



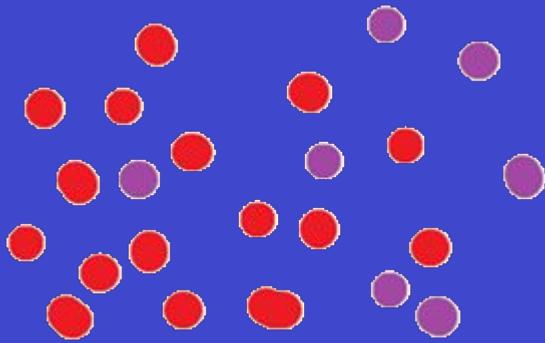
# Gap Analysis: Main issues in geographical coordinates (CURATION + WORKFLOW)

November 6, 2025

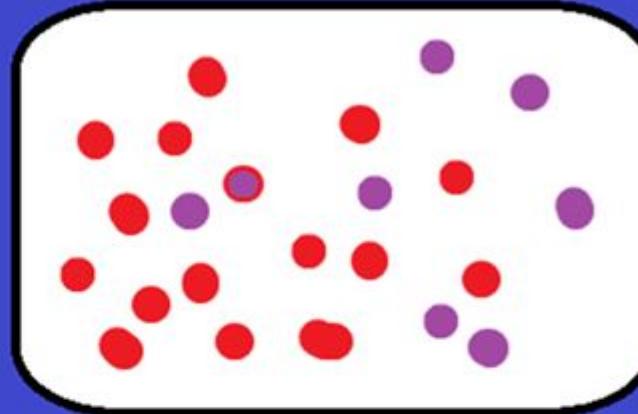
Alliance Bioversity International & CIAT



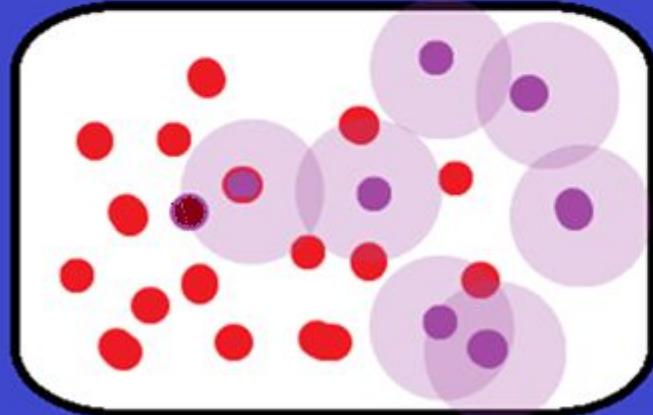
# The workflow for a gap analysis

**A**

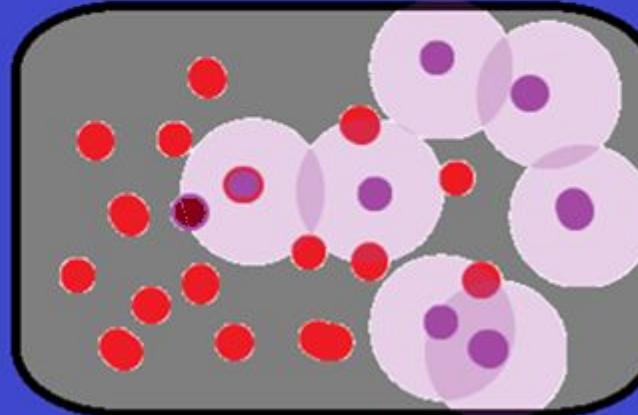
Species occurrences

**B**

Realized niche

**C**

Sampled  
germplasm

**D**

Where to collect

- Germplasm
- Other coordinates
- Collected germplasm area
- Potential area to be collected

# Basics of data curation

## Activity

-Taxonomic data

-Geographical coordinates

-Environmental information

## What respond?

-The species that I am analyzing have other scientific names or it is even a valid name?

-How accurate is the geographical information found for my species?

-What environmental information can be used to model the species distribution of the species?

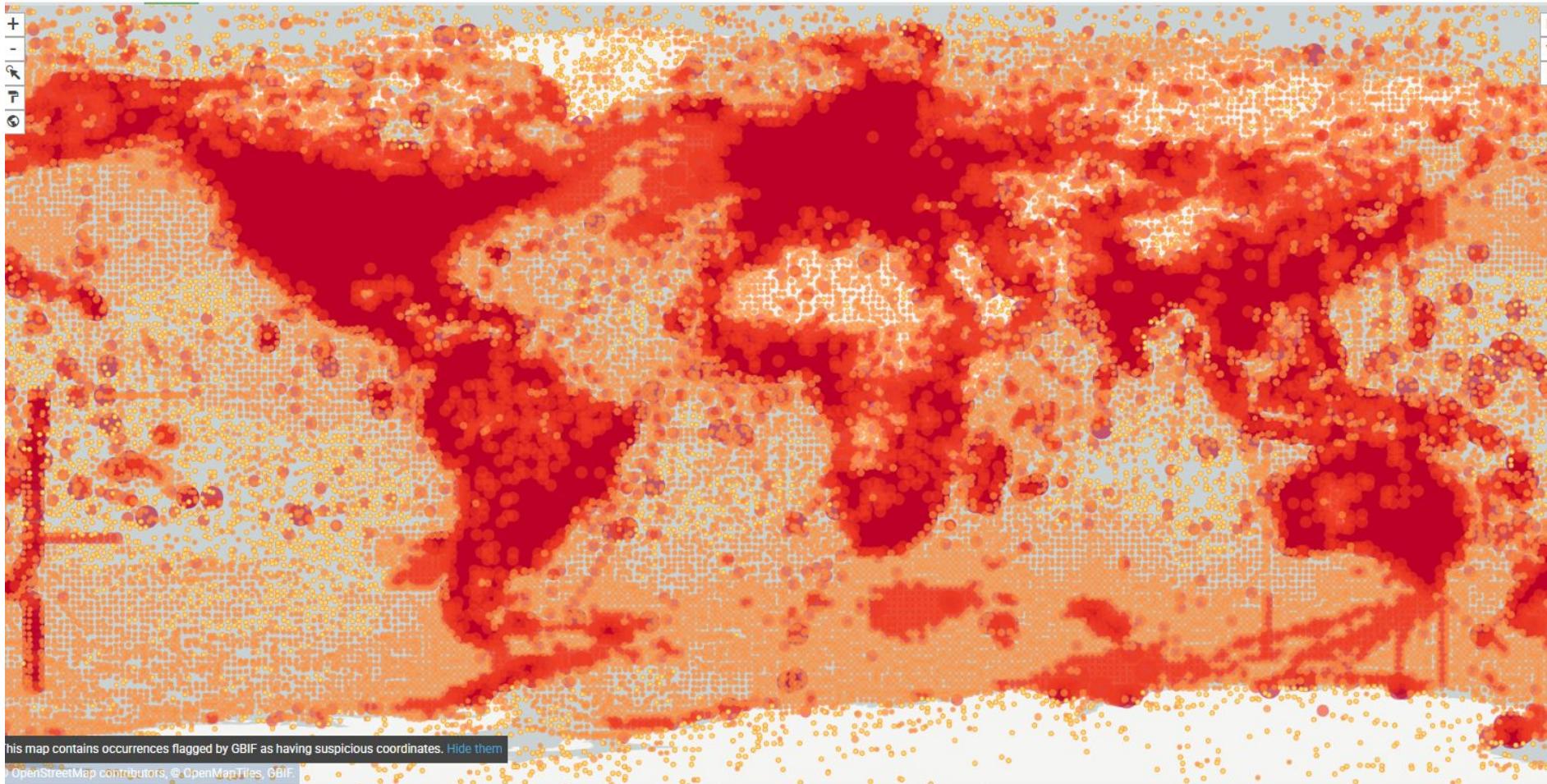


# Why is important to curate geographical coordinates?

# Databases need curation!

SEARCH OCCURRENCES | 2,893,528,002 WITH COORDINATES

TABLE GALLERY MAP TAXONOMY METRICS DOWNLOAD



This map contains occurrences flagged by GBIF as having suspicious coordinates. [Hide them](#)

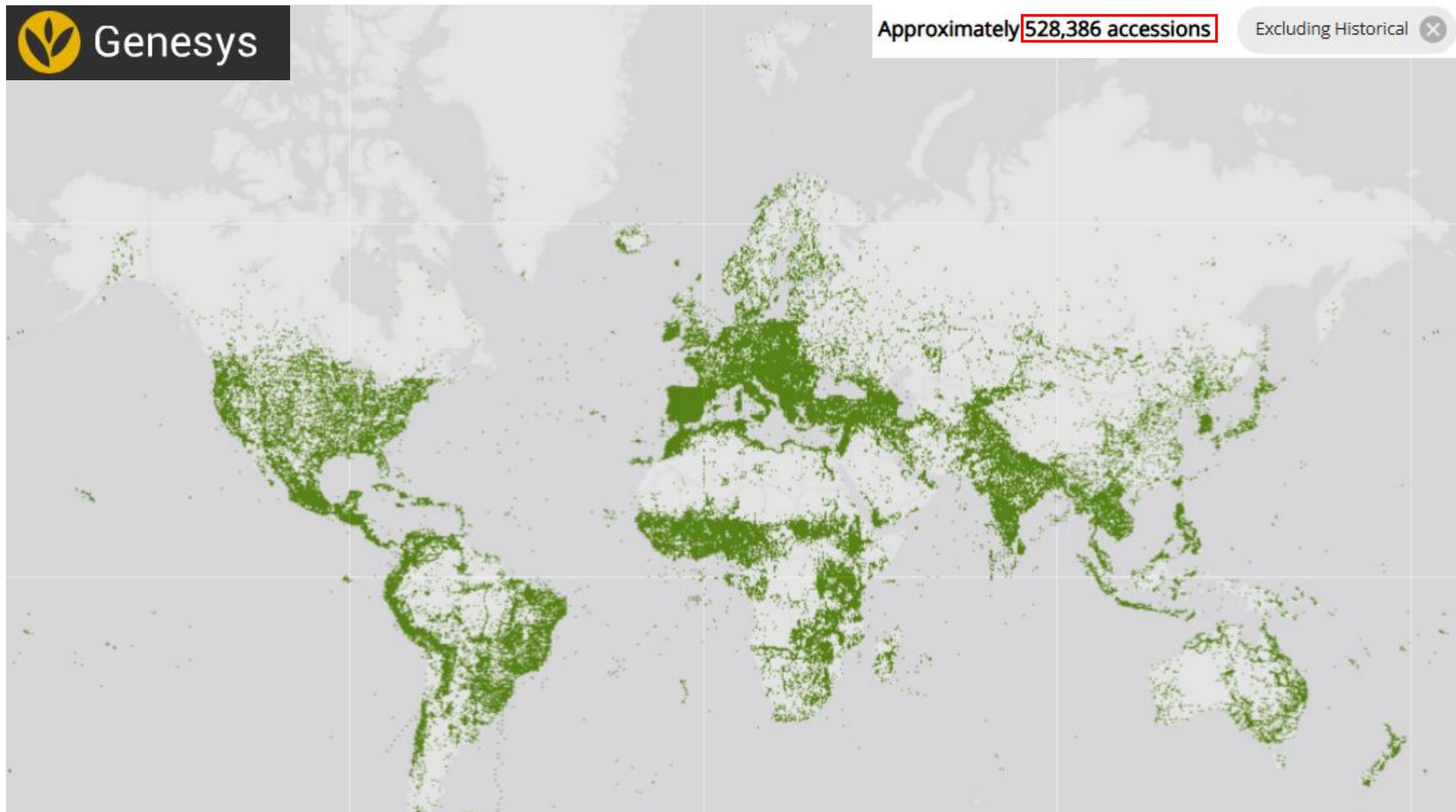
© OpenStreetMap contributors, © OpenMapTiles, GBIF.



Genesys

Approximately 528,386 accessions

Excluding Historical



# *Helianthus annuus* L.

Published in: L. (1753). In: Sp. Pl. 904. source: Catalogue of Life

Annual Sunflower In English

OVERVIEW    3 TREATMENTS    METRICS

84,706 OCCURRENCES

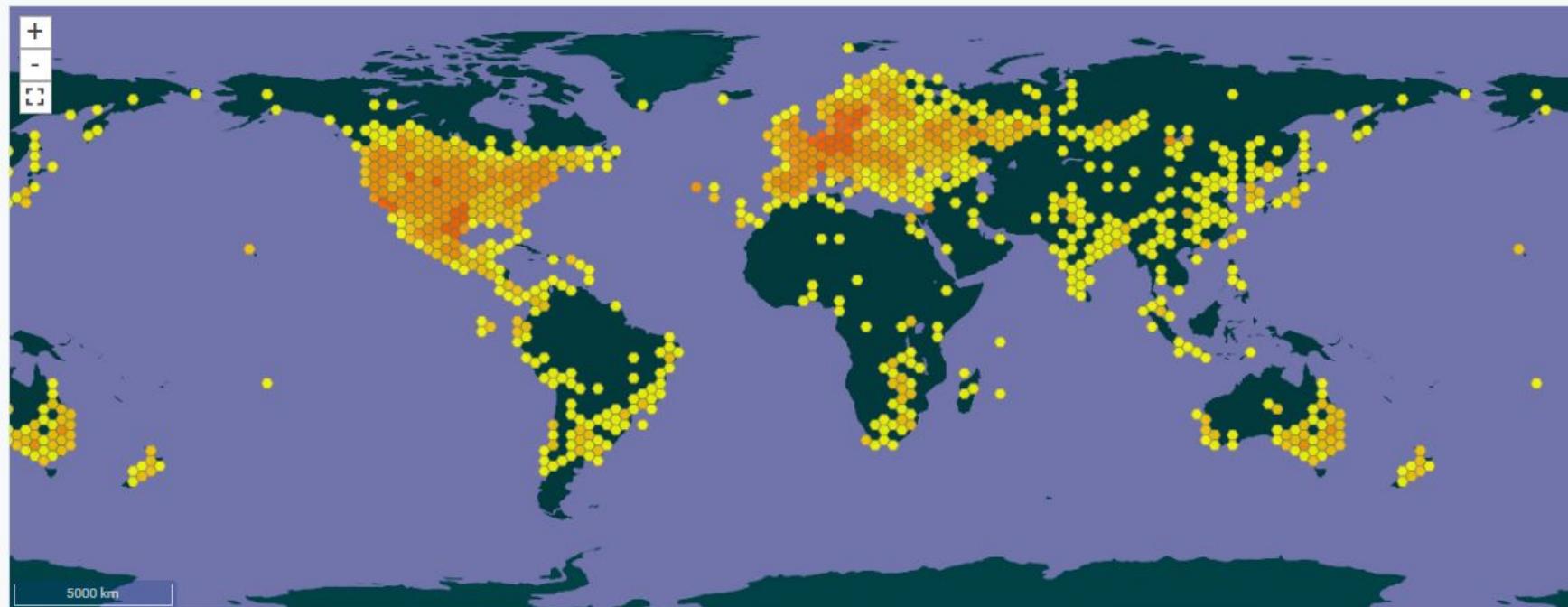
9 INFRASPECIES

28,188 OCCURRENCES WITH IMAGES



SEE GALLERY

56,417 GEOREFERENCED RECORDS



SPECIES | ACCEPTED

# *Amaranthus caudatus L.*

Published in: L. (1753). In: Sp. Pl.: 990. source: Catalogue of Life

Foxtail in English

<https://www.gbif.org/species/6109611>

OVERVIEW 5 TREATMENTS METRICS

7,297 OCCURRENCES

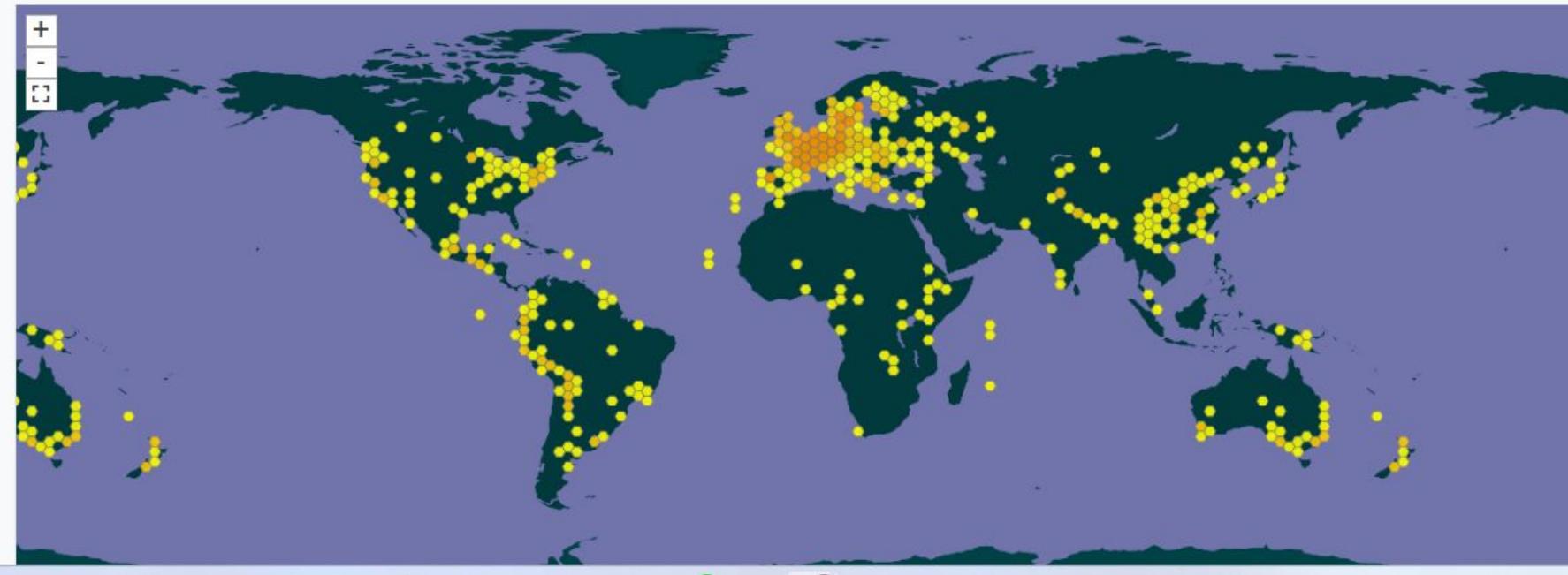
2 INFRASPECIES

1,671 OCCURRENCES WITH IMAGES



SEE GALLERY

4,011 GEOREFERENCED RECORDS

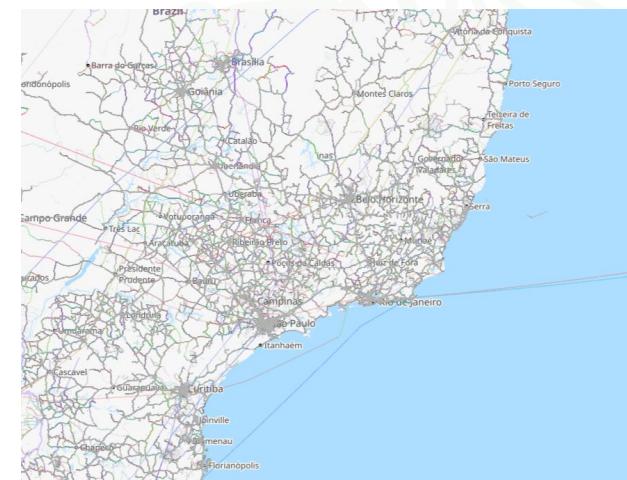
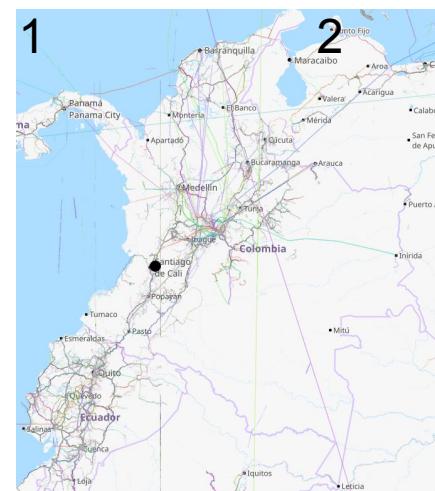
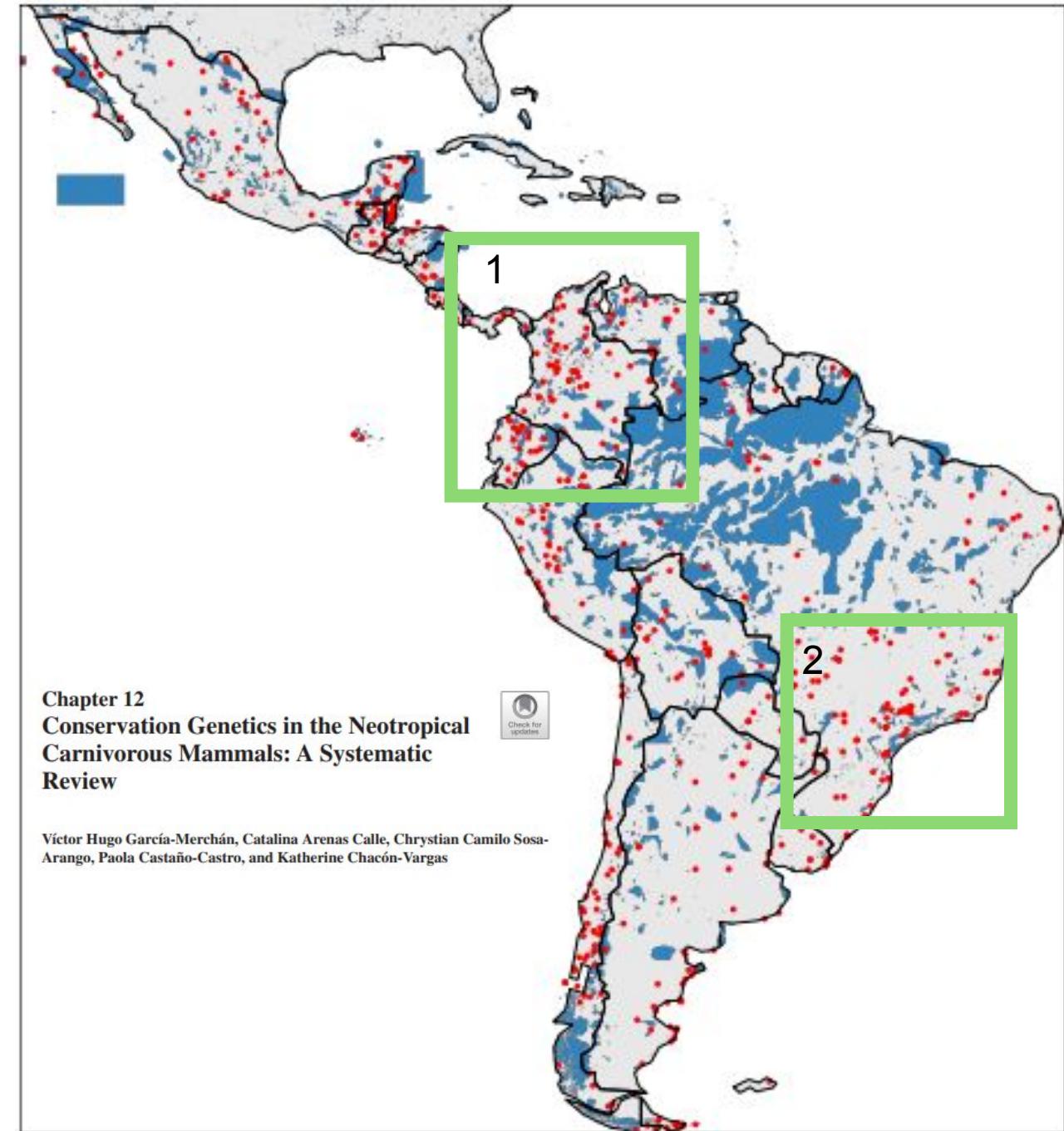


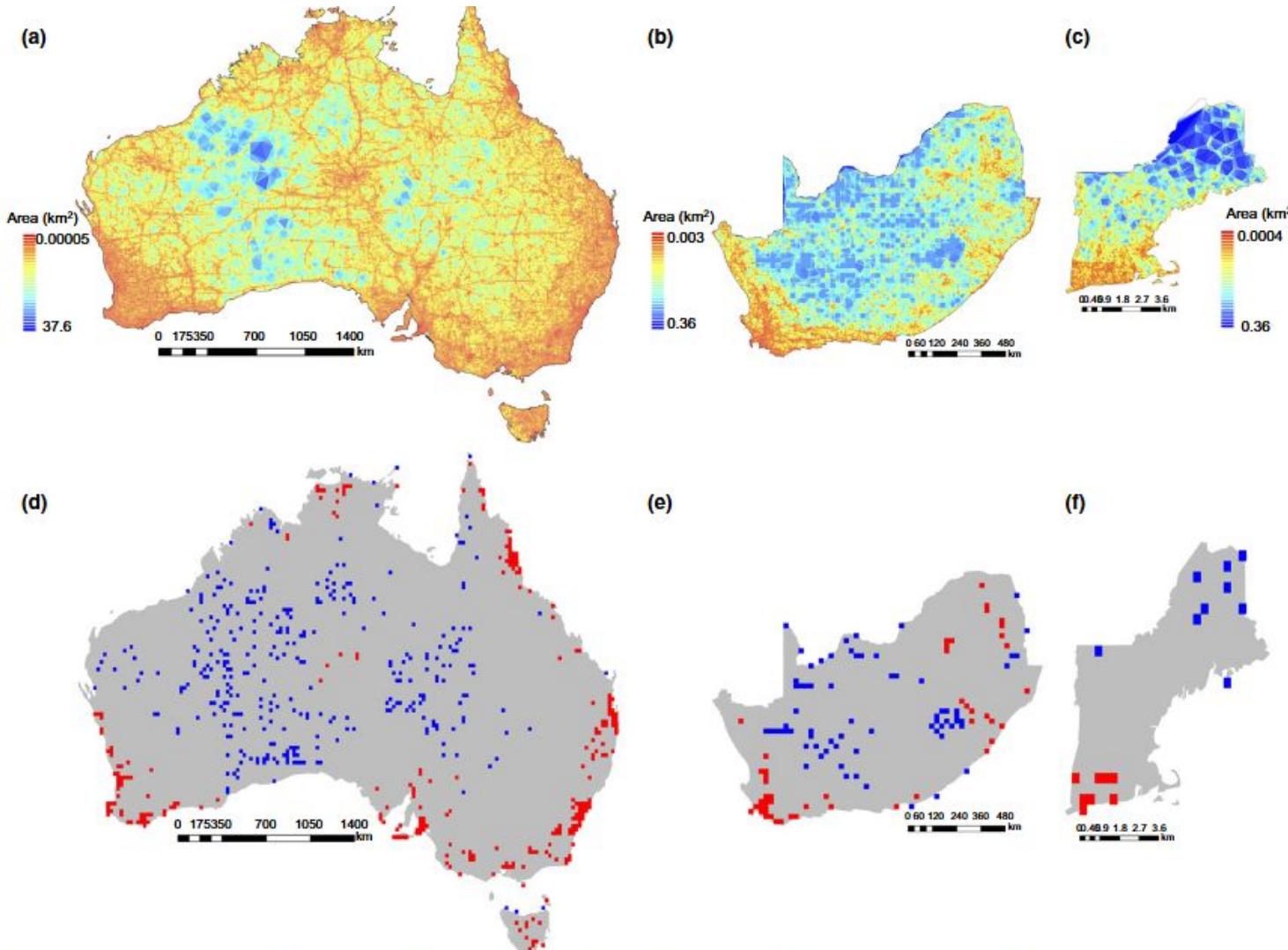
# Sampling bias is common in biological collections!

- Roadsides
- Cities
- Accessible areas

## Chapter 12 Conservation Genetics in the Neotropical Carnivorous Mammals: A Systematic Review

Victor Hugo García-Merchán, Catalina Arenas Calle, Chrystian Camilo Sosa-Arango, Paola Castaño-Castro, and Katherine Chacón-Vargas





**Fig. 1** Spatial bias in herbarium collections. (a–c) The geographic distribution of herbarium collecting activity depicting the spatial variation in sampling effort using Delaunay polygon tiles for (a) Australia ( $n = 857\,245$  locales), (b) South Africa ( $n = 61\,130$  locales), and (c) New England ( $n = 130\,374$  locales). (d–e) Hotspots (red) and coldspots (blue) of herbarium sampling within quarter degree grids for (d) Australia, (e) South Africa and (f) New England. The hotspots and coldspots are the top and lowest 2.5% quantiles, respectively, of the number of specimens per locale.

## Widespread sampling biases in herbaria revealed from large-scale digitization

Barnabas H. Daru<sup>1\*</sup>, Daniel S. Park<sup>1\*</sup>, Richard B. Primack<sup>2</sup>, Charles G. Willis<sup>1</sup>, David S. Barrington<sup>3</sup>, Timothy J. S. Whitfeld<sup>4</sup>, Tristram G. Seidler<sup>5</sup>, Patrick W. Sweeney<sup>6</sup>, David R. Foster<sup>7</sup>, Aaron M. Ellison<sup>7,8</sup> and Charles C. Davis<sup>1</sup>

- Herbarium specimens tended to be collected closer than expected to roads and herbaria ( $P < 0.01$ )
- More than 50% of herbarium specimens were collected within 2 km of road-sides in all three floras
- A tendency for specimens to be collected at lower elevation

# Main issues in coordinates

- Missing coords (some issues):
- Inaccurate geographical information reported
- Disappeared administrative regions and countries
- Protected sites (e.g., Federal protected areas in USA in the case of *H. paradoxus*)

# Main issues in coordinates

- Accuracy
- Changes between formats
- Duplicated coords
- Commas instead period (e.g. 1,2999; 1.2999)
- Wrong Longitude and Latitude
- Wrong coords format! (e.g. UTM, decimal degress, hours, minute, second)
- Unknown datum!
- Coords in sea
- Truncated coords (E.g. longitude represented as latitude)



# Examples of geographical coordinates issues

# Examples of descriptions in natural history collections:

Table 1. Types of locality descriptions commonly found in natural history collections.

Type	Description	Examples
1) dubious	The locality explicitly states that the information contained therein is in question.	'Isla Boca Brava?', 'presumably central Chile'
2) can not be located	Either the locality data are missing, or they contain other than locality information, or the locality cannot be distinguished from among multiple possible candidates, or the locality cannot be found with available references.	'locality not recorded', 'Bob Jones', 'lab born', 'summit', 'San Jose, Mexico'
3) demonstrably inaccurate	The locality contains irreconcilable inconsistencies.	'Sonoma County side of the Gualala River, Mendocino County'
4) coordinates	The locality consists of a point represented with coordinate information.	'42.4532 84.8429', 'UTM 553160 4077280'
5) named place	The locality consists of a reference to a geographic feature (e.g., town, cave, spring, island, reef, etc.) having a spatial extent.	'Alice Springs', 'junction of Dwight Avenue and Derby Street'
6) offset	The locality consists of an offset (usually a distance) from a named place.	'5 km outside Calgary'
7) offset along a path	The locality describes a route from a named place.	'1 km S of Missoula via Route 93' "600 m up the W Fork of Willow Creek" '6 km N and 4 km W of Welna'
8) offsets in orthogonal directions	The locality consists of a linear distance in each of two orthogonal directions from a named place.	
9) offset at a heading	The locality contains a distance in a given direction.	'50 km NE Mombasa'

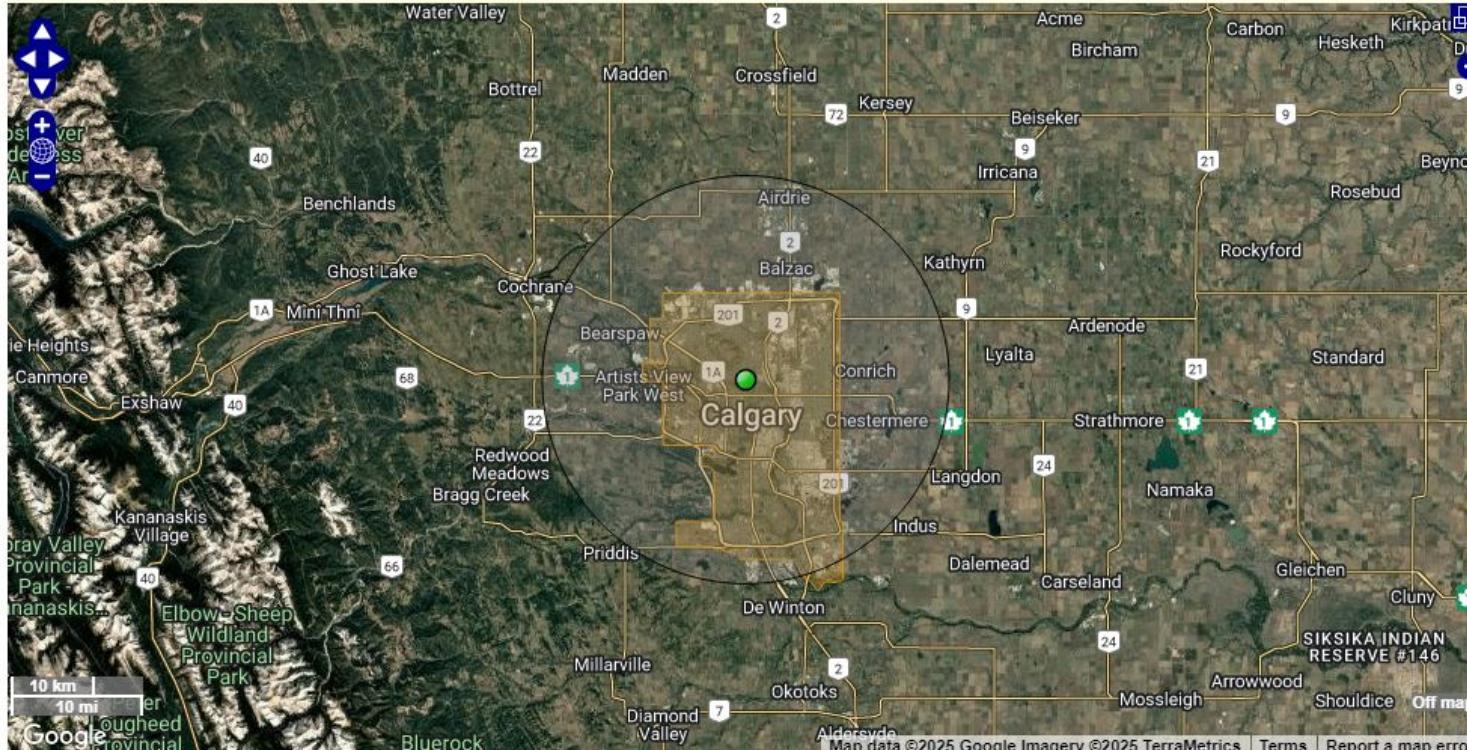
Wieczorek et al., 2004

# High uncertainty is present! (what is the

[Home](#) | [Web Application](#) | [Collaborative Georeferencing](#) | [Developer Resources](#) | [Education & Outreach](#) | [Support and Contacts](#)



GEOLocate Web Application



Workbench    1 possible location found

Draw polygon  Place marker  Measure

Locality String: 5 km outside calgary

Country: Canada

State:

County:

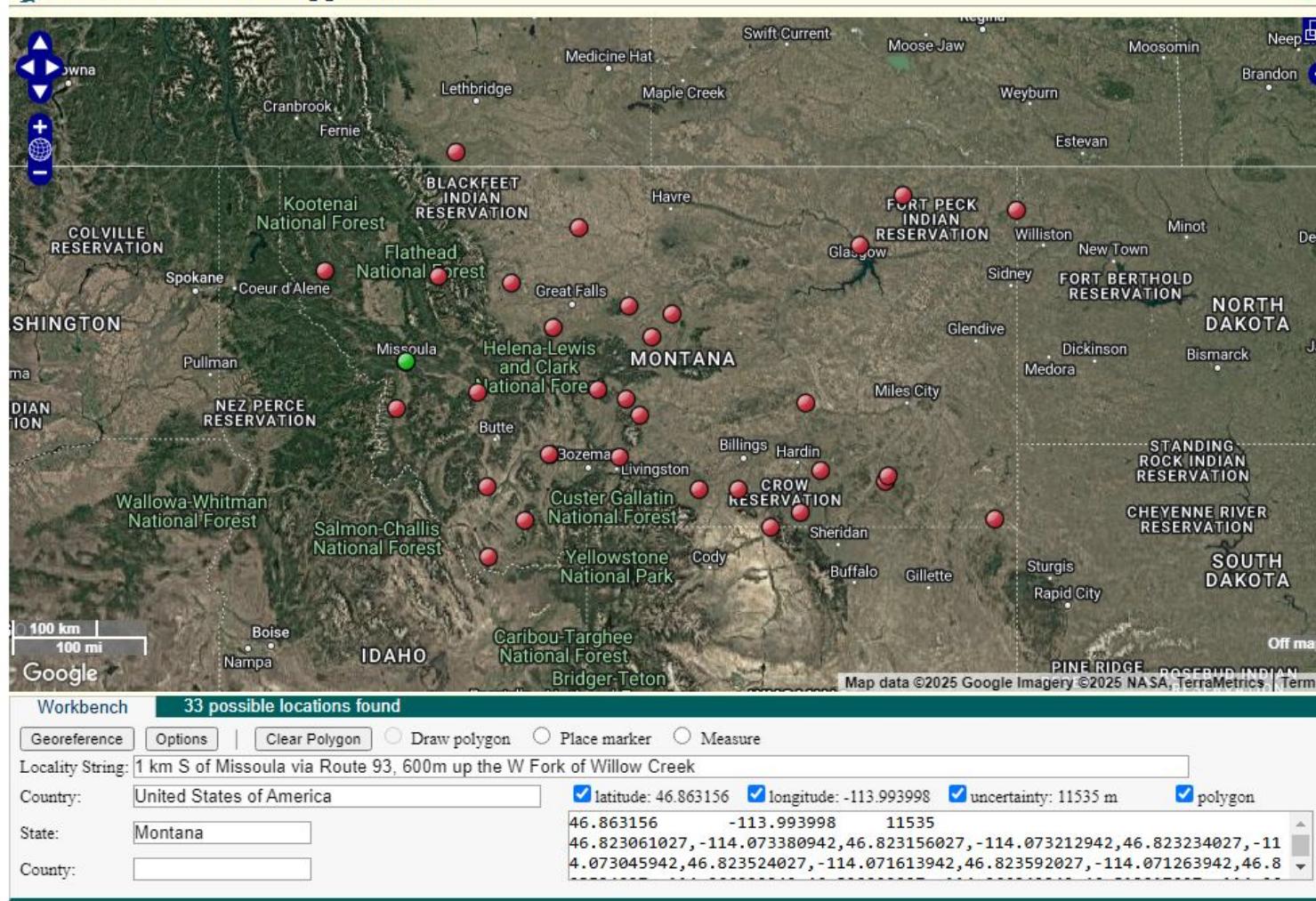
latitude: 51.083333  longitude: -114.083333  uncertainty: 25992 m  polygon

1.1020006891,-114.265751975,51.102234544,-114.262659051,51.1027595864,-1  
14.260091841,51.1026135735,-114.257319777,51.1017386699,-114.252915086,5  
0.0996376612,-114.247006848,51.0986455788,-114.245664905,51.0980035248,-1

# 33 possible locations!

[Home](#) | [Web Application](#) | [Collaborative Georeferencing](#) | [Developer Resources](#) | [Education & Outreach](#) | [Support and Contacts](#)

## GEOLocate Web Application



# Let's see accuracy:

	A	B	C
	lon	lat	
1			
2 original	-78.46284602	-0.183254568	
3 coord truncated 1	-78.462846	-0.183255	
4 coord truncated 2	-78.4628	-0.1833	
5 coord truncated 3	-78.46	-0.18	
6 coord truncated 4	-78.5	-0.2	
7 coord truncated 5	-78	0	

Species: *Amaranthus caudatus* L.

Location: South America &gt; Ecuador

Basis of record: Human observation



Dataset: iNaturalist Research-grade Observations

Publisher: iNaturalist.org

Reference: <https://www.inaturalist.org/observations/197748581>

Issues: Continent derived from coordinates

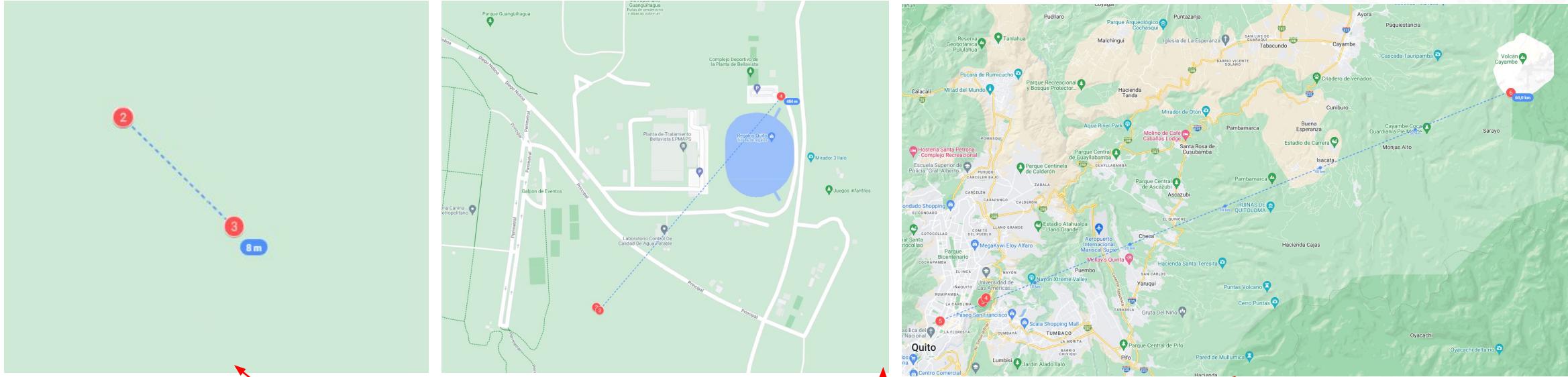


## Location

Term	Interpreted	Original	Remarks
Continent	SOUTH_AMERICA		Inferred
Coordinate uncertainty in metres	357	357	
Country or area	Ecuador		Inferred
Country code	EC	EC	
Decimal latitude	-0.183255	-0.183254568	Coordinate rounded
Decimal longitude	-78.462846	-78.462846021	Coordinate rounded
Geodetic datum	WGS84	EPSG:4326	Altered
State province	Pichincha	Pichincha	
Verbatim locality	Parque Metropolitano Guanguitagua, Quito, Pichincha, EC	Parque Metropolitano Guanguitagua, Quito, Pichincha, EC	

<https://www.gbif.org/occurrence/451646>

<https://www.google.com/maps/d/edit?mid=19tZfXiauYtgdmI0j4iMZFddwSJ08SRE&usp=sharing>



A	B	C
1	lon	lat
2 original	-78.46284602	-0.183254568
3 coord truncated 1	-78.462846	-0.183255
4 coord truncated 2	-78.4628	-0.1833
5 coord truncated 3	-78.46	-0.18
6 coord truncated 4	-78.5	-0.2
7 coord truncated 5	-78	0

# The accuracy is important in geographical data!

Decimal Places	Degrees	Distance
0	1.0	111 km
1	0.1	11.1 km
2	0.01	1.11 km
3	0.001	111 m
4	0.0001	11.1 m
5	0.00001	1.11 m
6	0.000001	111 mm
7	0.0000001	11.1 mm
8	0.00000001	1.11 mm

## WHAT THE NUMBER OF DIGITS IN YOUR COORDINATES MEANS

LAT/LON PRECISION	MEANING
28°N, 80°W	YOU'RE PROBABLY DOING SOMETHING SPACE-RELATED
28.5°N, 80.6°W	YOU'RE POINTING OUT A SPECIFIC CITY
28.52°N, 80.68°W	YOU'RE POINTING OUT A NEIGHBORHOOD
28.523°N, 80.683°W	YOU'RE POINTING OUT A SPECIFIC SUBURBAN CUL-DE-SAC
28.5234°N, 80.6830°W	YOU'RE POINTING TO A PARTICULAR CORNER OF A HOUSE
28.52345°N, 80.68309°W	YOU'RE POINTING TO A SPECIFIC PERSON IN A ROOM, BUT SINCE YOU DIDN'T INCLUDE DATUM INFORMATION, WE CAN'T TELL WHO
28.5234571°N, 80.6830941°W	YOU'RE POINTING TO WALDO ON A PAGE
28.523457182°N, 80.683094159°W	"HEY, CHECK OUT THIS SPECIFIC SAND GRAIN!"
28.523457182818284°N, 80.683094159265358°W	EITHER YOU'RE HANDING OUT RAW FLOATING POINT VARIABLES, OR YOU'VE BUILT A DATABASE TO TRACK INDIVIDUAL ATOMS. IN EITHER CASE, PLEASE STOP.

<https://support.garmin.com/en-US/?faq=hRMBoCTy5a7HqVkxukhHd8>



# Error types in geographical coordinates

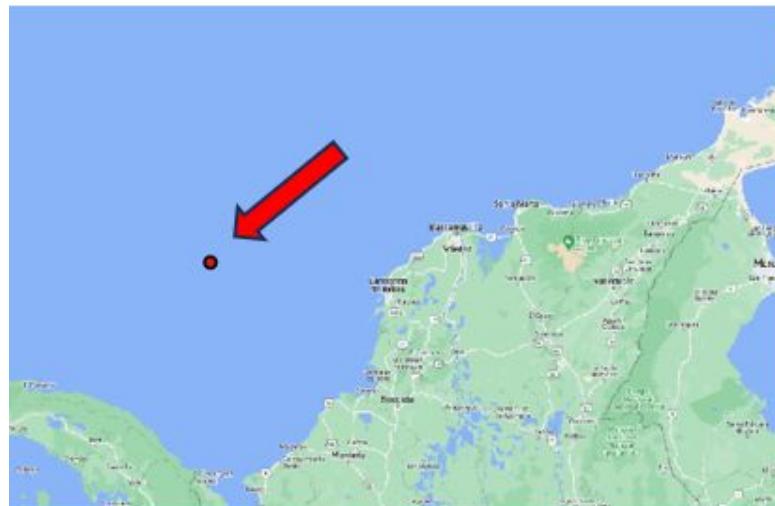
- Duplicated coordinates:

Different accessions can have the same coordinates, but their related information can be different.

Common_names	Latitude	Longitude
Rochelas	2.9167	-75
Rochelas	2.9167	-75
Rochelas	2.9167	-75
Revoltura	2.9167	-75
Revoltura	2.9167	-75
Revoltura	2.9167	-75

# Error types in geographical coordinates

- Coordinates in the ocean:



# Error types in geographical coordinates

- Low coordinates precision:

Coordinates can fall right outside the correct region or country.

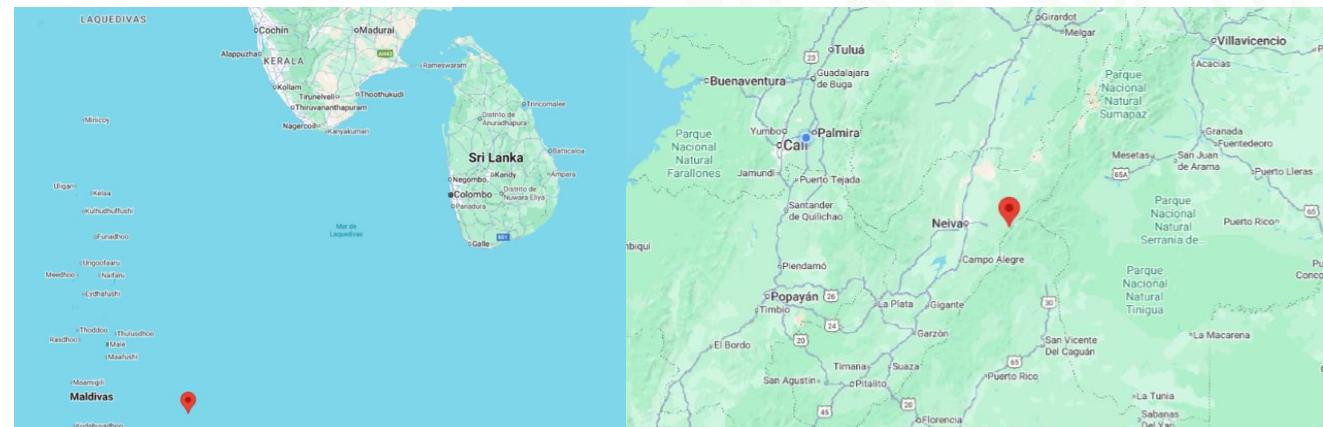


# Error types in geographical coordinates

- Inverted coordinates sign :

Either the latitude, the longitude, or both have the wrong sign.

Latitude	Longitude
2.9167	75
2.9167	-75



A conversion was done from degrees, minutes, and seconds, but the hemisphere (W/E, N/S) was not considered in the conversion.

# Error types in geographical coordinates

- Zero coordinates:

Latitude	Longitude
0	0
0	-75

There can be a lack of standard reporting of missing data

# Error types in geographical coordinates

- Coordinates out of collecting country

Country	Latitude	Longitude
Colombia	3.029	114.028
Colombia	2.9167	-75
Colombia	2.9167	-75

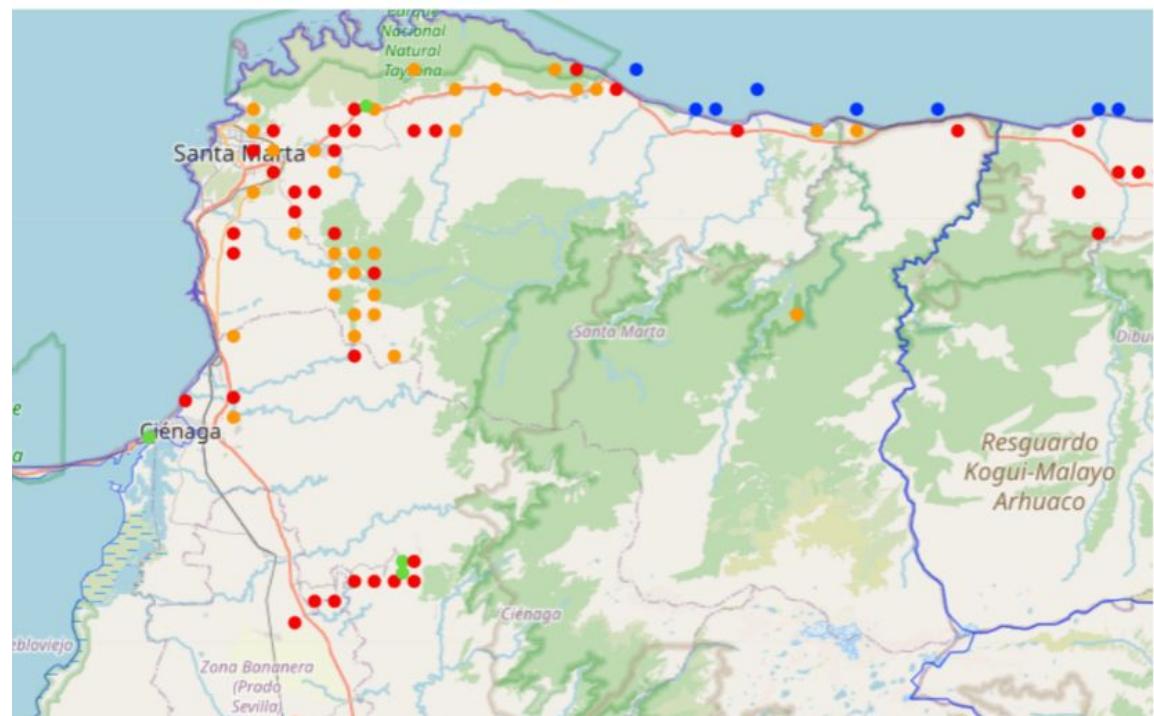


Country of collection in the passport data does not match to where the coordinate falls.

\*The donor country is reported whereas the actual collection location

# Error types in geographical coordinates

- Straight-line pattern in latitude or longitude:
  - Sampling effort?
  - Errors in coordinates?
  - ?



# Error types in geographical coordinates

- Decimal degrees
  - Missing E/W and/or N/S letters

Common_names	Latitude	Longitude	Common_names	Latitude	Lat_letter	Longitude	Lon_letter
Rochelas	2.9167 ° N	75 ° W	Rochelas	2.9167	N	75	W
Revoltura	2.9167N	75W	Revoltura	2.9167	N	75	W
Revoltura	<b>2.9167N</b>	<b>75</b>	Revoltura	<b>2.9167</b>	<b>N</b>	<b>75</b>	

# Error types in geographical coordinates

- Degrees, Minutes, Seconds (DMS)
  - Missing symbols ° or ' or “, or missing values at degree, minute or second

Common_names	Latitude	Longitude
Rochelas	40° 42'46"N	74° 0' 22"W
Revoltura	40 42 46 N	74 0' 22"W
Revoltura	40° 42'46 N	74° 0' 22"
Rochelas	40° 42'N	74° 22

# Error types in geographical coordinates

- Degrees and Decimal minutes (DMM)
  - Missing symbols ° or ' or “, or missing values at degree, minute or second

Common_names	Latitude	Longitude
Rochelas	40° 42.767'N	74° 0.367'W
Revoltura	40 N	74 22 W
Revoltura	40° 42'46	74° 0' 22"
Rochelas	40 42 N	74 22

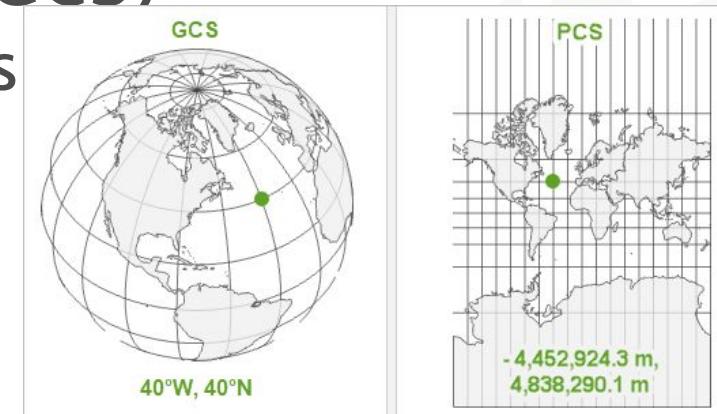
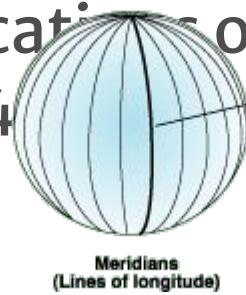
# Error types in geographical coordinates

- Datum

- A datum provides a frame of reference for measuring locations on the surface of the earth. It defines the origin and orientation of latitude and longitude lines
  - WGS 1984 (The most used)

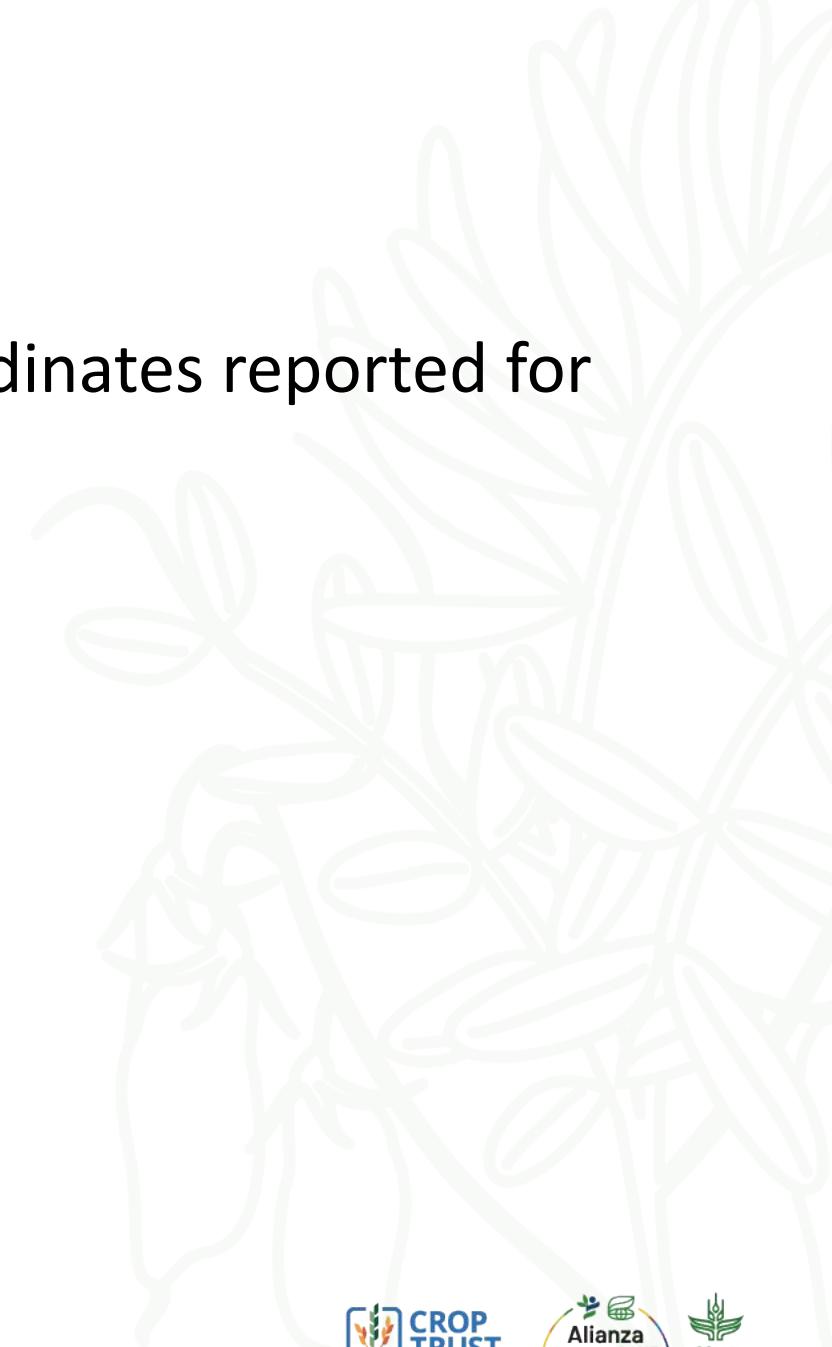
- Geographic Coordinate System (GCS)

- Define locations on a model of the earth



# Geographical coordinates

- How to evaluate the quality of geographical coordinates reported for a given accession?
- Ideas?





How to evaluate the quality of  
geographical coordinates reported  
for a given accession?

Ideas?



# Georeferentiation

**Obtaining geographical information from  
passport data**

# How to obtain records from existent data (Georeferentiation)

• <https://www.geo-locate.org/> (Let's try georeferencing some data!)

Table 1. Types of locality descriptions commonly found in natural history collections.

Type	Description	Examples
1) dubious	The locality explicitly states that the information contained therein is in question.	'Isla Boca Brava?', 'presumably central Chile'
2) can not be located	Either the locality data are missing, or they contain other than locality information, or the locality cannot be distinguished from among multiple possible candidates, or the locality cannot be found with available references.	'locality not recorded', 'Bob Jones', 'lab born', 'summit', 'San Jose, Mexico'
3) demonstrably inaccurate	The locality contains irreconcilable inconsistencies.	'Sonoma County side of the Gualala River, Mendocino County'
4) coordinates	The locality consists of a point represented with coordinate information.	'42.4532 84.8429', 'UTM 553160 4077280'
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6) offset	The locality consists of an offset (usually a distance) from a named place.	'5 km outside Calgary'
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9) offset at a heading	The locality contains a distance in a given direction.	'50 km NE Mombasa'

Wieczorek et al., 2004



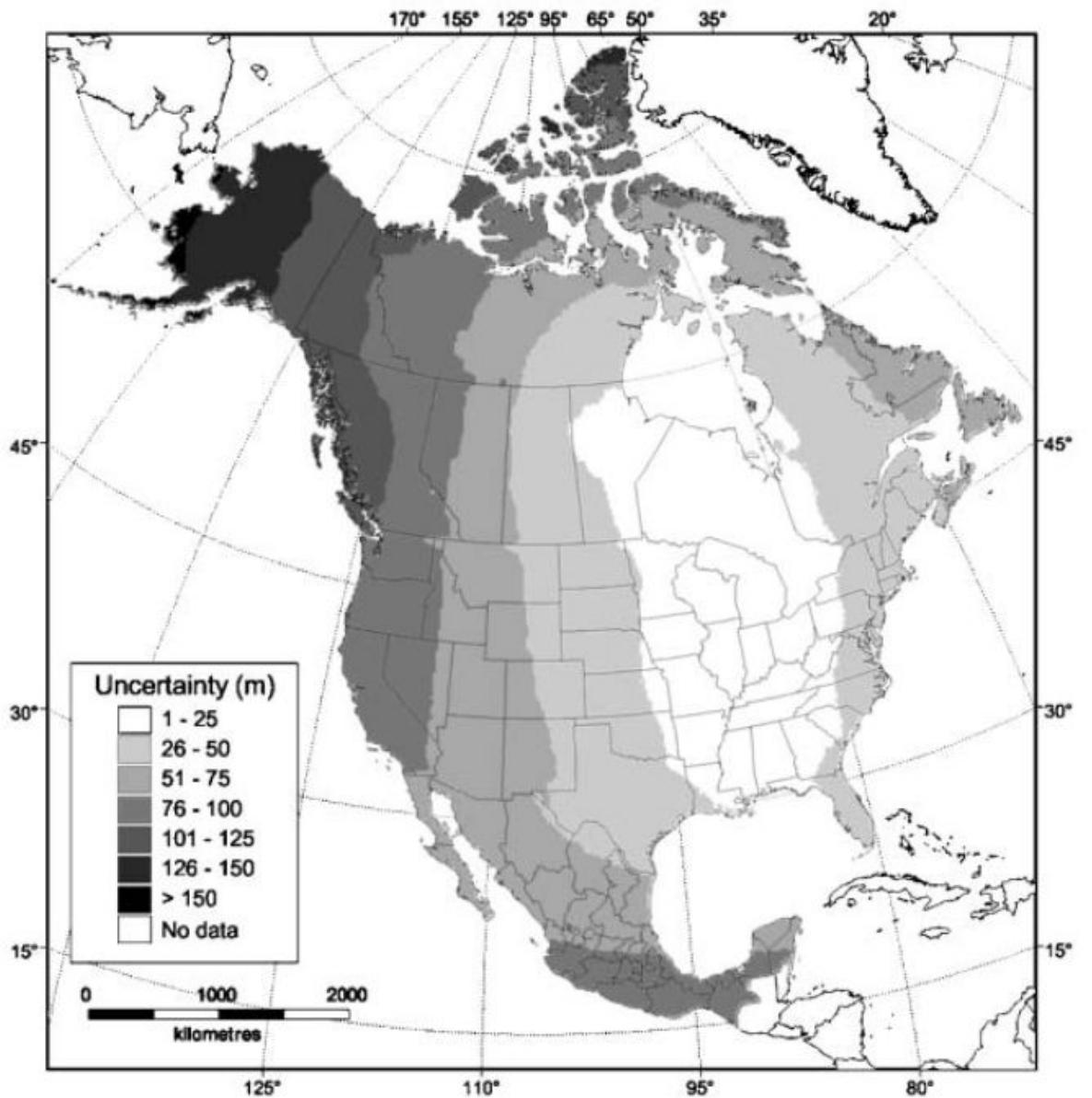


Figure 2. Uncertainty from not knowing whether coordinates were taken from a source using NAD27 or NAD83 – the geodetic datums most commonly used on maps in Canada, the USA, and Mexico.

- The uncertainty matters
- Point-radius method:  
The point-radius method describes a locality as a coordinate pair and a distance from that point (that is, a circle)

Examples: ‘**9 km N of Bakersfield**’ (fraction is 1/1, uncertainty should be 1 km)  
 ‘**9.5 km N of Bakersfield**’ (fraction is ½, uncertainty should be 0.5 km)  
 ‘**9.75 km N of Bakersfield**’ (fraction is ¾, uncertainty should be 0.25 km)  
 ‘**9.6 km N of Bakersfield**’ (fraction is 6/10, uncertainty should be 0.1 km)

For measurements that appear as integer multiples of powers of 10 (for example, 10, 20, 300, 4000), use 0.5 times ten to that power for the uncertainty.

Examples: ‘**140 km N of Bakersfield**’ (uncertainty should be 5 km)  
 ‘**100 km N of Bakersfield**’ (uncertainty should be 50 km)  
 ‘**2000 m N of Bakersfield**’ (uncertainty should be 500 m)



# Recommendations to report geographical data

How to report geographical data!

# There is not a unique way to report data. Nevertheless...

- Follow Multicrop Passport Descriptors (MCPD)!  
<https://cgospace.cgiar.org/server/api/core/bitstreams/7947d48c-5cf1-4164-8c61-fa276d658463/content>
- Follow Darwin Core Standards! <http://rs.tdwg.org/dwc>
- Follow FAO standards! <https://www.fao.org/4/i3704e/i3704e.pdf>

# MCDP

**Note:** The following two mutually exclusive formats can be used for latitude:

**15.1 Latitude of collecting site** (Decimal degrees format) **(DECLATITUDE)**

Latitude expressed in decimal degrees. Positive values are North of the Equator; negative values are South of the Equator (e.g. -44.6975).

**15.2 Latitude of collecting site** (Degrees, Minutes, Seconds format) **(LATITUDE)**

Degrees (2 digits) minutes (2 digits), and seconds (2 digits) followed by N (North) or S (South) (e.g. 103020S). Every missing digit (minutes or seconds) should be indicated with a hyphen. Leading zeros are required (e.g. 10---S; 011530N; 4531--S).

**Note:** The following two mutually exclusive formats can be used for longitude:

**15.3 Longitude of collecting site** (Decimal degrees format) **(DECLONGITUDE)**

Longitude expressed in decimal degrees. Positive values are East of the Greenwich Meridian; negative values are West of the Greenwich Meridian (e.g. +120.9123).

**15.4 Longitude of collecting site** (Degrees, Minutes, Seconds format) **(LONGITUDE)**

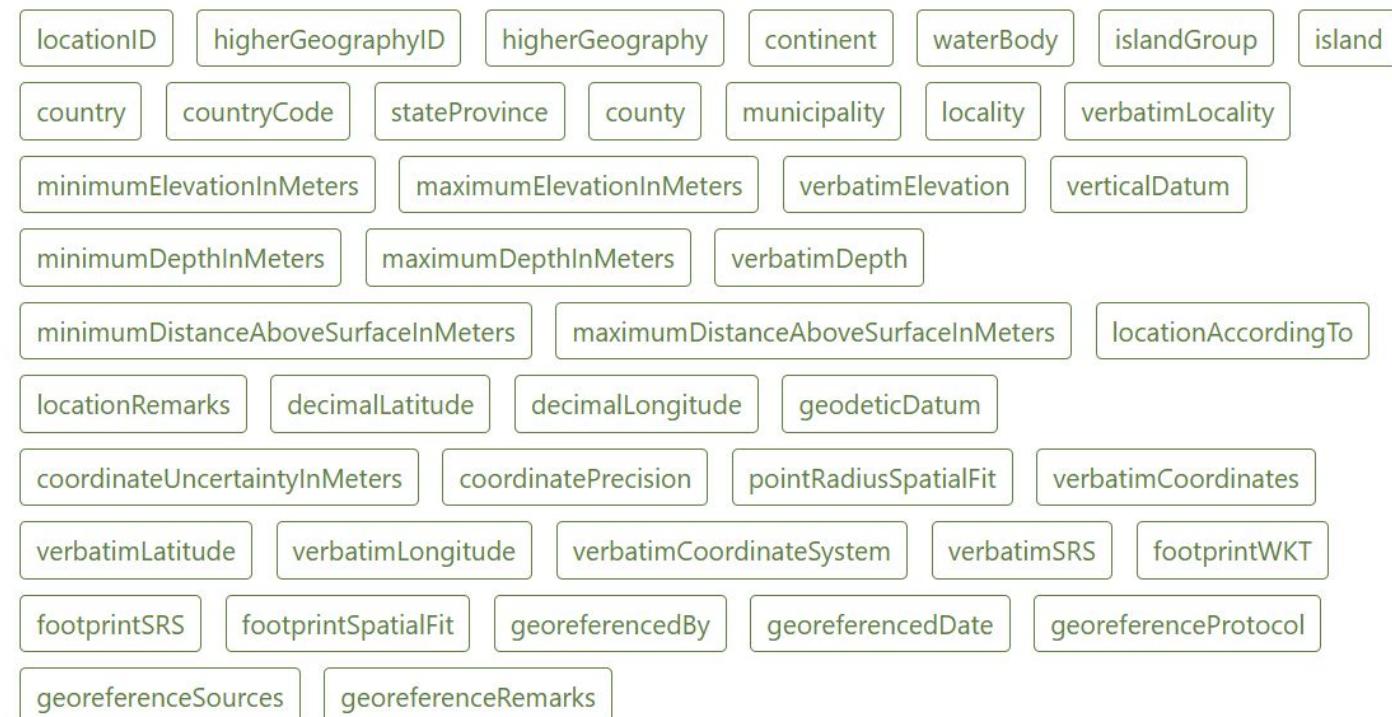
Degrees (3 digits), minutes (2 digits), and seconds (2 digits) followed by E (East) or W (West) (e.g. 0762510W). Every missing digit (minutes or seconds) should be indicated with a hyphen. Leading zeros are required (e.g. 076---W).

<b>15.5 Coordinate uncertainty [m]</b>	(COORDUNCERT)
Uncertainty associated with the coordinates in metres. Leave the value empty if the uncertainty is unknown.	
<b>15.6 Coordinate datum</b>	(COORDDATUM)
The geodetic datum or spatial reference system upon which the coordinates given in decimal latitude and decimal longitude are based (e.g. WGS84, ETRS89, NAD83). The GPS uses the WGS84 datum.	
<b>15.7 Georeferencing method</b>	(GEOREFMETH)
The georeferencing method used (GPS, determined from map, gazetteer, or estimated using software). Leave the value empty if georeferencing method is not known.	
<b>16. Elevation of collecting site [masl]</b>	(ELEVATION)
Elevation of collecting site expressed in metres above sea level. Negative values are allowed.	
<b>17. Collecting date of sample [YYYYMMDD]</b>	(COLLDATE)
Collecting date of the sample, where YYYY is the year, MM is the month and DD is the day. Missing data (MM or DD) should be indicated with hyphens or '00' [double zero].	

# DarwinCore

 <https://dwc.tdwg.org/terms/#location>

## Location



### decimalLatitude

Identifier	<a href="http://rs.tdwg.org/dwc/terms/decimalLatitude">http://rs.tdwg.org/dwc/terms/decimalLatitude</a>
Definition	The geographic latitude (in decimal degrees, using the spatial reference system given in dwc:geodeticDatum) of the geographic center of a dcterms:Location. Positive values are north of the Equator, negative values are south of it. Legal values lie between -90 and 90, inclusive.
Comments	
Examples	-41.0983423

### decimalLongitude

Identifier	<a href="http://rs.tdwg.org/dwc/terms/decimalLongitude">http://rs.tdwg.org/dwc/terms/decimalLongitude</a>
Definition	The geographic longitude (in decimal degrees, using the spatial reference system given in dwc:geodeticDatum) of the geographic center of a dcterms:Location. Positive values are east of the Greenwich Meridian, negative values are west of it. Legal values lie between -180 and 180, inclusive.
Comments	
Examples	-121.1761111

## International Standards

Reference for CPC Guidelines

FAO Genebank Standards  
for Plant Genetic Diversity (FAO 2014)

### Standards for Documentation for Orthodox Seeds

- 4.7.1 Passport data of 100 percent of the accessions should be documented using FAO/Bioversity multi-crop passport descriptors.
- 4.7.2 All data and information generated in the genebank relating to all aspects of conservation and use of the material should be recorded in a suitably designed database.

### Standards for Documentation for Field Genebanks

- 5.8.1 Passport data for all accessions should be documented using the FAO/Bioversity multi-crop passport descriptors. In addition, accession information should also include inventory, map and plot location, regeneration, characterization, evaluation, orders, distribution data and user feedback.
- 5.8.2 Field management processes and cultural practices should be recorded and documented.
- 5.8.3 Data from 5.8.1. and 5.8.2 should be stored and changes updated in an appropriate database system and international data standards adopted.

### Standards for documentation in vitro and cryopreservation

- 6.6.1 Passport data for all accessions should be documented using the FAO/Bioversity multi-crop passport descriptors. In addition, accession information should also include inventory, orders, distribution and data user feedback.
- 6.6.2 Management data and information generated in the genebank should be recorded in a suitable database, and characterization and evaluation data (C/E data) should be included when recorded.
- 6.6.3 Data from 6.6.1. and 6.6.2 should be stored and changes updated in an appropriate database system and international data standards adopted.

MSB Partnership Collections  
(Millennium Seed Bank Partnership 2015)

### Data management

- 5.1 A data management system, using recognised seed bank data standards, is in use and capable of export in standard format.



CPC  
Best Plant  
Conservation  
Practices  
to Support  
Species Survival  
in the Wild

# Genebank Standards

for Plant Genetic Resources  
for Food and Agriculture



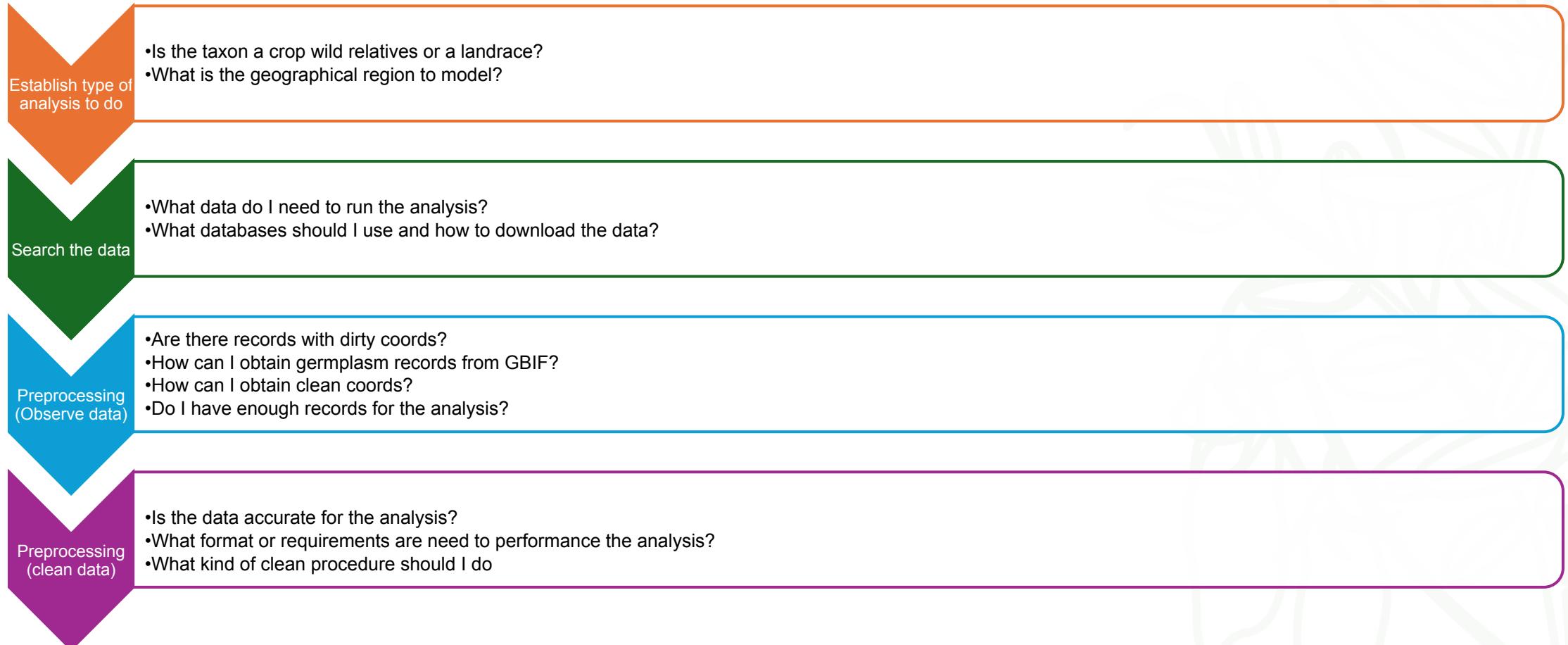
COMMISSION ON  
GENETIC RESOURCES  
FOR FOOD AND  
AGRICULTURE



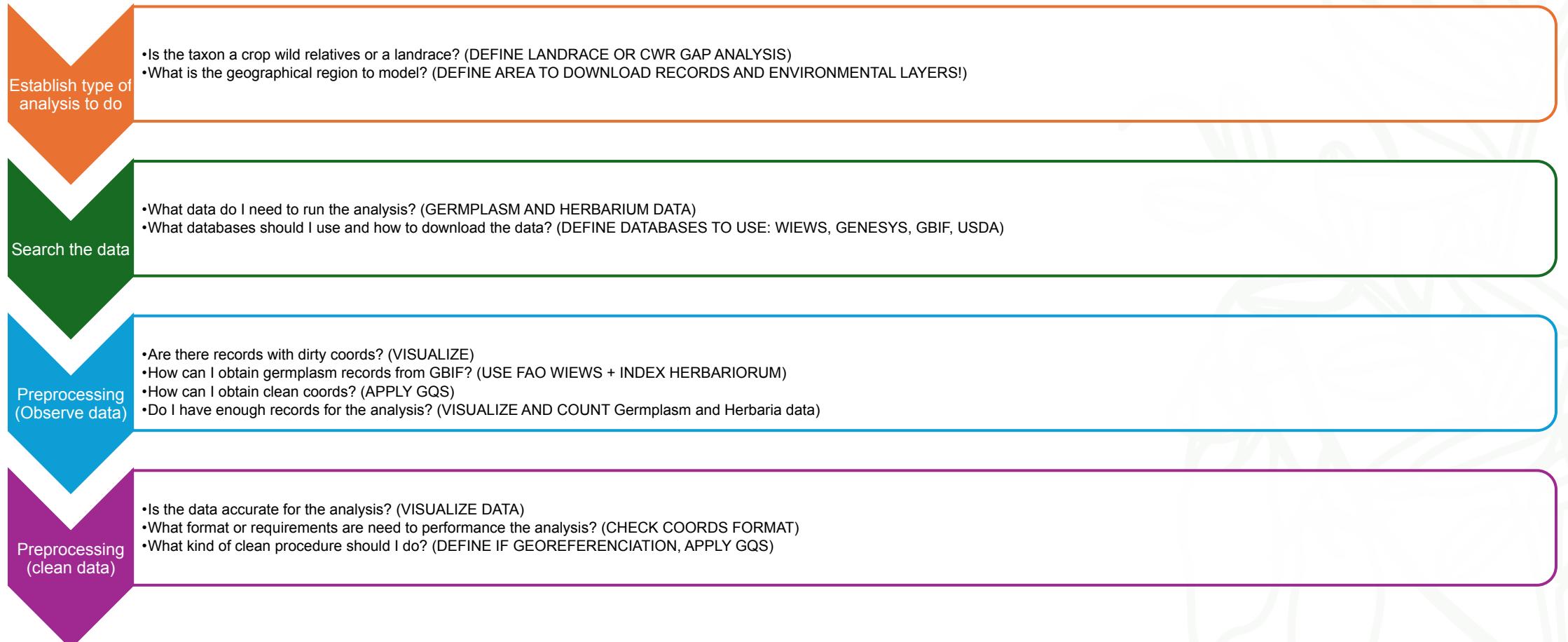


# What did we do to obtain data for the gap analyses?

# The questions



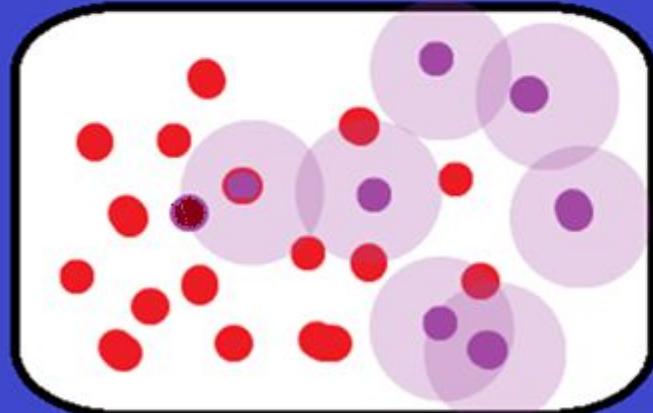
# The questions + the procedures





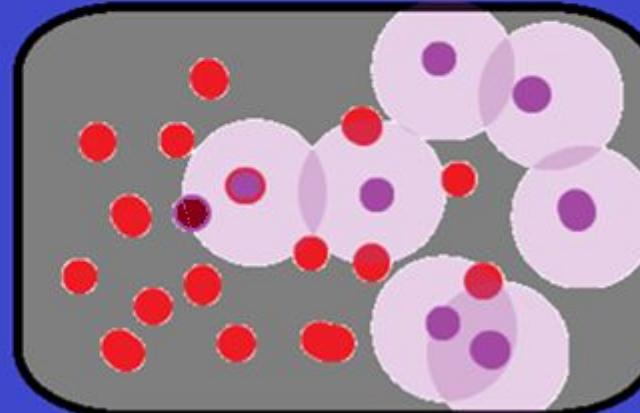
# What a gap analysis step by step looks like!

**Species occurrences**

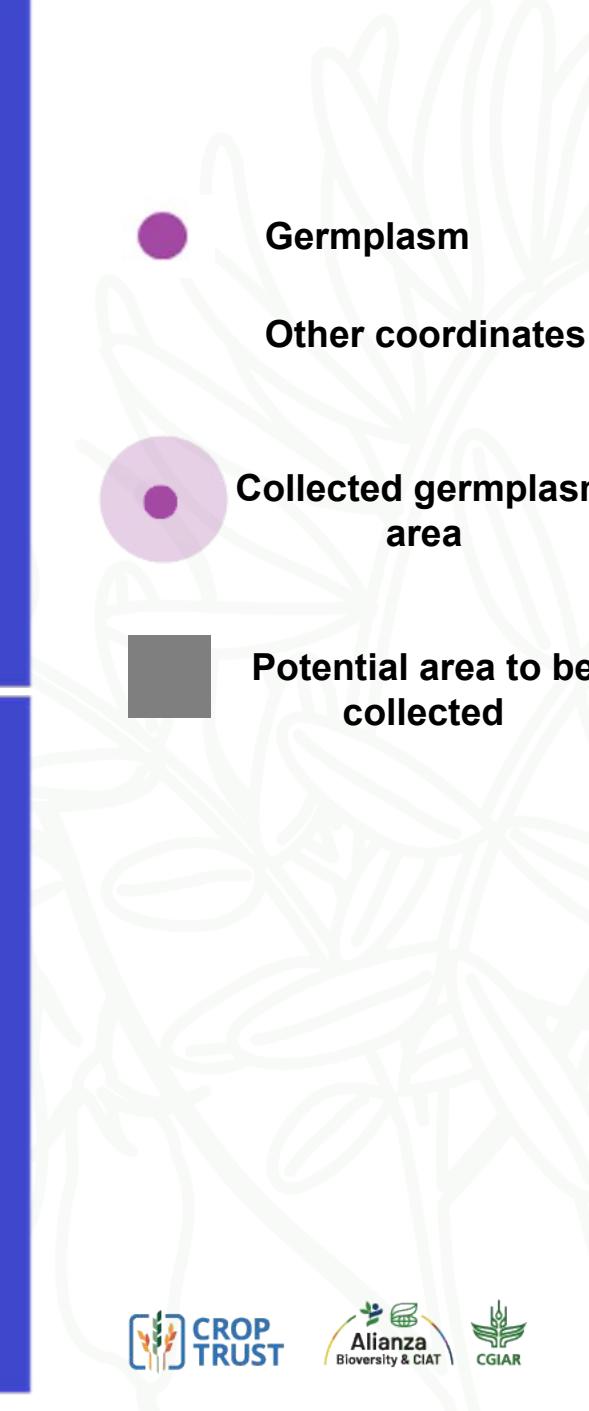


**Sampled  
germplasm**

**Realized niche**



**Where to collect**

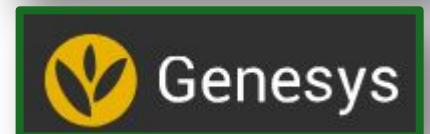
- 
-  Germplasm
  -  Other coordinates
  -  Collected germplasm area
  -  Potential area to be collected

# Define taxa status for the analysis

**Diversity and Distributions** A Journal of Conservation Biogeography  
BIODIVERSITY RESEARCH | Open Access | 1  
A gap analysis modelling framework to prioritize collecting for ex situ conservation of crop landraces  
Julian Ramirez-Villalobos, Colin K. Khoury, Harold A. Achiganay, Andres C. Mendez, Maria Victoria Diaz, Chrystian C. Sosa, Daniel G. Debouck, Zakaria Kehef, Luigi Guarino

OPEN ACCESS Freely available online PLOS one  
A Gap Analysis Methodology for Collecting Crop Genepools: A Case Study with *Phaseolus* Beans

# Download



Viewer Dashboard

INITIATIVE ON Genebanks

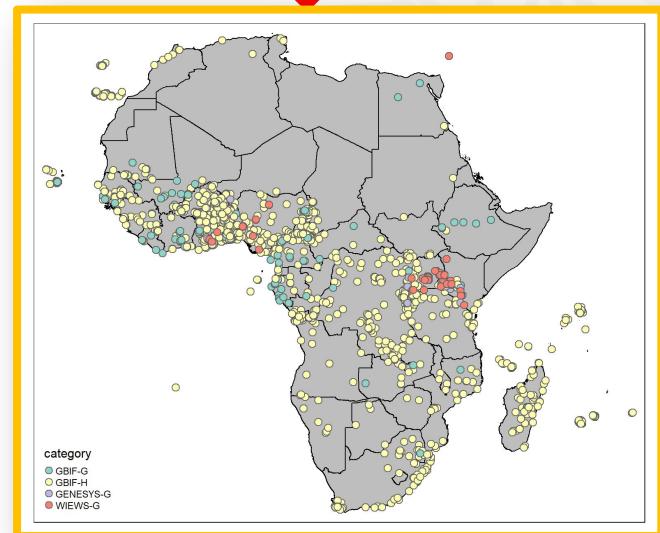
### COORDINATES QUALITY STATUS

Last update 23-09-2024

Total Accessions	Missing coordinates	Missing coordinates percentage
------------------	---------------------	--------------------------------

# Obtain Germplasm and herbarium records from GBIF

crop_name	ORIGC	ELEVATI	INSTCODE	DECLATITU	DECLONGITU	ACCNUMB	COLLSITE	stat	source_t	database
Eleusine indica	KEN	NA	Bioversity	-0.53	37.45	2023350	Embu, Mbigue Farm, Eastern	G	GBIF	gbif_3543
Eleusine indica	KEN	NA	Bioversity	-0.53	37.45	2023350	Embu, Mbigue Farm, Eastern	G	GBIF	gbif_3544
Eleusine indica	CMR	NA	Bioversity	10.8	13.83	2023360	Mokolo village Mokolo Mayo-Tsanaga Extreme-Nord	G	GBIF	gbif_3545
Eleusine indica	NER	NA	Bioversity	12.5	2.55	2023635	18.6 km from Tapoa down the course of Niger River, Gungu Makoni area Say	G	GBIF	gbif_3546
Eleusine indica	ZMB	NA	Bioversity	-12.56	30.23	2023635	3 km SW from Kounkala Camp, Parc National De Manovo-Gevanda-Saint Fir	G	GBIF	gbif_3547
Eleusine indica	KEN	NA	Bioversity	-0.05	34.85	2023371	Khos area, 13 km from Kisumu	G	GBIF	gbif_3548
Eleusine indica	CAF	NA	Bioversity	8.46	21.21	2023370	3 km SW from Kounkala Camp, Parc National De Manovo-Gevanda-Saint Fir	G	GBIF	gbif_3549
Eleusine indica	COD	NA	Bioversity	-0.7	29.38	2023373	Corozal town, 5th Avenue Rutshuru Corozal Kivu	G	GBIF	gbif_3550
Eleusine indica	KEN	NA	Bioversity	-0.58	34.46	2023360	Kisumu, opposite Imperial Hotel	G	GBIF	gbif_3551
Eleusine indica	MRT	NA	Bioversity	18.01	-12.23	2023360	6 km North of Four Ajar towards Tidjikja Tagant	G	GBIF	gbif_3552
Eleusine indica	KEN	NA	Bioversity	-0.36	35.28	2023362	Chezlat centre, 54 km on Kericho Kisii road	G	GBIF	gbif_3553
Eleusine indica	COD	NA	Bioversity	1.65	29.58	2023374	25 km NE of Beni to Kamango Beni North Kivu	G	GBIF	gbif_3554
Eleusine indica	KEN	NA	Bioversity	-0.46	34.45	2023631	Rodi Kamany, 12 km on Horna bay to Rongo road	G	GBIF	gbif_3555
Eleusine indica	BDI	NA	Bioversity	-3.16	29.36	2023364	12 km N of Bujumbura 2 km S of cross road on RIG 9 at Ferme de Randa Gihia	G	GBIF	gbif_3556
Eleusine indica	GNO	NA	BRLU	1.85	9.75	1986730	BATA	H	GBIF	gbif_3557
Eleusine indica	COD	NA	BRLU	0.55	25.183333	1986720	Kisangani, en aval du barrage de la Tshopo, sur la rive droite de la Tshopo	F	GBIF	gbif_3558
Eleusine indica	TGO	NA	BRLU	6.733333	0.683333	1986733	route de Glikop Wonouga	H	GBIF	gbif_3559
Eleusine indica	BEN	NA	BRLU	6.366667	2.4	1986732	Cotonou, Hotel Croix du Sud	H	GBIF	gbif_3560
Eleusine indica	GNO	NA	BRLU	NA	NA	1986714	Bata	H	GBIF	gbif_3561
Eleusine indica	BFA	NA	BRLU	11.166667	-4.3	1986734	Bobo-Dioulasso	H	GBIF	gbif_3562
Eleusine indica	BFA	NA	BRLU	14.083333	-0.05	1986735	Dori (Sahel), oasis plinire de Diomga (5 km au Nord de Dori)	H	GBIF	gbif_3563
Eleusine indica	COD	NA	BRLU	0.566667	25.083333	1986720	Kisangani, Ile Kongolo la confluence de la Lindi et du fleuve Za	Forester	GBIF	gbif_3564
Eleusine indica	COD	NA	BRLU	0.516667	25.2	1986722	Kisangani, zone Makiso, collectif plateau Boyoma, blocs universitaires	Forester	GBIF	gbif_3565
Eleusine indica	CIV	NA	BRLU	5	-6.25	1986731	10 km N.W. of Sasandra	H	GBIF	gbif_3566
Eleusine indica	GAB	NA	BRLU	NA	NA	1986715	Libreville-Cap Esterias, km 8, centre d'appui technique l'Invaculture	H	GBIF	gbif_3567
Eleusine indica	COD	NA	BRLU	-0.066667	25.366667	1986726	km 82, route de Kisangani vers Ubundu (rive gauche)	Forester Central	GBIF	gbif_3568



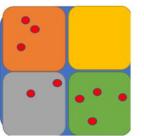
# Differences between gap analysis methodologies

CWR =

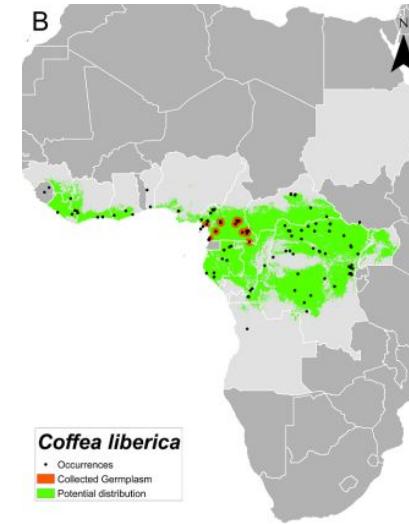
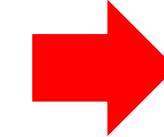
$$SRS = \frac{\# \text{ samples in genebanks}}{\# \text{ total taxon observations}}$$



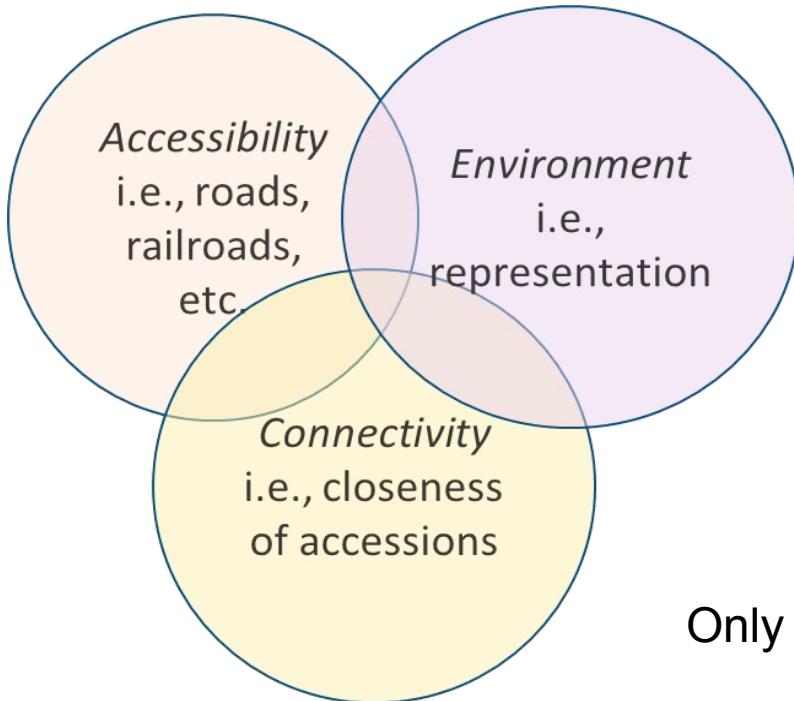
$$GRS = \frac{\text{white area}}{\text{blue + white area}}$$



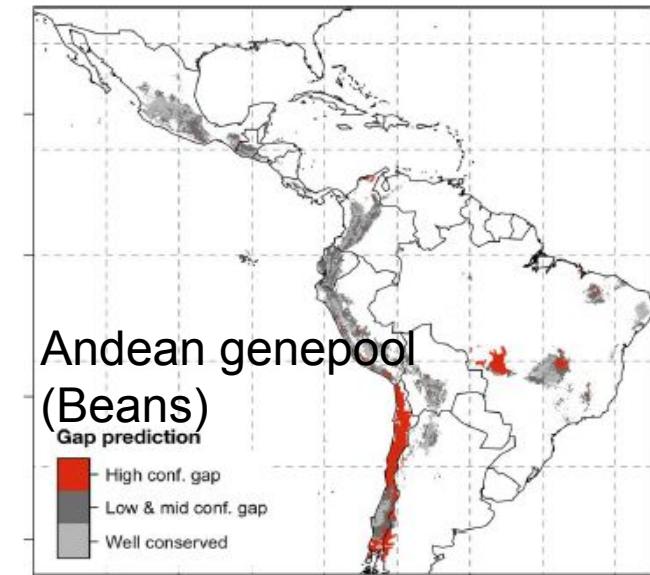
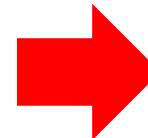
$$ERS = \frac{\# \text{ squares w/ red dot}}{\text{total # squares}}$$



Landraces =



Only based on coords



Alliance

Bioversity  
International

CIAT  
International Center for Tropical Agriculture  
Since 1967 Science to cultivate change

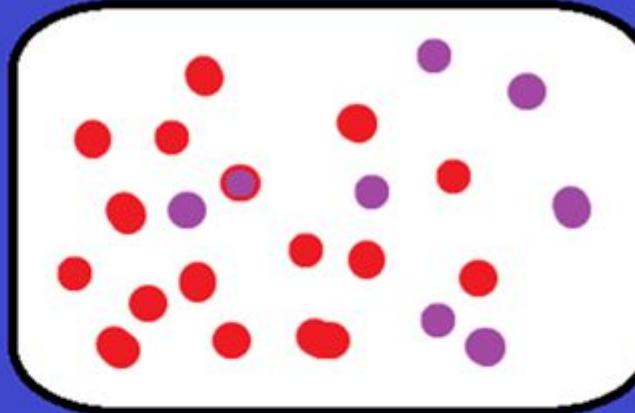


# The workflow for a gap analysis

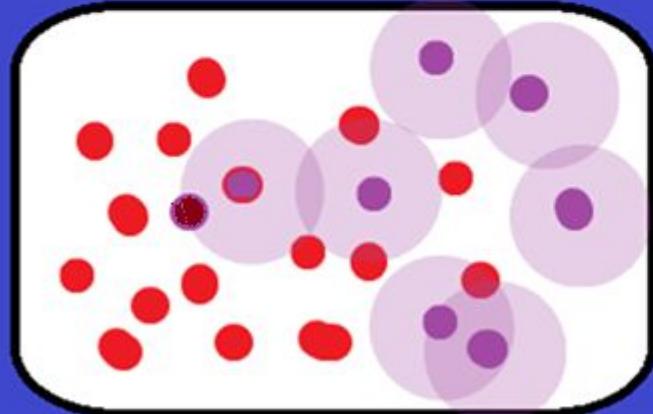
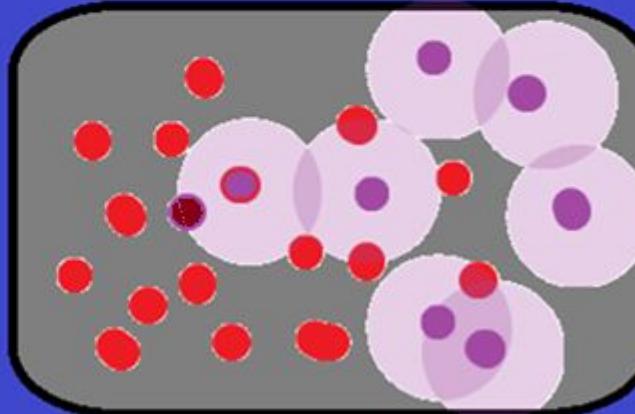
**A**

Species occurrences

Sampled  
germplasm

**B**

Realized niche

**C****D**

Where to collect

- Germplasm
- Other coordinates
- Collected germplasm area
- Potential area to be collected



# Questions?