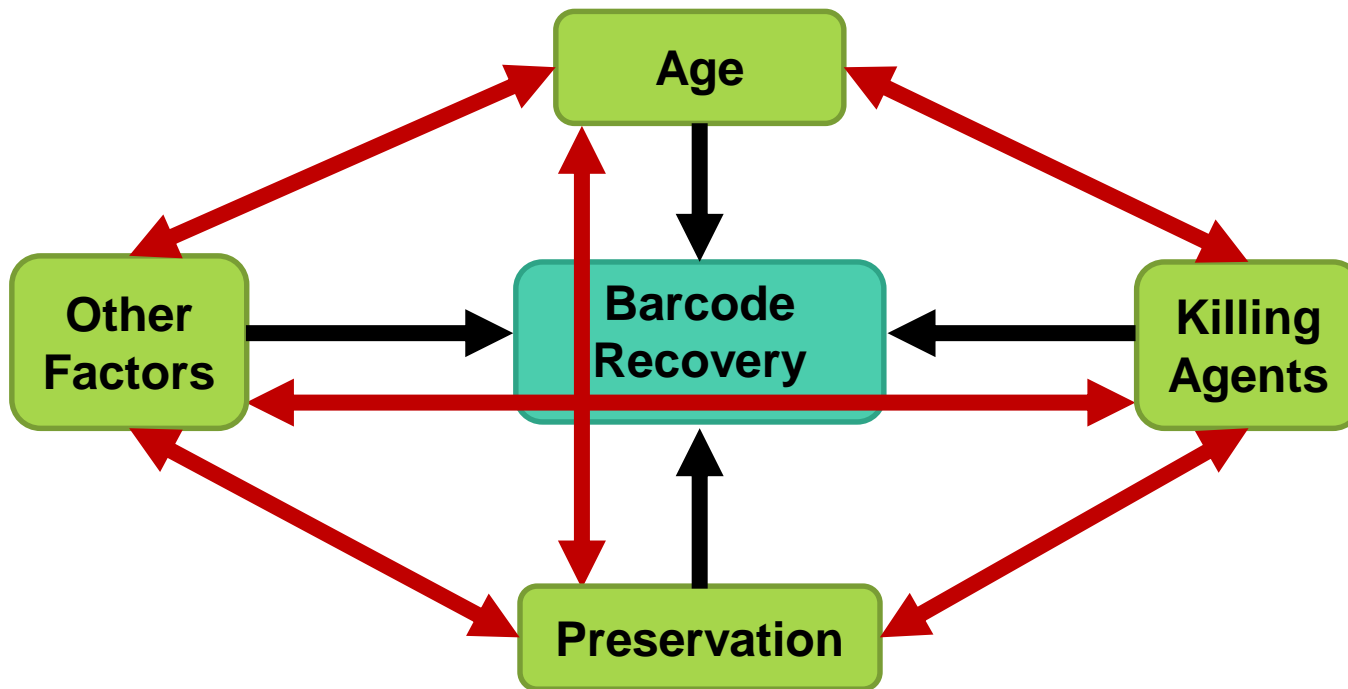


# Specimen Selection

## Overview

### Select for Optimal Success

- Factors:





# Specimen Selection

## Age

- **Young:** 0-20 years old
- **Old:** > 20 years old

Factors	Barcode Recovery	
	High	Low
Age	Young	Old
# Reps	1-3	2-5

Nguruman, KENYA  
Acacia woodlands  
1° 52' S 36° 4' E  
11 MAR 1998  
R. S. Copeland

SRI LANKA: Ham. Dist.  
Palatupana Tank  
15-50ft, 18-20 Jan.  
1979, malaise trap

Queensland.  
Brisbane  
(M. G. G. G.)  
1901

# Specimen Selection

## Killing agents/Collections Methods

### ⊘ Avoid

- Formalin
- Ethyl acetate
- Diluted propylene glycol
- Most histological solutions

Factors	Barcode Recovery	
	High	Low
<b>Killing Agents</b>	Kill jar - Cyanide Kill jar - Ammonia Ethanol Freezing	Ethyl acetate Formaldehyde Propylene glycol Soapy water
<b># Reps</b>	1-3	2-5

Berkeley, Calif.  
at light 11-18-60  
J. Powell, Coll.

CANADA:QC: Lac St-Francois  
Nat. Wildl. Area, NE of Aménag  
Therrien (45°00.17'N, 74°30.63'W)  
26.v-03.vi.1999, F. Beaulieu Carex  
meadow pan trap T2d

KENYA, Coast Province  
Muhaka Forest, Malaise  
trap, 22-29.XII.1999  
4° 19.47' S, 39° 31.45' E  
R. Copeland

USA, CA, Kern Co., Walker  
Pass cmpg, 35.663905,  
-118.036926, 1540 m  
11.V.2016 afternoon  
sweeping lowers  
leg. J.-F. Landry & V. Albu  
CNCLEP00146675

# Specimen Selection

## Preservation

### Avoid

- Low % ethanol
- Dilution
- High ratio of tissue/ethanol
- Acetone

Factors	Barcode Recovery	
	High	Low
Preservation	Dry	Ethanol
	Frozen Ethanol	Acetone
# Reps	1-3	2-5



# Specimen Selection

## Other factors

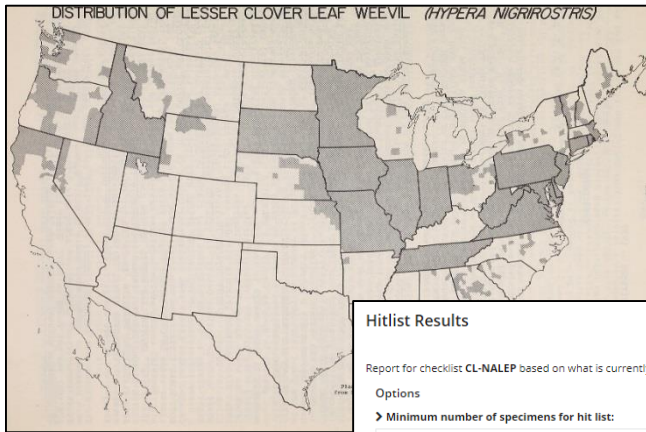


Factors	Barcode Recovery Variable
Other	Specimens relaxed
	Geographic coverage
	Target Collectors
# Reps	1-5

# Specimen Selection

## Other factors

1



2

**Hitlist Results** [Download Hitlist](#)

Report for checklist **CL-NALEP** based on what is currently missing from the BOLD database

Options

> Minimum number of specimens for hit list:  [Update](#)

**Needs Specimens (4029)**

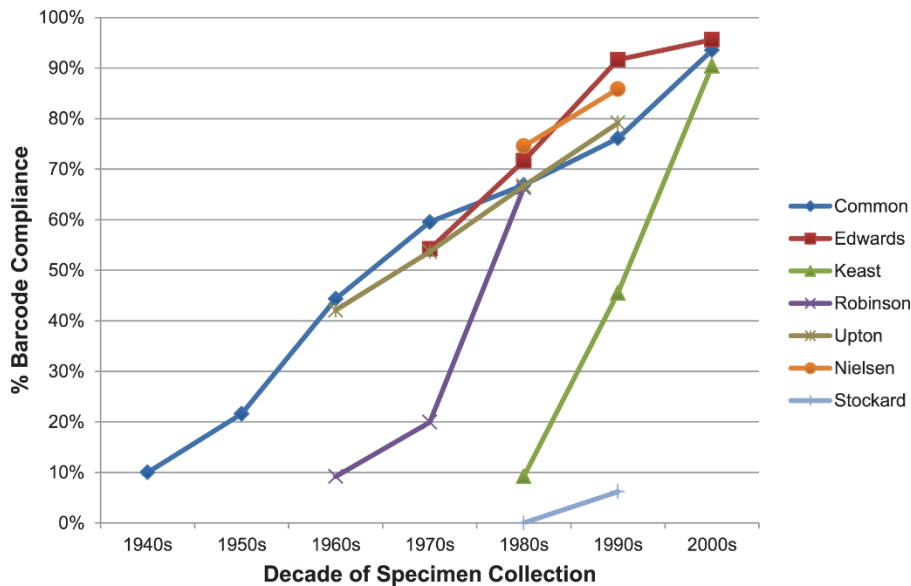
Taxa	Kingdom
<i>Acentria ephemerella ephemerella</i> (s.str.)	
<i>Achalarus albociliatus albociliatus</i> (s.str.)	
<i>Acleris implexana ferrumixtana</i>	
<i>Acleris implexana implexana</i> (s.str.)	
<i>Acleris schalleriana viburnana</i>	
<i>Acossus populi angrezi</i>	
<i>Acossus populi orc</i>	
<i>Acossus populi populi</i> (s.str.)	
<i>Acrolophus griseus griseus</i> (s.str.)	
<i>Acrolophus laticapitanus clarkii</i>	
<i>Acrolophus laticapitanus heinrichi</i>	

Factors	Barcode Recovery Variable
Other	Specimens relaxed
	Geographic coverage (1)
	Target (2)
# Reps	Collectors
	1-5



# Specimen Selection

## Other factors



Factors	Barcode Recovery Variable
Other	Specimens relaxed
	Geographic coverage
# Reps	Target
	Collectors

# Specimen Selection

## Summary

- Aggregate by high and low success factors for optimal sequence recovery

Factors	Barcode Recovery	
	High	Low
Age	Young	Old
Killing Agents	Kill jar - Cyanide Kill jar - Ammonia Ethanol Freezing	Ethyl acetate Formaldehyde Propylene glycol Soapy water
Preservation	Dry Frozen ethanol	Ethanol Acetone
# Reps	1-3	2-5

Factors	Barcode Recovery Variable
Other	Specimens relaxed Geographic coverage Target Collectors
# Reps	1-5

# Specimen Selection

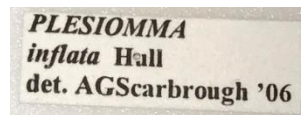
## Ideal Specimens

- **Intact Specimen**

- Abdomen present
- All legs
- All wings

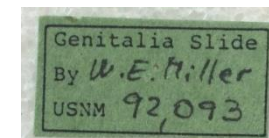


- **Expert Identification**



- **Other relevant information**

- Genitalia slides
- Type series, e.g. Paratypes, Allotypes



# Specimen Selection

## Plants

### Selection:

- 1 Samples must be thoroughly dried, no fresh or ETOH preserved samples
- 2 Ideal specimen: contains leaves of green color and not permanently attached to paper
- 3 Preference of young over old
  - > 100 years may be suitable if still with green color



### Avoid:

- Specimens dried with ethanol
  - e.g. some succulent plants in tropical or subtropical collections



# Specimen Selection

## Vertebrates

- **Selection**

- Not needed for frozen tissue, age not a factor
- Alternatively select skin or hair, be cautious of chemical treatment

- **Tissue sampling only** (more details at 11:45)

- No labelling or arraying
- Often a few individual samples

- **If recorded in digital database**

- Add a note, sampled for DNA



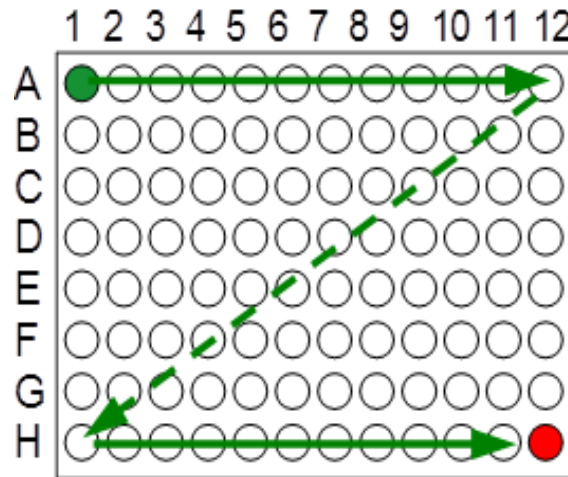
# Specimen Array

## Invertebrates

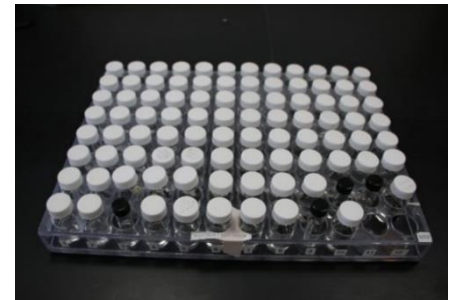
### Array in 96 well format

- Recommended Sample ID/Locator format
  - Array number + well locator
    - CCDB-28449-A01, CCDB-28449-A02,....
- H12 (●) : control well

12 Column Format



CCDB-28449





# Specimen Array

## Invertebrates - Grouping within Arrays

- Keep the factors affecting barcode recovery in mind while arraying

Factors	Barcode Recovery	
	High	Low
Age	Young	Old
Killing Agents	Kill jar - Cyanide Kill jar - Ammonia Ethanol Freezing	Ethyl acetate Formaldehyde Propylene glycol Soapy water
Preservation	Dry Frozen ethanol	Ethanol Acetone
# Reps	1-3	2-5

# Specimen Array

## Invertebrates - Grouping within Arrays

### “Specimen removal labels”

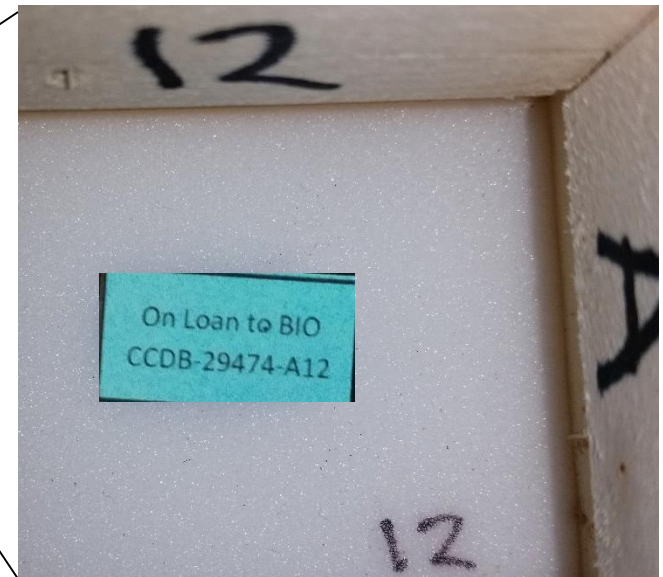
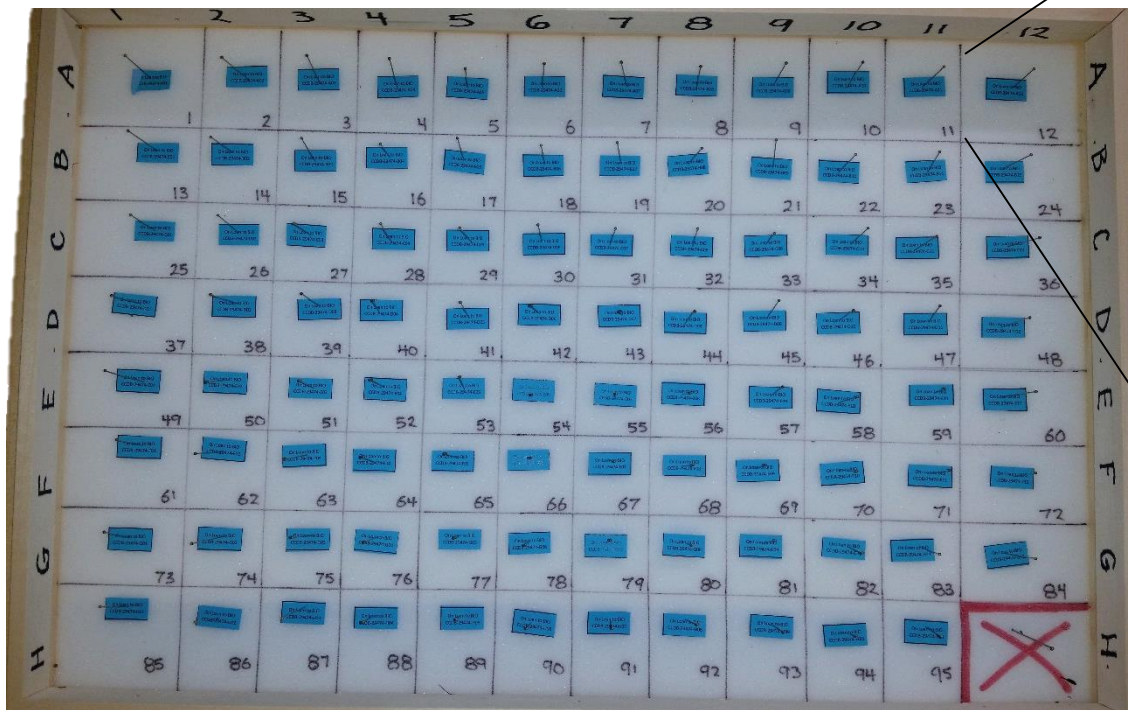
- Serve as place holders within the collection to return vouchers to their original locations
  - Include borrower and sample ID
- **2 colors can help organize array by low and high success, e.g.**
  - 1 array with blue labels for young specimens
  - 1 array with orange labels for older specimens



# Specimen Array

## Invertebrates - Pinned Materials

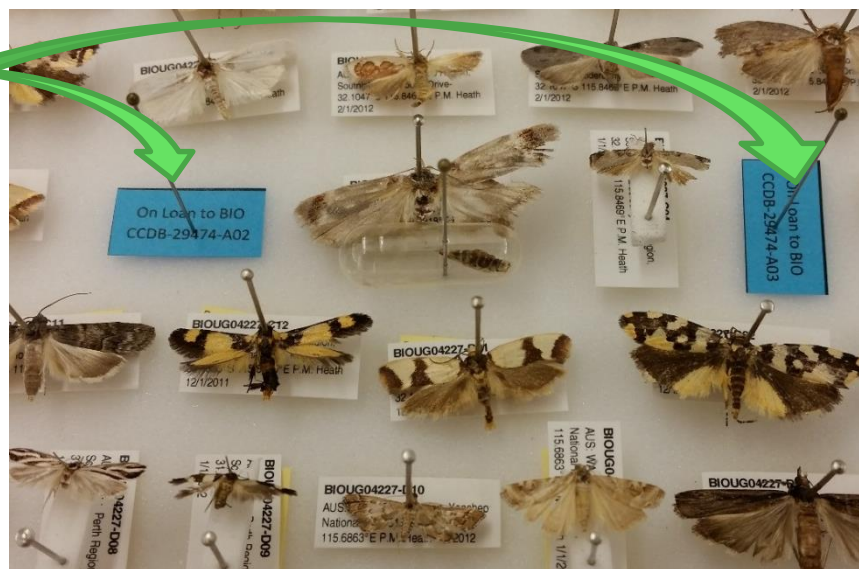
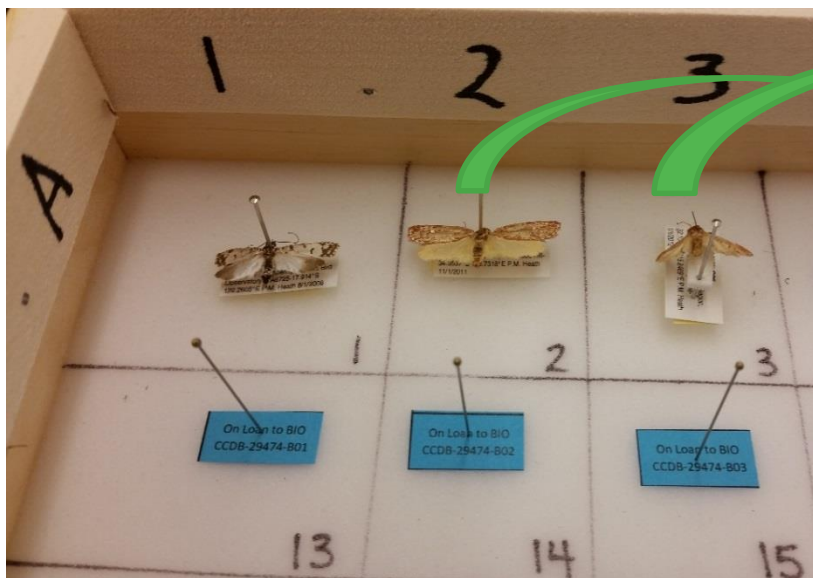
- “Specimen removal labels” added to array box



# Specimen Array

## Invertebrates - Pinned Materials

- Example





# Specimen Array

## Invertebrates - Pinned Materials

- Example



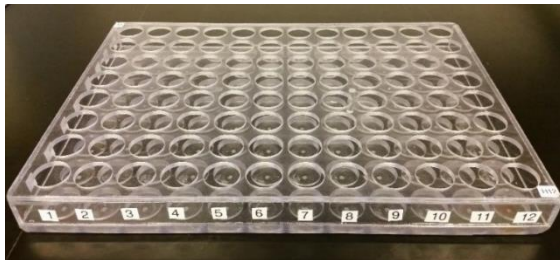
# Specimen Array

## Invertebrates – Fluid/Envelope Materials

### Arraying Options



Array 10 x 10



Array 12 x 8



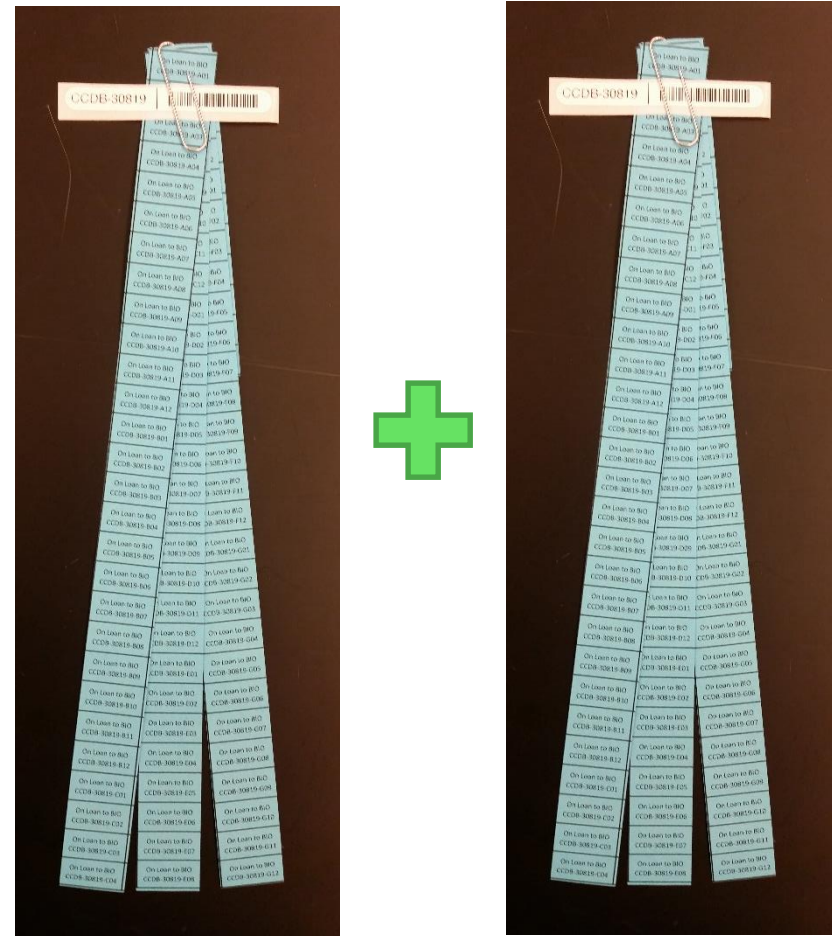


# Specimen Array

## Invertebrates – Fluid/Envelope Materials

### “Specimen removal labels”

- 2 sets
  - 1<sup>st</sup> as place holder for the collection
  - 2<sup>nd</sup> for the vial taken out of the collection
- Can be pre-cut in strips

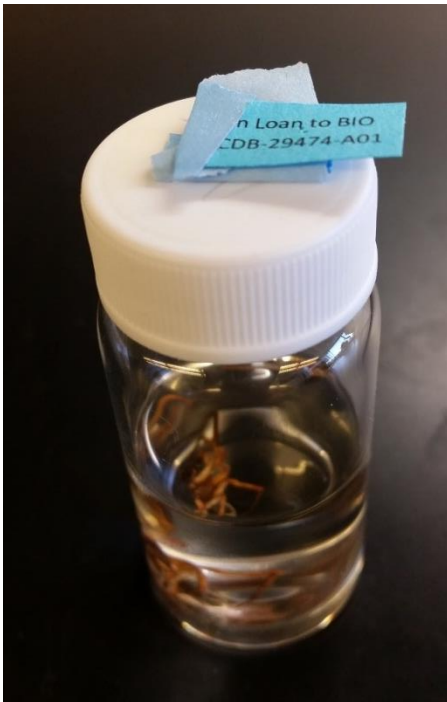


# Specimen Array

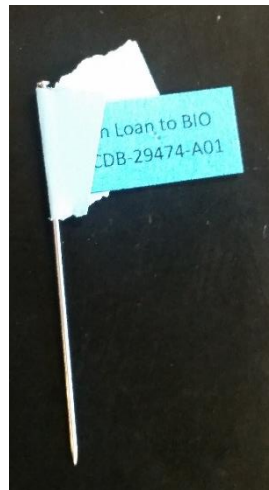
## Invertebrates - Fluid Materials

- Example

1<sup>st</sup> label



2<sup>nd</sup> label



# Specimen Array

## Invertebrates - Fluid Materials

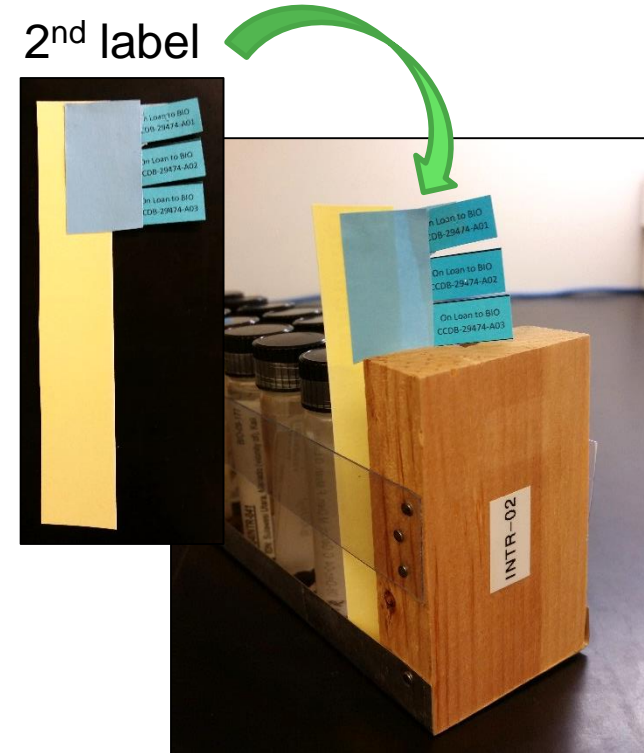
### Case with multiple specimens per vial

- Can leave gaps in the array for the # of specimens taken

1<sup>st</sup> label



2<sup>nd</sup> label

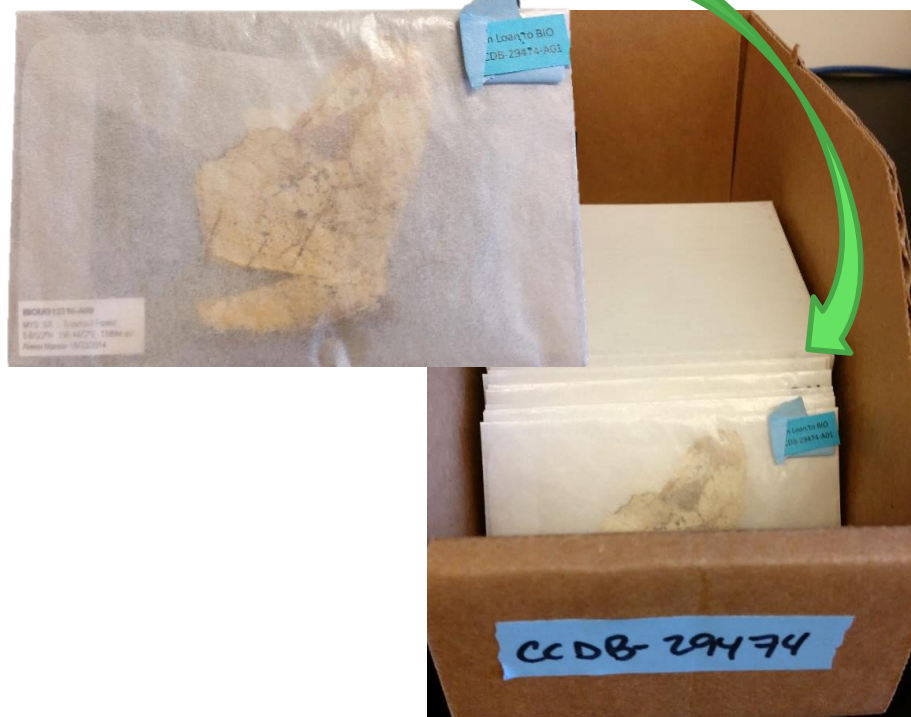


# Specimen Array

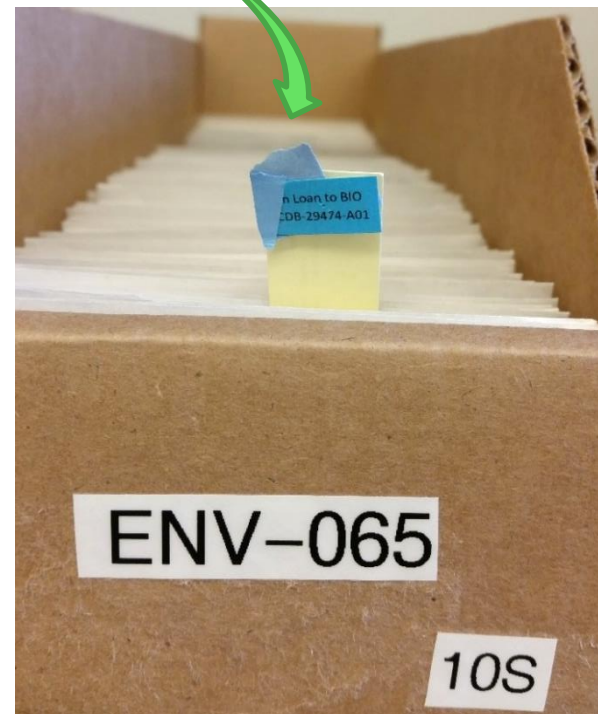
## Invertebrates - Envelope Materials

- Example

1<sup>st</sup> label



2<sup>nd</sup> label





# Specimen Array

## Invertebrates

- Enter minimum required data on spreadsheet while arraying
  - Array # + well locator, taxonomy, location and country**

Sample ID	Order	Family	Subfamily	Tribe	Genus/Species	Notes (e.g. cabinet/drawer #)	Institution Label	Country
CCDB-29466-A01	Lepidoptera	Geometridae	Larentiinae		<i>Cambogia tegularia</i>	Geometridae Laurentiinae Z1		Brazil
CCDB-29466-A02	Lepidoptera	Geometridae	Larentiinae		<i>Cambogia tegularia</i>	Geometridae Laurentiinae Z1		Brazil
CCDB-29466-A03	Lepidoptera	Geometridae	Larentiinae		<i>Cambogia tegularia</i>	Geometridae Laurentiinae Z1		Brazil
CCDB-29466-A04	Lepidoptera	Geometridae	Larentiinae		<i>Amaurinia paraviolascens</i>	Geometridae Laurentiinae Z1		Venezuela
CCDB-29466-A05	Lepidoptera	Geometridae	Larentiinae		<i>Amaurinia boliviensis</i>	Geometridae Laurentiinae Z1		Columbia
CCDB-29466-A06	Lepidoptera	Geometridae	Larentiinae		<i>Amaurinia auruda</i>	Geometridae Laurentiinae Z1		Venezuela
CCDB-29466-A07	Lepidoptera	Geometridae	Larentiinae		<i>Chlorotimandra viridis</i>	Geometridae Laurentiinae Z1		Chile
CCDB-29466-A08	Lepidoptera	Geometridae	Larentiinae		<i>Chlorotimandra viridis</i>	Geometridae Laurentiinae Z1		Chile
CCDB-29466-A09	Lepidoptera	Geometridae	Larentiinae		<i>Chlorotimandra viridis</i>	Geometridae Laurentiinae Z1		Argentina
CCDB-29466-A10	Lepidoptera	Geometridae	Larentiinae		<i>Anchiphyllia pellicata</i>	Geometridae Laurentiinae AA 3		Chile
CCDB-29466-A11	Lepidoptera	Geometridae	Larentiinae		<i>Anchiphyllia pellicata</i>	Geometridae Laurentiinae AA 3		Chile
CCDB-29466-A12	Lepidoptera	Geometridae	Larentiinae		<i>Anchiphyllia pellicata</i>	Geometridae Laurentiinae AA 3		Chile
CCDB-29466-B01	Lepidoptera	Geometridae	Larentiinae		<i>Trotocalpe albilunata</i>	Geometridae Laurentiinae AA 3		Venezuela
CCDB-29466-B02	Lepidoptera	Geometridae	Ennominae		<i>Cannagara himerodes</i>	Geometridae Ennominae AA17		Mexico
CCDB-29466-B03	Lepidoptera	Geometridae	Ennominae		<i>Cannagara himerodes</i>	Geometridae Ennominae AA17		Mexico
CCDB-29466-B04	Lepidoptera	Geometridae	Ennominae		<i>Cannagara himerodes</i>	Geometridae Ennominae AA17		Mexico
CCDB-29466-B05	Lepidoptera	Geometridae	Ennominae		<i>Bagodares prosa</i>	Geometridae Ennominae AA18		Venezuela
CCDB-29466-B06	Lepidoptera	Geometridae	Ennominae		<i>Thysanopyga fractimaculata</i>	Geometridae Ennominae AA19		Brazil
CCDB-29466-B07	Lepidoptera	Geometridae	Ennominae		<i>Thysanopyga fractimaculata</i>	Geometridae Ennominae AA19		Brazil
CCDB-29466-B08	Lepidoptera	Geometridae	Ennominae		<i>Mimomma ochriplaga</i>	Geometridae Ennominae AA19		Brazil
CCDB-29466-B09	Lepidoptera	Geometridae	Ennominae		<i>Mimomma ochriplaga</i>	Geometridae Ennominae AA19		Brazil

# Specimen Array

## Invertebrates

Enter minimum required data on spreadsheet while arraying

- **Taxonomy**
  - Take identification from tray (Usually most recent)
  - Sometimes no identification on the specimen
  - Label ID could be a synonym
- **Focus on the species column**
  - Hierarchy can be filled later



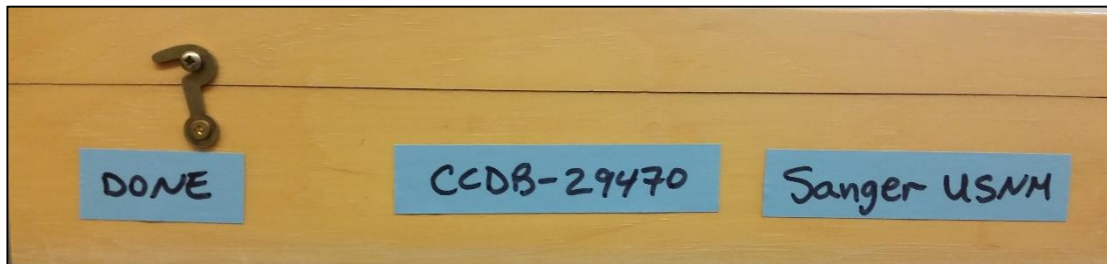


# Specimen Array

## Invertebrates

**Properly label each array boxes with array number**

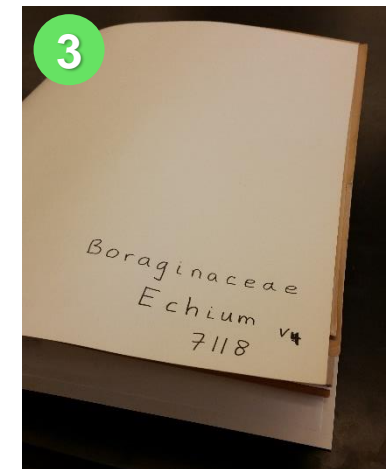
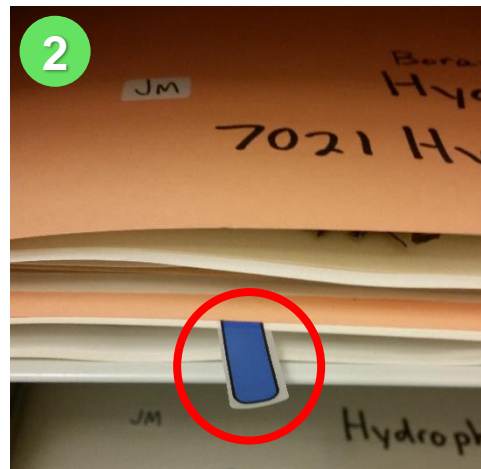
- Add “DONE” when completely filled to organize your arrays
- Can add grouping on the box, e.g. Sanger, Old, ....



# Specimen Array

## Plants

- Use page marker or post-its as place holder
  - 1 Add 1<sup>st</sup> label on the cabinet
  - 2 Add 2<sup>nd</sup> label for the species folder location
  - 3 Take the whole folder to station
    - Limit yourself to small number of folders at the time (e.g. 10 species folder)

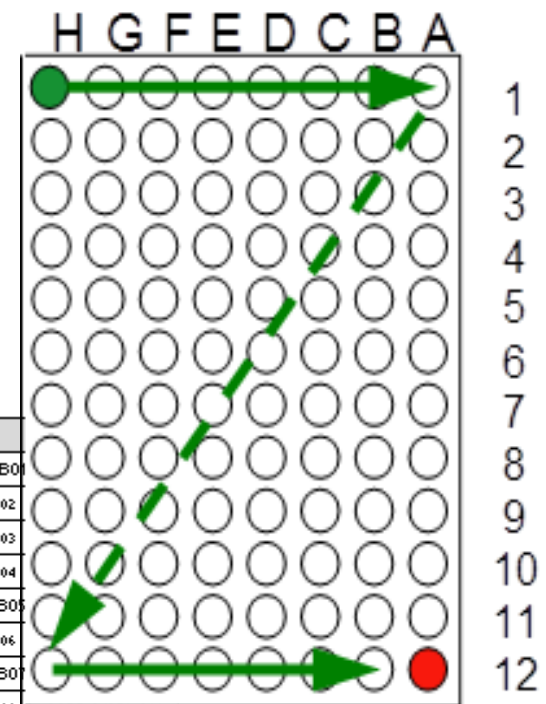


# Specimen Array

## Plants

- No arraying: placed in sequence
- Usually labelled, imaged and tissue sampled at the same time
  - More details at 11:45am
- Different orientation
  - A12 (●) : control well

### 8 Column Format



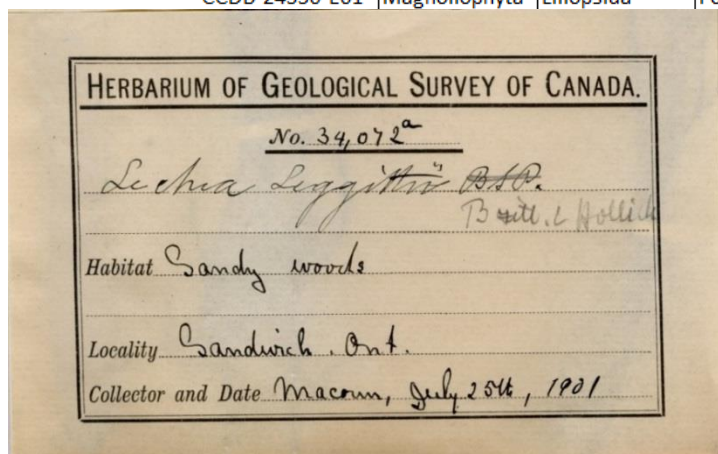
*	H	G	F	E	D	C	B	
01	CCDB-24350-H01	CCDB-24350-G01	CCDB-24350-F01	CCDB-24350-E01	CCDB-24350-D01	CCDB-24350-C01	CCDB-24350-B01	
02	CCDB-24350-H02	CCDB-24350-G02	CCDB-24350-F02	CCDB-24350-E02	CCDB-24350-D02	CCDB-24350-C02	CCDB-24350-B02	
03	CCDB-24350-H03	CCDB-24350-G03	CCDB-24350-F03	CCDB-24350-E03	CCDB-24350-D03	CCDB-24350-C03	CCDB-24350-B03	
04	CCDB-24350-H04	CCDB-24350-G04	CCDB-24350-F04	CCDB-24350-E04	CCDB-24350-D04	CCDB-24350-C04	CCDB-24350-B04	
05	CCDB-24350-H05	CCDB-24350-G05	CCDB-24350-F05	CCDB-24350-E05	CCDB-24350-D05	CCDB-24350-C05	CCDB-24350-B05	
06	CCDB-24350-H06	CCDB-24350-G06	CCDB-24350-F06	CCDB-24350-E06	CCDB-24350-D06	CCDB-24350-C06	CCDB-24350-B06	
07	CCDB-24350-H07	CCDB-24350-G07	CCDB-24350-F07	CCDB-24350-E07	CCDB-24350-D07	CCDB-24350-C07	CCDB-24350-B07	
08	CCDB-24350-H08	CCDB-24350-G08	CCDB-24350-F08	CCDB-24350-E08	CCDB-24350-D08	CCDB-24350-C08	CCDB-24350-B08	CCDB-24350-A08
09	CCDB-24350-H09	CCDB-24350-G09	CCDB-24350-F09	CCDB-24350-E09	CCDB-24350-D09	CCDB-24350-C09	CCDB-24350-B09	CCDB-24350-A09
10	CCDB-24350-H10	CCDB-24350-G10	CCDB-24350-F10	CCDB-24350-E10	CCDB-24350-D10	CCDB-24350-C10	CCDB-24350-B10	CCDB-24350-A10
11	CCDB-24350-H11	CCDB-24350-G11	CCDB-24350-F11	CCDB-24350-E11	CCDB-24350-D11	CCDB-24350-C11	CCDB-24350-B11	CCDB-24350-A11
12	CCDB-24350-H12	CCDB-24350-G12	CCDB-24350-F12	CCDB-24350-E12	CCDB-24350-D12	CCDB-24350-C12	CCDB-24350-B12	CONTROL

# Specimen Array

## Plants

- Decide how many reps for each species
- Fill at least Sample ID Taxonomy and Country on data entry spreadsheet (more details at 11:00)
  - The rest can be databased from the image later

Sample ID	Phylum	Class	Order	Family	Subfamily	Tribe	Genus/Species	Notes	Institution	Country
CCDB-24350-H01	Pinophyta	Pinidae	Pinales	Pinaceae			Picea pungens			Canada
CCDB-24350-G01	Magnoliophyta	Liliopsida	Alismatales	Hydrocharitaceae			Elodea bifoliata			Canada
CCDB-24350-F01	Magnoliophyta	Liliopsida	Poales	Poaceae	Pooideae		Triticum durum			Canada
CCDB-24350-E01	Magnoliophyta	Liliopsida	Poales	Poaceae	Pooideae		Elymus virginicus			Canada
			Poales	Poaceae	Pooideae		Puccinellia tenella			Canada
			Poales	Poaceae	Pooideae		Festuca frederikseniae			Canada
			Poales	Poaceae	Chloridoideae		Diplachne fusca			Canada
			Poales	Poaceae			Tridens flavus			Canada
			Poales	Poaceae	Pooideae		Deschampsia alpina			Canada
			Polypodiales	Isoetaceae			Isoetes maritima			Canada
			Polypodiales	Isoetaceae			Isoetes engelmannii			Canada
			Polypodiales	Isoetaceae			Isoetes acadensis			Canada
			Pinales	Pinaceae			Pinus albicaulis			Canada
			Polypodiales	Dryopteridaceae	Dryopteridoideae		Polystichum setigerum			Canada
			Polypodiales	Pteridaceae	Vittarioideae		Adiantum capillus-veneris			Canada
			Alismatales	Potamogetonaceae			Potamogeton oblongus			Canada
			Poales	Pinaceae			Picea pungens			Canada



# What to Pack

## Invertebrates - All Preservations

- **Prepare museum data entry template**
  - Can prepare a spreadsheet for each of your barcode labels and enter a “Sample ID” i.e. barcode label + well locator
  - Save them as the array #, e.g. CCDB-29068

	A	B	C	D	E	F	G	H	I
1	Specimen ID	Order	Family	Subfamily	Tribe	Genus/Species	Notes (e.g. cabinet/drawer #)	Institution Label	Country
2	CCDB-XXXXX-A01								
3	CCDB-XXXXX-A02								
4	CCDB-XXXXX-A03								
5	CCDB-XXXXX-A04								
6	CCDB-XXXXX-A05								
7	CCDB-XXXXX-A06								
8	CCDB-XXXXX-A07								
9	CCDB-XXXXX-A08								
10	CCDB-XXXXX-A09								
11	CCDB-XXXXX-A10								
12	CCDB-XXXXX-A11								
13	CCDB-XXXXX-A12								
14	CCDB-XXXXX-B01								
15	CCDB-XXXXX-B02								
16	CCDB-XXXXX-B03								
17	CCDB-XXXXX-B04								
18	CCDB-XXXXX-B05								
19	CCDB-XXXXX-B06								
20	CCDB-XXXXX-B07								
21	CCDB-XXXXX-B08								

# What to Pack

## Invertebrates - All Preservations

- **Prepare specimen removal labels matching your array number**

	A	B	C	D	E
1	USNM	USNM	USNM	USNM	USNM
2	On Loan to BIO CCDB-29068-A01	On Loan to BIO CCDB-29454-A01	On Loan to BIO CCDB-29455-A01	On Loan to BIO CCDB-29456-A01	On Loan to BIO CCDB-29457-A01
3	On Loan to BIO CCDB-29068-A02	On Loan to BIO CCDB-29454-A02	On Loan to BIO CCDB-29455-A02	On Loan to BIO CCDB-29456-A02	On Loan to BIO CCDB-29457-A02
4	On Loan to BIO CCDB-29068-A03	On Loan to BIO CCDB-29454-A03	On Loan to BIO CCDB-29455-A03	On Loan to BIO CCDB-29456-A03	On Loan to BIO CCDB-29457-A03
5	On Loan to BIO CCDB-29068-A04	On Loan to BIO CCDB-29454-A04	On Loan to BIO CCDB-29455-A04	On Loan to BIO CCDB-29456-A04	On Loan to BIO CCDB-29457-A04
6	On Loan to BIO CCDB-29068-A05	On Loan to BIO CCDB-29454-A05	On Loan to BIO CCDB-29455-A05	On Loan to BIO CCDB-29456-A05	On Loan to BIO CCDB-29457-A05



# What to Pack

## Invertebrates - All Preservations

- **Specimen removal labels**
  - Can print 2 color, e.g.:
    - 1 array with blue labels for young specimens
    - 1 array with orange labels for older specimens
  - **Preparation**
    - Cut into strips
    - OR pre-cut and pin in empty boxes

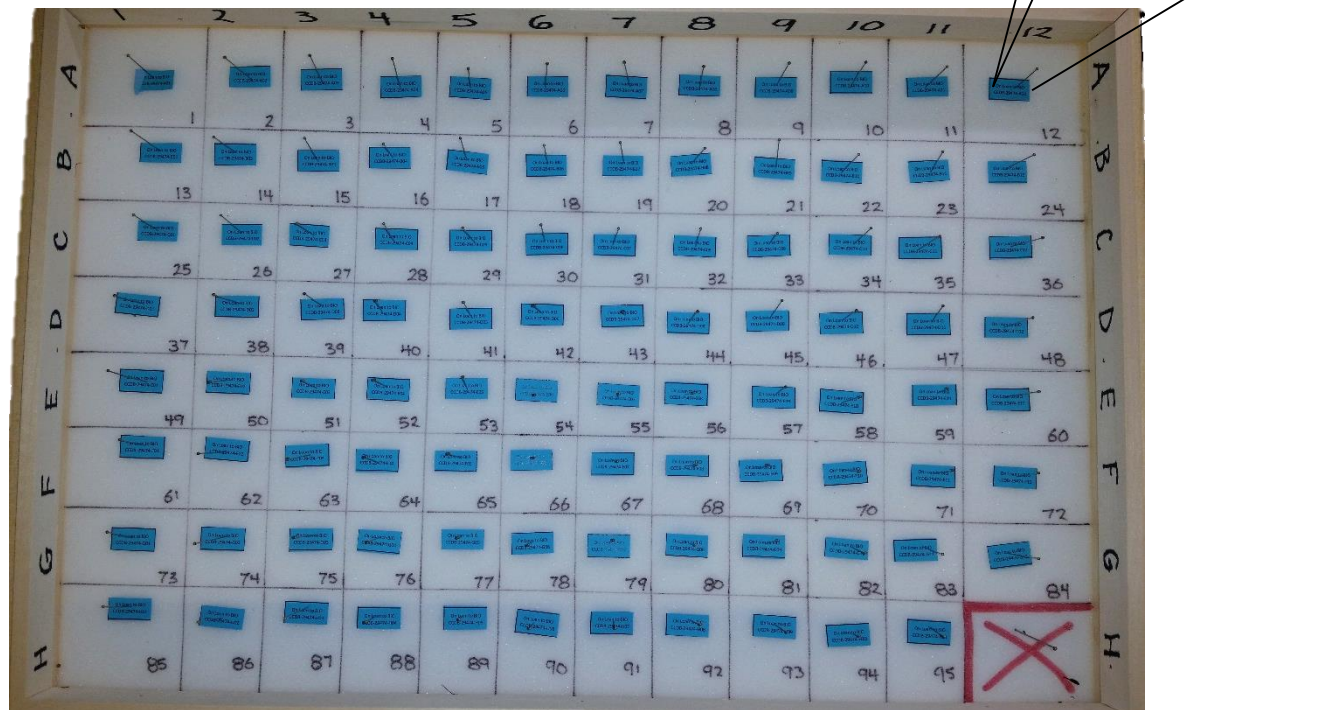


# What to Pack

## Invertebrates - Pinned Materials

- **Preparing arrays**

- Can draw your own grid on foam and glue it in a box
- Can fill with removal labels ahead of time



# What to Pack

## Invertebrates - Pinned Materials

- **If you are sampling at the museum**
  - Generate DNA barcode labels to link specimen to sequence (more details at 11:45)
  - CBG uses canary yellow paper but consult with museum

BOX 1	BOX 2	BOX 3	BOX 4	BOX 5	Barcode of life DNA voucher specimen Sample ID: CCDB-29472-A03
Barcode of life DNA voucher specimen Sample ID: CCDB-29470-A01	Barcode of life DNA voucher specimen Sample ID: CCDB-29471-A01	Barcode of life DNA voucher specimen Sample ID: CCDB-29472-A01	Barcode of life DNA voucher specimen Sample ID: CCDB-29473-A01	Barcode of life DNA voucher specimen Sample ID: CCDB-29474-A01	
Barcode of life DNA voucher specimen Sample ID: CCDB-29470-A02	Barcode of life DNA voucher specimen Sample ID: CCDB-29471-A02	Barcode of life DNA voucher specimen Sample ID: CCDB-29472-A02	Barcode of life DNA voucher specimen Sample ID: CCDB-29473-A02	Barcode of life DNA voucher specimen Sample ID: CCDB-29474-A02	
Barcode of life DNA voucher specimen Sample ID: CCDB-29470-A03	Barcode of life DNA voucher specimen Sample ID: CCDB-29471-A03	Barcode of life DNA voucher specimen Sample ID: CCDB-29472-A03	Barcode of life DNA voucher specimen Sample ID: CCDB-29473-A03	Barcode of life DNA voucher specimen Sample ID: CCDB-29474-A03	
Barcode of life DNA voucher specimen Sample ID: CCDB-29470-A04	Barcode of life DNA voucher specimen Sample ID: CCDB-29471-A04	Barcode of life DNA voucher specimen Sample ID: CCDB-29472-A04	Barcode of life DNA voucher specimen Sample ID: CCDB-29473-A04	Barcode of life DNA voucher specimen Sample ID: CCDB-29474-A04	

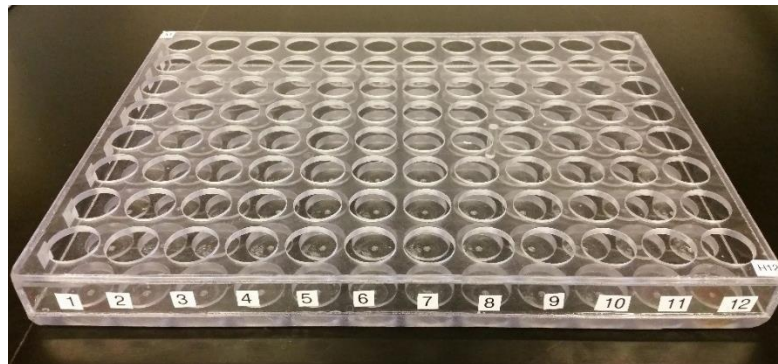
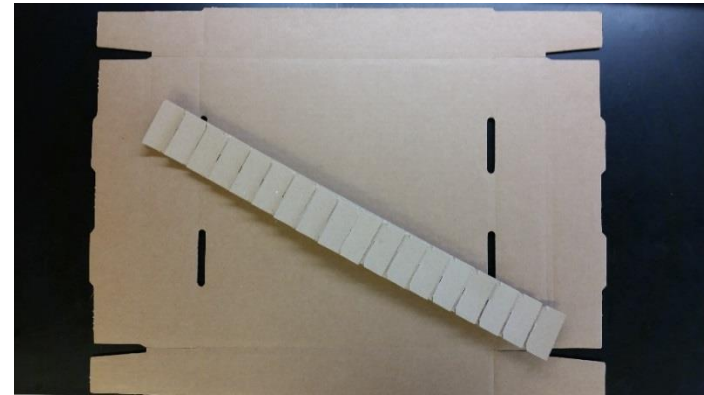
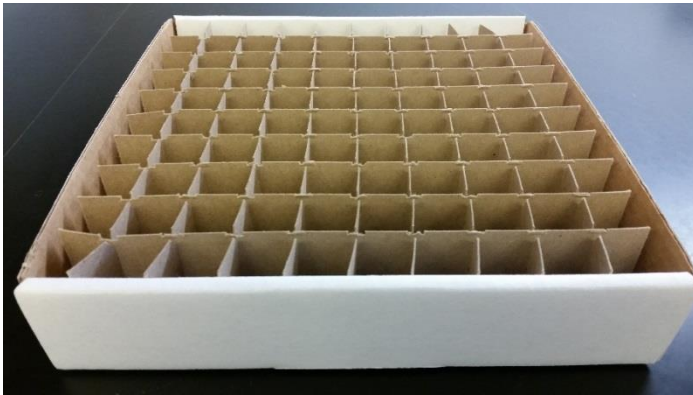
# What to Pack

## Invertebrates - Fluid Materials

- **Fluid boxes**

2 sets of labels for each

On Loan to BIO  
CCDB-29474-A01





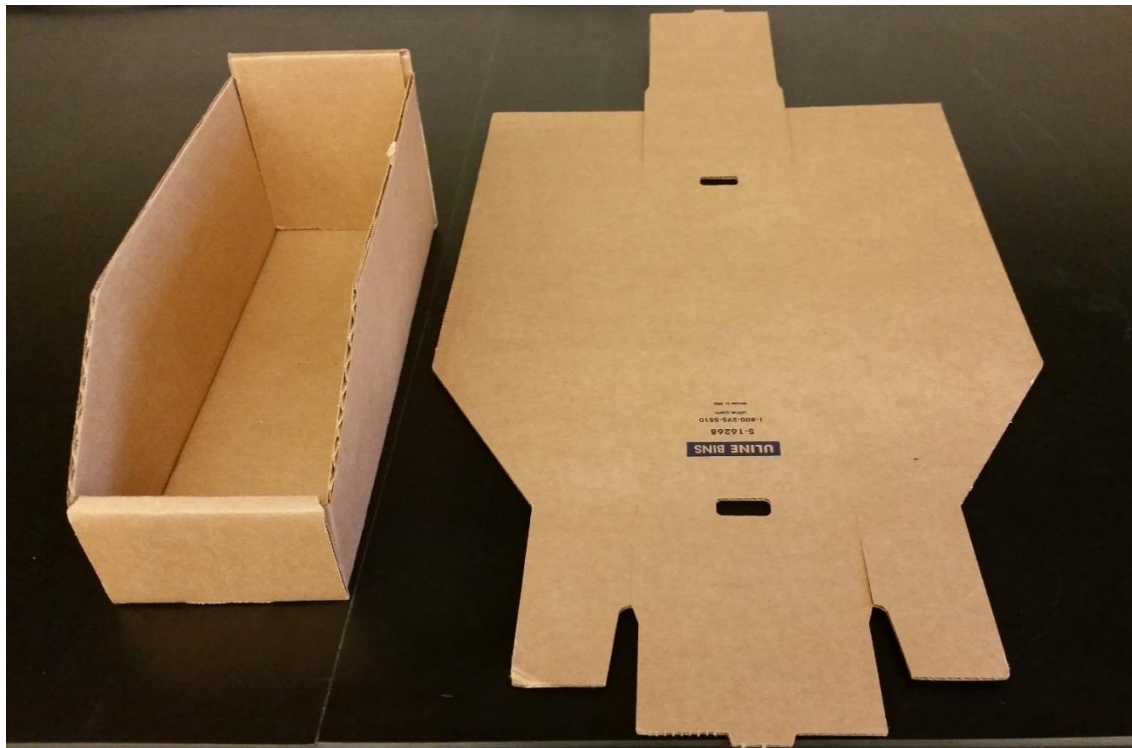
# What to Pack

## Invertebrates - Envelope Materials

- **Envelope tray**

2 sets of labels for each

On Loan to BIO  
CCDB-29474-A01



# What to Pack

## Plants

- **Prepare museum/DNA voucher labels**
  - Print on acid free paper

Page marker for the collection

 **CCDB**  
Canadian Centre for  
DNA Barcoding  
BIOUG 2014  
**CCDB-23308 A01**  
DNA Barcode of Life: Tissue  
sampled by the Biodiversity  
Institute of Ontario

 **CCDB**  
Canadian Centre for  
DNA Barcoding  
BIOUG 2014  
**CCDB-23308 A02**  
DNA Barcode of Life: Tissue  
sampled by the Biodiversity  
Institute of Ontario

 **CCDB**  
Canadian Centre for  
DNA Barcoding  
BIOUG 2014  
**CCDB-23308 A03**  
DNA Barcode of Life: Tissue  
sampled by the Biodiversity  
Institute of Ontario

 **CCDB**  
Canadian Centre for  
DNA Barcoding  
BIOUG 2014  
**CCDB-23308 A05**  
DNA Barcode of Life: Tissue  
sampled by the Biodiversity  
Institute of Ontario

 **CCDB**  
Canadian Centre for  
DNA Barcoding  
BIOUG 2014  
**CCDB-23308 A06**  
DNA Barcode of Life: Tissue  
sampled by the Biodiversity  
Institute of Ontario

 **CCDB**  
Canadian Centre for  
DNA Barcoding  
BIOUG 2014  
**CCDB-23308 A07**  
DNA Barcode of Life: Tissue  
sampled by the Biodiversity  
Institute of Ontario

 **CCDB**  
Canadian Centre for  
DNA Barcoding  
BIOUG 2014  
**CCDB-23308 A09**  
DNA Barcode of Life: Tissue  
sampled by the Biodiversity  
Institute of Ontario

 **CCDB**  
Canadian Centre for  
DNA Barcoding  
BIOUG 2014  
**CCDB-23308 A10**  
DNA Barcode of Life: Tissue  
sampled by the Biodiversity  
Institute of Ontario

 **CCDB**  
Canadian Centre for  
DNA Barcoding  
BIOUG 2014  
**CCDB-23308 A11**  
DNA Barcode of Life: Tissue  
sampled by the Biodiversity  
Institute of Ontario

 **CCDB**  
Canadian Centre for  
DNA Barcoding  
BIOUG 2014  
**CCDB-23308 B02**  
DNA Barcode of Life: Tissue  
sampled by the Biodiversity  
Institute of Ontario

 **CCDB**  
Canadian Centre for  
DNA Barcoding  
BIOUG 2014  
**CCDB-23308 B03**  
DNA Barcode of Life: Tissue  
sampled by the Biodiversity  
Institute of Ontario

 **CCDB**  
Canadian Centre for  
DNA Barcoding  
BIOUG 2014  
**CCDB-23308 B04**  
DNA Barcode of Life: Tissue  
sampled by the Biodiversity  
Institute of Ontario

 **CCDB**  
Canadian Centre for  
DNA Barcoding  
BIOUG 2014  
**CCDB-23308 B06**  
DNA Barcode of Life: Tissue  
sampled by the Biodiversity  
Institute of Ontario

 **CCDB**  
Canadian Centre for  
DNA Barcoding  
BIOUG 2014  
**CCDB-23308 B07**  
DNA Barcode of Life: Tissue  
sampled by the Biodiversity  
Institute of Ontario

 **CCDB**  
Canadian Centre for  
DNA Barcoding  
BIOUG 2014  
**CCDB-23308 B08**  
DNA Barcode of Life: Tissue  
sampled by the Biodiversity  
Institute of Ontario

 **CCDB**  
Canadian Centre for  
DNA Barcoding  
BIOUG 2014  
**CCDB-23308 B10**  
DNA Barcode of Life: Tissue  
sampled by the Biodiversity  
Institute of Ontario

 **CCDB**  
Canadian Centre for  
DNA Barcoding  
BIOUG 2014  
**CCDB-23308 B11**  
DNA Barcode of Life: Tissue  
sampled by the Biodiversity  
Institute of Ontario

 **CCDB**  
Canadian Centre for  
DNA Barcoding  
BIOUG 2014  
**CCDB-23308 B12**  
DNA Barcode of Life: Tissue  
sampled by the Biodiversity  
Institute of Ontario

 **CCDB**  
Canadian Centre for  
DNA Barcoding  
BIOUG 2014  
**CCDB-23308 C02**  
DNA Barcode of Life: Tissue  
sampled by the Biodiversity  
Institute of Ontario

 **CCDB**  
Canadian Centre for  
DNA Barcoding  
BIOUG 2014  
**CCDB-23308 C03**  
DNA Barcode of Life: Tissue  
sampled by the Biodiversity  
Institute of Ontario

 **CCDB**  
Canadian Centre for  
DNA Barcoding  
BIOUG 2014  
**CCDB-23308 C04**  
DNA Barcode of Life: Tissue  
sampled by the Biodiversity  
Institute of Ontario





# What to Pack

## All Groups

- **Imaging equipment** (more details at 11:45)
- **Backup copy of spreadsheets**
- **Other items:**



- **Logistics**
  - Permits/Customs/Documentation, arrival time at museum, etc.

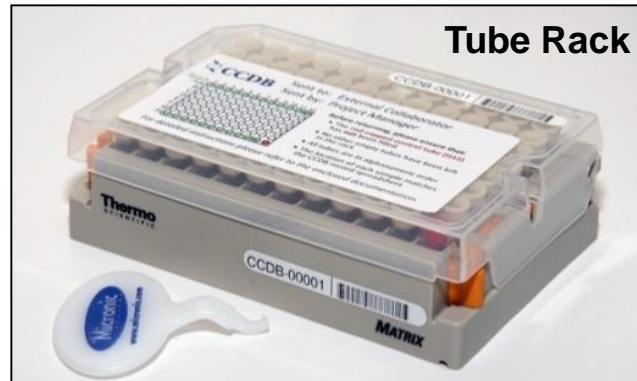
# What to Pack

## All Groups

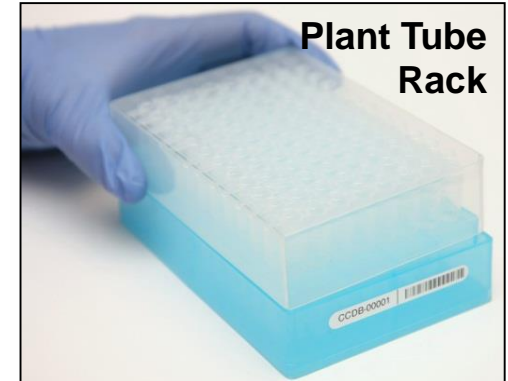
- Choosing your tissue sampling media



Microplate



Tube Rack



Plant Tube Rack

- If using CCDB sampling kit
  - Request at: [ccdbcol@uoguelph.ca](mailto:ccdbcol@uoguelph.ca)

# What to Pack

## All Groups

- Included in CCDB sampling kit
  - Sampling media with barcode label
  - Instructions (e.g. invertebrates, plants)
  - BMAA
  - Plate Record



Microplate

**MICROPLATE AND DATA SUBMISSION PACKAGE**  
SAMPLING KIT INSTRUCTIONS

This sampling kit is aimed to facilitate the submission of animal tissue samples and collateral information for processing at the Canadian Centre for DNA Barcoding (CCDB). The contents are:

- Containers (up to 10) for housing tissue samples along with data sheets
- A paper CCDB Record Form (or its Excel spreadsheet version CCDB-0000.xls sent by email)
- The Biological Material Analysis Agreement (a PDF attached in the package and sent by email)
- Instructions (a PDF attached in the package and a copy sent by email)

Please ensure that all required information and data pertaining to the material are complete prior to the arrival of containers to the CCDB. This includes:

**Physical items**

- Filled microplate(s)
- Signed BMAA

**Digital items**

- Completed CCDB Record Form(s)
- Completed BOLD Specimen Data Submission
- Completed BOLD Specimen Image Submission

The following sections (A-C) are designed to help you prepare the material being sent to the CCDB. Please read all instructions before proceeding with tissue sampling.

**IMPORTANT: For submission of DNA sequences or PCR products, a different sampling kit is required.**

**A – CONTAINER DESCRIPTION - MICROPLATE**

Each microplate contains 96 sampling wells that are arranged in an 8x12 format. The sampling array starts with well A01. Well H12 should be left empty as a negative control; each plate accommodates 95 tissue samples. See section D for details of the sampling procedure.

Each plate is individually numbered with a unique barcode (CCDB Number), which should be entered into the corresponding CCDB Record (see section H).

**B – DIGITAL SPECIMEN DATA SUBMISSION**

Prior to molecular analysis at the CCDB, accompanying data must be submitted in a compliant format via two independent channels: the CCDB and the Barcode of Life Data Systems (BOLD).

1. The CCDB Record named CCDB-0000\_Record.xls is emailed to the recipient and used to record the location of samples in the corresponding animal submitters. Each sample must be assigned a Sample ID, which is a unique identifier linking the sample (tissue or DNA) with its source specimen. See section I for more details. Each container will have a corresponding CCDB Record.

2. A BOLD Specimen Data Submission is the first step in the process of creating records on BOLD. There will be one specimen data submission for each tissue sample. Please refer to the BOLD handbook, found by the link below, for more details on the specimen data submission protocol: <http://www.biodiversityinformatics.org.au/manual/bold/submitting-specimens.html>

**Note:** The Sample ID field within the specimen data spreadsheet should be identical (in case and with no alterations) to the Sample ID entered in the CCDB Record(s).

3. A BOLD Specimen Image Submission is an additional requirement for some analytical services (see <http://bold.ccdb.ca/submitting> for details) and should be uploaded to BOLD to complement the specimen data submission. Please refer to BOLD handbook, found by the following link, for details on the image submission protocol: <http://www.biodiversityinformatics.org.au/manual/bold/submitting-specimens.html>

**IBOL Biological Material Transfer and Data Policy Agreement**

Unless explicitly negotiated otherwise, all biological materials shipped to the Biodiversity Institute of Ontario fall under the standard provisions of the IBOL Biological Material Transfer Agreement (v. 2009-07), and all data submitted to BOLD and generated by the Canadian Centre for DNA Barcoding (CCDB) or BOLD, shall remain the property of the CCDB or BOLD. Full texts can be downloaded from the IBOL website at <http://www.biodiversityinformatics.org.au/manual/bold/submitting-specimens.html> or requested from your contact person at the CCDB or BOLD. Please acknowledge that you have read and agreed to these conditions by filling out and signing the Implementing Letter below either in electronic or hard copy form.

**IMPLEMENTING LETTER**

The purpose of this letter is to provide a record of the biological material transfer and to memorialize the agreement between the Provider of biological materials (identified below) and the Canadian Centre for DNA Barcoding (CCDB) and the Biodiversity Institute of Ontario (BIO) under the terms and conditions of the IBOL Biological Material Transfer Agreement (v. 2009-07) and the CCDB Data & Resource Sharing Policies (v. 2009-07). The implementing letter becomes effective when filed and signed by the Provider. The parties executing this implementing letter certify that their respective organizations have accepted and further agree to be bound by these terms for the transfer specified below.

**1. Provider**

Name: \_\_\_\_\_ Organization name and address: \_\_\_\_\_  
Position: \_\_\_\_\_  
Phone: \_\_\_\_\_  
E-mail: \_\_\_\_\_

**2. Recipient:** Canadian Centre for DNA Barcoding, Biodiversity Institute of Ontario  
University of Guelph, 578 Gordon Street, Guelph, Ontario, Canada N1G 2W1  
Phone: +1 519 824-4123 ext. 56703

**3. Description of Biological Materials**

Type of material sent: \_\_\_\_\_ Comments: \_\_\_\_\_  
☐ whole voucher  
☐ tissue sample  
☐ DNA extract  
☐ PCR product

**4. IBOL Theme / Workshop:**

**On behalf of the Provider of Biological Materials:** \_\_\_\_\_  
Signature: \_\_\_\_\_  
Date signed: \_\_\_\_\_

**CCDB Canadian Centre for DNA Barcoding**  
SAMPLE RECORD DATA INPUT SHEET version 5.1.0

1. SORT ORDER - ANIMAL PLATE/BOX

2. Type of sample container: microplate  
☐ Multiple containers (up to 10)  
Container CCDB Number: CCDB-24350

3. Sample Locator BOLD Sample IDs

4	CCDB-24350 A01
5	CCDB-24350 A02
6	CCDB-24350 A03
7	CCDB-24350 A04
8	CCDB-24350 A05
9	CCDB-24350 A06
10	CCDB-24350 A07
11	CCDB-24350 A08
12	CCDB-24350 A09
13	CCDB-24350 A10
14	CCDB-24350 A11
15	CCDB-24350 A12
16	CCDB-24350 B01
17	CCDB-24350 B02
18	CCDB-24350 B03
19	CCDB-24350 B04
20	CCDB-24350 B05
21	CCDB-24350 B06
22	CCDB-24350 B07
23	CCDB-24350 B08
24	CCDB-24350 B09
25	CCDB-24350 B10
26	CCDB-24350 B11
27	CCDB-24350 B12
28	CCDB-24350 C01
29	CCDB-24350 C02
30	CCDB-24350 C03
31	CCDB-24350 C04
32	CCDB-24350 C05
33	CCDB-24350 C06
34	CCDB-24350 C07
35	CCDB-24350 C08
36	CCDB-24350 C09
37	CCDB-24350 C10
38	CCDB-24350 C11
39	CCDB-24350 C12
40	CCDB-24350 D01
41	CCDB-24350 D02
42	CCDB-24350 D03
43	CCDB-24350 D04
44	CCDB-24350 D05
45	CCDB-24350 D06
46	CCDB-24350 D07
47	CCDB-24350 D08
48	CCDB-24350 D09
49	CCDB-24350 D10

Enter CCDB number from container barcode label => CCDB-24350

Proceed to type or paste Sample ID's for your samples into the white cells of the 'Well Locator' field (column B)

Confirm proper container selection:

Confirm correct sampling order - click to view array map (enable macros)

Microplate (animal tissue)

SAMPLING ORDER: Begin sampling with position A01 and finish at H11  
DO NOT fill and DO NOT ENTER DATA for CONTROL WELL - H12

Please ensure that your data submission meets the following criteria:

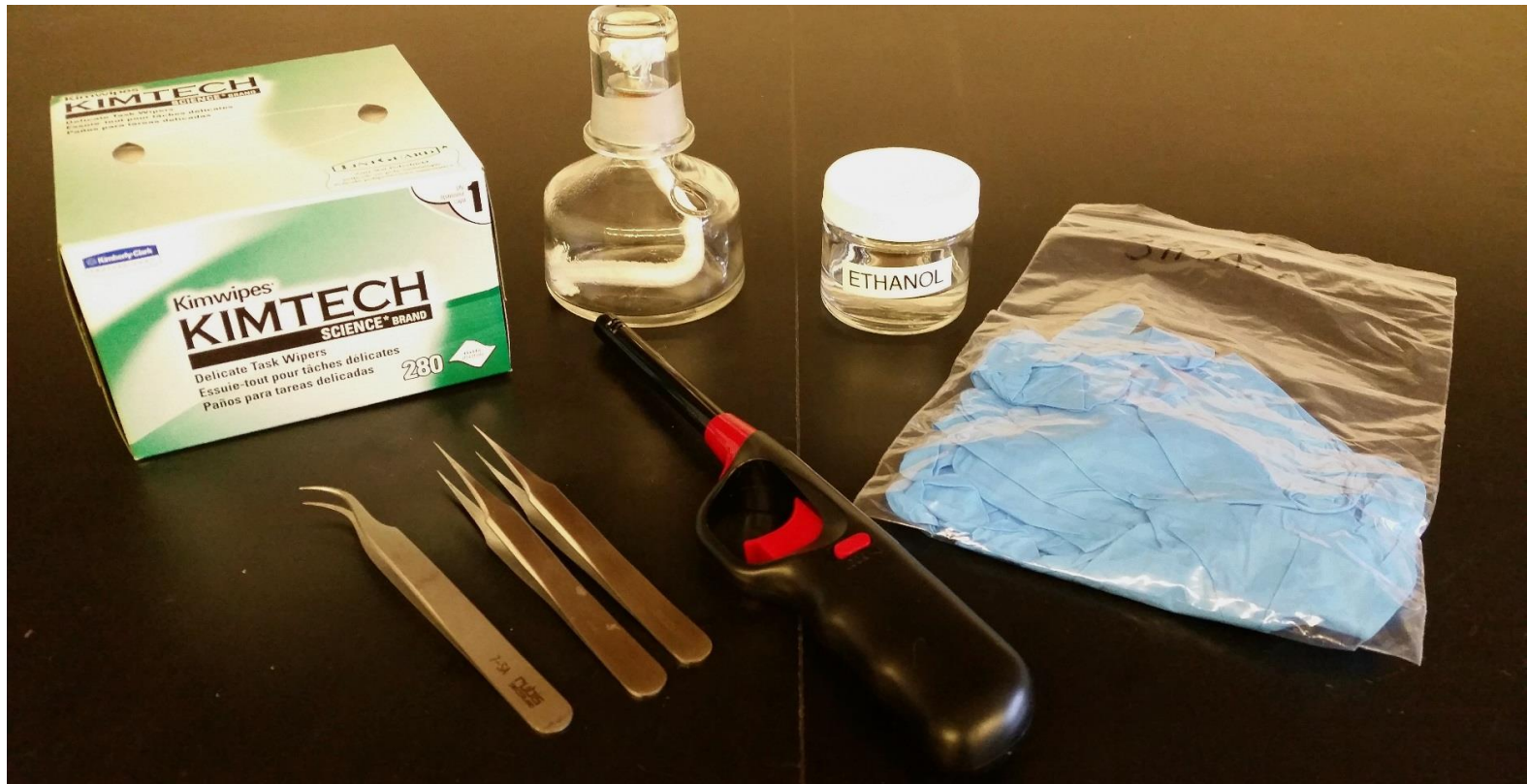
- Sample ID's are unique identifiers unambiguously linking each tissue sample with the corresponding BOLD record and collection voucher specimen
- The order of Sample ID's in this CCDB record should match the position of the corresponding tubes, wells or blotting circles (refer to sample layout map on next sheet)
- Sample ID's should be at least 5 (five) characters long
- Sample ID's should NOT be duplicated (each sample submitted only once)
- Sample ID's should NOT contain delimiters or invalid characters

DATA INPUT Array Map For lab use only

# What to Pack

## If Sampling on Site

- **Tissue sampling supplies** (more details at 11:45)



# What to Pack

## If Sampling on Site - Invertebrates

- **Prepare microplate**
  - With 30µL ethanol per well and 12-strip caps

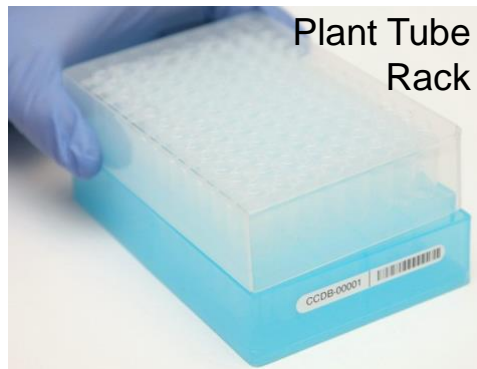




# What to Pack

## If Sampling on Site - Plants

- **Prepare plant box**
  - Bring extra 8 strips cap, beads and plant tube rack



# What to Pack

## Summary

Pinned	Fluid	Envelope	Plants/Fungi	Vertebrates
Museum data entry template				
DNA barcode labels			Museum/DNA labels	Add digital note to database
Array box	Fluid box	Envelope box	Unarrayed	Unarrayed
Microplate (if sampling on site)			Plant tube rack	Microplate or Tube rack
Specimen removal labels (x1)	Specimen removal labels (x2)		Page marker or post-it	Not applicable
★ Tissue sampling: ethanol burner, small jar for ethanol, lighter, forceps, gloves				ELIMINase, water, jars (x4), forceps, gloves
★ Imaging equipment				If applicable
Optional: backup copy of spreadsheets, extras (boxes, tubes, pins), gel caps, labelling tape, scissors, marker, pen, pencil, post-it				

★ If borrowing specimens, bring just in case

# Before Leaving the Museum

Loan/BMTA Forms

Other Duties

# Loans & BMTA Forms

Provide a list of all borrowed specimens

- All specimen arrays combined in one excel file
- Provides the total numbers of specimens
- Array # + well locator, **taxonomy**, location and **country**

Specimen ID	Order	Family	Subfamily	Tribe	Genus/Species	Notes (e.g. cabinet/drawer #)	Institution Label	Country
CCDB-29466-A01	Lepidoptera	Geometridae	Larentiinae		<i>Cambogia tegularia</i>	Geometridae Laurentiinae Z1		Brazil
CCDB-29466-A02	Lepidoptera	Geometridae	Larentiinae		<i>Cambogia tegularia</i>	Geometridae Laurentiinae Z1		Brazil
CCDB-29466-A03	Lepidoptera	Geometridae	Larentiinae		<i>Cambogia tegularia</i>	Geometridae Laurentiinae Z1		Brazil
CCDB-29466-A04	Lepidoptera	Geometridae	Larentiinae		<i>Amaurinia paraviolascens</i>	Geometridae Laurentiinae Z1		Venezuela
CCDB-29466-A05	Lepidoptera	Geometridae	Larentiinae		<i>Amaurinia boliviensis</i>	Geometridae Laurentiinae Z1		Columbia
CCDB-29466-A06	Lepidoptera	Geometridae	Larentiinae		<i>Amaurinia auruda</i>	Geometridae Laurentiinae Z1		Venezuela
CCDB-29466-A07	Lepidoptera	Geometridae	Larentiinae		<i>Chlorotimandra viridis</i>	Geometridae Laurentiinae Z1		Chile
CCDB-29466-A08	Lepidoptera	Geometridae	Larentiinae		<i>Chlorotimandra viridis</i>	Geometridae Laurentiinae Z1		Chile
CCDB-29466-A09	Lepidoptera	Geometridae	Larentiinae		<i>Chlorotimandra viridis</i>	Geometridae Laurentiinae Z1		Argentina
CCDB-29466-A10	Lepidoptera	Geometridae	Larentiinae		<i>Anchiphylia pellicata</i>	Geometridae Laurentiinae AA 3		Chile
CCDB-29466-A11	Lepidoptera	Geometridae	Larentiinae		<i>Anchiphylia pellicata</i>	Geometridae Laurentiinae AA 3		Chile
CCDB-29466-A12	Lepidoptera	Geometridae	Larentiinae		<i>Anchiphylia pellicata</i>	Geometridae Laurentiinae AA 3		Chile
CCDB-29466-B01	Lepidoptera	Geometridae	Larentiinae		<i>Trotcalpe albilunata</i>	Geometridae Laurentiinae AA 3		Venezuela
CCDB-29466-B02	Lepidoptera	Geometridae	Ennominae		<i>Cannagara himerodes</i>	Geometridae Ennominae AA17		Mexico
CCDB-29466-B03	Lepidoptera	Geometridae	Ennominae		<i>Cannagara himerodes</i>	Geometridae Ennominae AA17		Mexico
CCDB-29466-B04	Lepidoptera	Geometridae	Ennominae		<i>Cannagara himerodes</i>	Geometridae Ennominae AA17		Mexico
CCDB-29466-B05	Lepidoptera	Geometridae	Ennominae		<i>Bagodares prosa</i>	Geometridae Ennominae AA18		Venezuela
CCDB-29466-B06	Lepidoptera	Geometridae	Ennominae		<i>Thysanopyga fractimaculata</i>	Geometridae Ennominae AA19		Brazil
CCDB-29466-B07	Lepidoptera	Geometridae	Ennominae		<i>Thysanopyga fractimaculata</i>	Geometridae Ennominae AA19		Brazil
CCDB-29466-B08	Lepidoptera	Geometridae	Ennominae		<i>Mimomma ochriplaga</i>	Geometridae Ennominae AA19		Brazil
CCDB-29466-B09	Lepidoptera	Geometridae	Ennominae		<i>Mimomma ochriplaga</i>	Geometridae Ennominae AA19		Brazil
CCDB-29466-B10	Lepidoptera	Geometridae	Ennominae		<i>Mimomma ochriplaga</i>	Geometridae Ennominae AA19		Brazil
CCDB-29466-B11	Lepidoptera	Geometridae	Ennominae		<i>Heteroleuca pullata</i>	Geometridae Ennominae AA21		Columbia
CCDB-29466-B12	Lepidoptera	Geometridae	Ennominae		<i>Dyschoroneura obsolescens</i>	Geometridae Ennominae AA21		Peru
CCDB-29466-C01	Lepidoptera	Geometridae	Ennominae		<i>Dyschoroneura obsolescens</i>	Geometridae Ennominae AA21		Peru
CCDB-29466-C02	Lepidoptera	Geometridae	Ennominae		<i>Dyschoroneura obsolescens</i>	Geometridae Ennominae AA21		Peru

# Loans & BMTA Forms

- Loan invoice

SI-7 (EMs Gen.)

SMITHSONIAN INSTITUTION  
NATIONAL MUSEUM OF NATURAL HISTORY  
Department of Entomology  
Collections Management Unit  
NHB MRC 165; 10th & Constitution Ave, N.W.; Box 37012; Washington, DC 20013-7012

Page 1 of 2

SHIPPING INVOICE

Date: 08 Jun 2017

Transaction #: 2080851

Please reference transaction number when tracking the material itemized below.

TO: ATTN: Valerie Levesque-Beaudin  
Biodiversity Institute of Ontario  
University of Guelph 579 Gordon Street  
Guelph, Ontario N1G 2W1  
CANADA

Due Date: 08 Jun 2020

Initiated By: Dr. Scott Miller

Approved By: Dr. Patricia Gentili-Poole

This material is sent as a loan for scientific study by Valerie Levesque-Beaudin at your request.

Description: 98 specimens of various insect orders for genetic sequencing as part of BOLD's 'missing families' project.

98 Specimen(s)

Itemized on the following page(s): 2

See page 2 for Conditions/Instructions.

Please return an electronic copy of any specimen-level data captured from these specimens (USNM bar-code labels can be provided). These specimens cannot be used for any biochemical study, including molecular systematics or bio-prospecting, without prior written approval. Please send a copy of any publications using USNM specimen or personnel assistance to the Initiator of the loan.

Return Primary Types in 6 months by Registered Mail, Airmail if possible. Please return specimen(s) directly to the initiator of the loan.  
INCLUDE TRANSACTION NUMBER WITH THE PACKAGE(S).

Please pack and ship all shipments to NMNH in accordance with all applicable government and carrier regulations.

Shipment #: 2053570	USFWS aDoc #: 2017BN2051951	RECEIVED IN GOOD ORDER AND ALL CONDITIONS ACCEPTED.
Method: Hand Carried	Shipping Office: NHB	(Name)
Payment: Prepaid	Carrier: Valerie Levesque-Beaudin	(Date)
	Tracking #:	
	# of Packages: 5	

Package Type(s): Box, Box, Box, Box, Box

☐ PLEASE SIGN, DATE AND RETURN THIS COPY TO THE OFFICE AT THE ABOVE ADDRESS  
☐ KEEP THIS COPY FOR YOUR RECORDS  
☐ DEPARTMENT COPY
 ☐ SHIPPING OFFICE COPY
 ☐ PACKAGE COPY



# Other Duties

- Inspection



**Australian  
CUSTOMS AND  
BORDER PROTECTION**

- Pack specimens for transportation

