Geographic coordinates
plus the metadata to make them useful
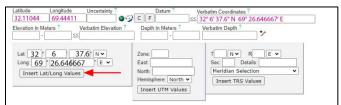
Biodiversity
Knowledge
Sharing

Introduction

Geographic coordinates, in theory, give the location of a point on the earth's surface but, in practice, more information, metadata, is required to interpret them. Georeferencing means providing the latitude and longitude of a location *plus the metadata that enables effective data sharing*. For more information, see "Georeferencing – background information" and "Georeferencing quick guide". The following notes are to help you understand the georeferencing fields in OpenHerbarium and OpenZooMuseum.

The fields

Latitude and **Longitude:** These two fields **require** data in decimal degrees, not degrees minutes and seconds (32° 6' 37.6"), nor degrees and decimal minutes (32° 6.626667"). If you have degrees minutes and seconds or degrees and decimal minutes they must be changed.

Converting data in the wrong format: Click the **F** button. That will bring up the screen shown below.

Enter the degree-minute-second data into the boxes on the lower left (being sure to put the latitude data in the latitude row and the longitude data in the longitude row). The latitude data in the example was in degrees, minutes, and seconds; the longitude data was in degrees and decimal minutes.

Then click the "Insert Lat/Long Values" button. When you do that, the program will calculate the decimal degrees for each value and enter it into the appropriate box above (see pink entries) AND it will enter the original information into the "Verbatim Coordinates" field.

Uncertainty: This gives data users some idea of how widely they must search around the location indicated by the latitude and longitude data to relocate the specimen or whether the data can be used to determine the species' preferred environment. The latitude and longitude indicate a point on the earth's surface, but the mechanisms used for determining their values are limited in their ability to provide exact numbers by many factors. For now, look at the table below to see how much distance there would be between locations with differences in latitude and longitude by the values shown.

How many decimal places? It is tempting to enter all the decimal places for the latitude and longitude that you obtain from the device or web site you use. Resist that temptation! The tables below show the distance in meters between latitudes and longitudes differing by 1 at different decimal positions. How many decimal places are justified? As a general guideline, botanists generally cannot afford equipment or devices that are accurate beyond the fourth decimal place, in other words, accurate to more than the

nearest 10 m. The accuracy your GPS states is based on several assumptions, most of which are not accurate, for example, that the air density between it and the satellites decreases in a uniform manner.

Notice that no matter where you are on the earth's surface, a difference in latitude along the same line of longitude means the same distance in metres because lines of latitude are equally spaced from the equator to the poles. That is not true for differences in degrees of longitude. They are about 111.111 km apart at the equator but come to the same point at the poles. The first table below shows distances at 10° North or South of the equator. The second table is for is for 10° North or South. Notice that the difference in metres for the same difference in longitude are greater at 10° North or South are than they are at 25° North or South. The tables use information provided by John D. Cook.

Table 1. Distances in metres between lines of latitude and longitude at 10° North or South.

Distance in metres between two points at different latitudes but on the same longitude			Distance in metres between two points at different longitudes but on the same latitude	
1°	109000 m		1°	109000 m
0.1°	10900 m		0.1°	10900 m
0.01°	1110 m		0.01°	1110 m
0.001°	109 m		0.001°	109 m
0.0001°	10.9 m		0.0001°	10.9 m
0.00001°	1.091 m		0.00001°	1.091 m
0.000001°	0.109 m [=10.9 cm]		0.000001°	0.109 m [=10.9 cm]
0.0000001°	0.0109 m [=1.09 cm]		0.0000001°	0.0109 m [=1.09 cm]

Table 2. Distances in metres between lines of latitude and longitude at 25° North or South.

Distance in metres between two points at different latitudes but on the same longitude			Distance in metres between two points at different longitudes but on the same latitude	
1°	111000 m		1°	100000 m
0.1°	11100 m		0.1°	10000 m
0.01°	1110 m		0.01°	1000 m
0.001°	111 m		0.001°	100 m
0.0001°	11.1 m		0.0001°	10 m
0.00001°	1.11 m		0.00001°	1 m
0.000001°	0.111 m [=11.1 cm]		0.000001°	0.1 m [= 10 cm]
0.0000001°	0.0111 m [=1.11 cm]		0.0000001°	0.01 m [=1 cm]

Table 3 (on the next page) shows the distances between different degrees of longitude at the equator (0° N & S), midway between the equator the poles (45° N & S), and at the poles.

Table 3. Distance in metres between lines longitude at three different latitudes

Difference in degrees	At the Equator (0°N or S)	At 45° N or S	At the poles (90° N or S)
1°	111000 m	78000 m°	0 m
0.1°	11100 m	7800 m	0 m
0.01°	1110 m	780 m	0 m
0.001°	111 m	78 m	0 m
0.0001°	11.1 m	7.8 m	0 m
0.00001°	1.11 m	0.78 m [=78 cm]	0 m
0.000001°	0.111 m [=11.1 cm]	0.078 m [= 7.8 cm]	0 m
0.0000001°	0.0111 m [=1.11 cm]	0.0078 m [= 7.8 mm]	0 m

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