EMu Documentation

Common Geo-reference Tab

Document Version 1

EMu Version 4.0

Contents

SECTION 1

Overview

Geo-referencing is the process of determining locality co-ordinates (Latitude, Longitude, Eastings, Northings, etc.) and associated error. At the North American User Group meeting in Chicago in 2005 the EMu Natural History Special Interest Group (NH SIG) proposed the design of a common tab for storing geo-referencing information. Discussions with a number of users took place over the next year and results were published on www.emuusers.org for review. After considering all feedback the group produced a proposal for implementation. EMu 4.0 implements the recommendations of that proposal in the *Sites* and *Collection Events* modules.

A number of changes to the previous design of the *Sites* and *Collection Events* modules have been introduced, including the following:

- A common display tab and associated search tabs were designed and built.

  All clients who store geo-referencing data in either the Sites or Collection Events modules have had their modules adapted to use the new tabs.
- Support for multiple opinions was added, allowing data from various sources to be recorded (e.g. a set of co-ordinates from a GPS device, another set from a map reading and another set derived automatically from the Precise Location via BioGeomancer).
- A set of common columns was added to both the Sites and Collection Events modules.

  All existing data was migrated from client specific fields into the new common fields. The introduction of a core set of fields allows for easier data interchange.
- The calculation of centroid values was updated to use the new columns.

  The centroid computation is now performed via an external service (fifo server) and used by the Windows client and the database server.
- The precision was modified to imply more accuracy for all computations where the form of a Latitude or Longitude is changed (e.g. Degrees / Minutes / Seconds to Decimal).

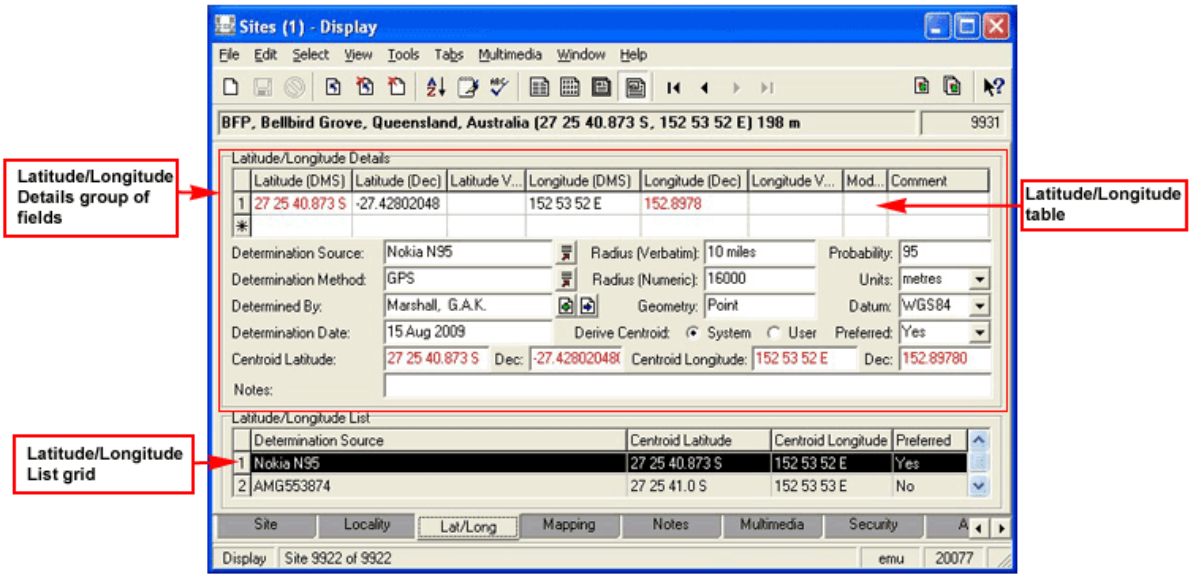
The changes have led to the merging of many disparate versions of geo-referencing data within EMu client implementations. The new tabs should meet the needs of clients and allow for the creation of features based on a common framework.

Special thanks to Larry Gall from Yale Peabody Museum of Natural History and the rest of the geo-referencing sub-committee for all their work.

SECTION 2

Lat/Long Display Tab

Geo-referencing information is stored in a new Lat/Long tab designed to contain all locality co-ordinate information and associated error values:



The Lat/Long tab is divided into two linked areas:

- The *Latitude/Longitude Details* group of fields at the top of the tab.
- The *Latitude/Longitude List* grid at the bottom of the tab.

As with other linked grids in EMu, data displaying in the *Latitude/Longitude Details* group of fields at the top of the tab depends on the row selected in the *Latitude/Longitude List* grid at the bottom of the tab: selecting a different row in the *Latitude/Longitude List* grid, displays a different set of values (opinion) in the *Latitude Longitude Details* group of fields.

Each row in the *Latitude/Longitude List* grid represents an opinion on the locality. For each opinion a set of latitude and longitude values can be defined. The *Latitude/Longitude* table located at the very top of the tab allows multiple points to be entered, with each point added as a row in the table. A single point specifies an exact location, while two points (generally) represent a line, three points represent a triangle and four a quadrilateral, etc.

Field Definitions

In this section a description of each field on the Lat/Long tab is provided.

First, a definition of the labels used to describe each field:

Label	Definition
Column	The name of the column in EMu's *Sites* and *Collection Events* modules.
Darwin Core Term	The name of the Darwin Core term for the column.
ABCD Identifier	The xpath for the Access to Biological Collection Data identifier for the column.
Description	A brief description of the content of the column.
Example Values	Samples values for the column.

Latitude (DMS): (Latitude/Longitude Details)

Column:	LatLatitude_nesttab
Darwin Core Term:	verbatimCoordinates verbatimCoordinateSystem
ABCD Identifier:	DataSets / DataSet / Units / Unit / Gathering / SiteCoordinateSets / SiteCoordinates / CoordinatesLatLong / CoordinatesText DataSets / DataSet / Units / Unit / Gathering / SiteCoordinateSets / SiteCoordinates / CoordinatesGrid / GridCellSystem
Description:	The latitude value for a given point specified in Degrees / Minutes / Seconds (DMS) format. The direction (either `N` or `S`) must be specified. The value must be between zero and 90 degrees. The value may be entered in either DMS or decimal format (decimal values are converted to DMS).

Example Values:	`12 34 15 N`
	`23 15 S`
	`27 32 18.45 S`

Latitude (Dec): (Latitude/Longitude Details)

Column:	LatLatitudeDecimal_nesttab
Darwin Core Term:	decimalLatitude
ABCD Identifier:	DataSets / DataSet / Units/Unit / Gathering / SiteCoordinateSets / SiteCoordinates / CoordinatesLatLong / LatitudeDecimal
Description:	The latitude value for a given point specified as a decimal number. The direction is not shown, as a negative value implies south and a positive value implies north.
Example Values:	`12.34267` `-27.9453765`

Latitude Verbatim: (Latitude/Longitude Details)

Column:	LatLatitudeVerbatim_nesttab
Darwin Core Term:	verbatimLatitude
ABCD Identifier:	DataSets / DataSet / Units / Unit / Gathering / SiteCoordinateSets / SiteCoordinates / CoordinatesLatLong / VerbatimLatitude
Description:	The latitude text as it appears originally. In many instances the value was recorded by hand on a label or in a journal. The latitude value as it appears on the label or in the journal is entered into this field.
Example Values:	`North 12 34` `27° 15' 18" South`

Longitude (DMS): (Latitude/Longitude Details)

Column:	LatLongitude_nesttab
Darwin Core Term:	verbatimCoordinates and verbatimCoordinateSystem
ABCD Identifier:	DataSets / DataSet / Units/Unit / Gathering / SiteCoordinateSets / SiteCoordinates / CoordinatesLatLong / CoordinatesText and DataSets / DataSet / Units / Unit / Gathering / SiteCoordinateSets / SiteCoordinates / CoordinatesGrid / GridCellSystem
Description:	The longitude value for a given point specified in Degrees / Minutes / Seconds (DMS) format. The direction (either `E` or `W`) must be specified. The value must be between zero and 180 degrees. The value may be entered in either DMS or decimal format (decimal values are converted to DMS).

Example Values:	`140 12 15 E`
	`62 15 W`
	`62 30 24.45 W`

Longitude (Dec): (Latitude/Longitude Details)

Column:	LatLongitudeDecimal_nesttab
Darwin Core Term:	decimalLongitude
ABCD Identifier:	DataSets / DataSet / Units / Unit / Gathering / SiteCoordinateSets / SiteCoordinates / CoordinatesLatlong / LongitudeDecimal
Description:	The longitude value for a given point specified as a decimal number. The direction is not shown, as a negative value implies west and a positive value implies east.
Example Values:	`140.9236` `-60.327656`

Longitude Verbatim: (Latitude/Longitude Details)

Column:	LatLongitudeVerbatim_nesttab
Darwin Core Term:	verbatimLongitude
ABCD Identifier:	DataSets / DataSet / Units / Unit / Gathering / SiteCoordinateSets / SiteCoordinates / CoordinatesLatlong / VerbatimLongitude
Description:	The longitude text as it appears originally. In many instances the value was recorded by hand on a label or in a journal. The longitude value as it appears on the label or in the journal is entered into this field.
Example Values:	`East 140 12` `62° 30' 24" West`

Modifier: (Latitude/Longitude Details)

Column:	LatModifier_nesttab
Darwin Core Term:	N/A
ABCD Identifier:	N / A
Description:	A modifier that applies to both the latitude and longitude values. The modifier generally provides feedback about the accuracy of the values.
Example Values:	`Approximate` `?`

Comments: (Latitude/Longitude Details)

Column:	LatComment_nesttab
Darwin Core Term:	georeferenceRemarks
ABCD Identifier:	DataSets / DataSet / Units / Unit/Gathering / SiteCoordinateSets / SiteCoordinates / GeoreferenceRemarks
Description:	General comments that apply to a particular latitude and longitude pair. If a comment applies to the overall opinion, the *Notes* field should be used.
Example Values:	`Last digit of latitude value difficult to read. Could be 8 or 9.` `Verbatim values were smudged and difficult to read.`

Determination Source: (Latitude/Longitude Details)

Column:	LatDetSource_tab
Darwin Core Term:	georeferenceSources
ABCD Identifier:	DataSets / DataSet / Units / Unit/Gathering / SiteCoordinateSets / SiteCoordinates / GeoreferenceSources
Description:	The source of the latitude/longitude pairs. It may be the gazetteer and version used, the map details, the name of the institution that provided the co-ordinates or the model of the GSP unit used.
Example Values:	`Alexandria Digital Library Gazetteer, Version 1.2` `AMG553874`

Determination Method: (Latitude/Longitude Details)

Column:	LatLatLongDetermination_tab
Darwin Core Term:	georeferenceProtocol
ABCD Identifier:	DataSets / DataSet / Units / Unit / Gathering / SiteCoordinateSets / SiteCoordinates / CoordinateMethod
Description:	The method used to calculate the latitude/longitude pairs. Each method used should be viewed as a separate set of readings resulting in one opinion per method used per person making the determination.

Example Values:	`GPS`
	`On-line Gazetteer`
	`Map`

Determined By: (Latitude/Longitude Details)

Column:	LatDeterminedByRef_tab
Darwin Core Term:	georeferencedBy
ABCD Identifier:	N/A
Description:	A link to the Parties record of the person who calculated the latitude/longitude values used.
Example Values:	`Wilson, Garry (ANM)` `National Museum`

Determination Date: (latitude/longitude Details)

Column:	LatDetDate_tab
Darwin Core Term:	N/A
ABCD Identifier:	N/A
Description:	The date the latitude/longitude values were calculated.
Example Values:	`12 September 2009` `02 / 04 / 2008`

Radius (Verbatim): (Latitude/Longitude Details)

Column:	LatRadiusVerbatim_tab
Darwin Core Term:	coordinatePrecision
ABCD Identifier:	DataSets / DataSet / Units / Unit / Gathering / SiteCoordinateSets / SiteCoordinates / CoordinatesLatLong / AccuracyStatement
Description:	The error distance as recorded originally. When latitude/longitude values are calculated the value derived is not exact. There is an error component whose size depends on the method used to derive the values. The radius is the distance from the specified point in which the actual location should appear.
Example Values:	`12 miles` `2000 metres`

Probability: (Latitude/Longitude Details)

Column:	LatRadiusProbability_tab
Darwin Core Term:	pointRadiusSpatialFit
ABCD Identifier:	DataSets / DataSet / Units / Unit/Gathering / SiteCoordinateSets / SiteCoordinates / PointRadiusSpatialFit
Description:	The numeric probability (between 1 and 100) that a given location falls within the error distance specified. A value of 100 represents complete certainty.
Example Values:	`90` `100`

Radius (Numeric): (Latitude/Longitude Details)

Column:	LatRadiusNumeric_tab
Darwin Core Term:	coordinateUncertaintyInMeters
ABCD Identifier:	DataSets / DataSet / Units / Unit / Gathering / SiteCoordinateSets / SiteCoordinates / CoordinatesLatlong / CoordinateErrorDistanceInMeters
Description:	The numeric representation of *Radius (Verbatim)*. The error distance is entered in metres typically, however the *Units* field allows other units to be specified.
Example Values:	`2000` `12.5`

Units: (Latitude/Longitude Details)

Column:	LatRadiusUnit_tab
Darwin Core Term:	coordinateUncertaintyInMeters
ABCD Identifier:	DataSets / DataSet / Units / Unit / Gathering / SiteCoordinateSets / SiteCoordinates / CoordinatesLatlong / CoordinateErrorDistanceInMeters
Description:	The unit type to apply to the *Radius (Numeric)* value.
Example Values:	`metres` `feet`

Geometry: (Latitude/Longitude Details)

Column:	LatGeometry_tab
Darwin Core Term:	footprintWKT
ABCD Identifier:	DataSets / DataSet / Units / Unit / Gathering / FootprintWKT
Description:	The overall shape represented by the latitude/longitude values. For a single set of values a point is defined, however for two sets of points a line may be defined or the points may be corners of a bounding box or even just two disparate locations.

Example Values:	`point`
	`triangle`
	`line`

Datum: (Latitude/Longitude Details)

Column:	LatDatum_tab
Darwin Core Term:	geodeticDatum and verbatimSRS
ABCD Identifier:	DataSets / DataSet / Units / Unit / Gathering / SiteCoordinateSets / SiteCoordinates / CoordinatesLatlong / SpatialDatum
Description:	A *datum* is a set of reference points on the earth's surface from which measurements are made. For geodesy it is the points used to determine latitude and longitude values. Maps and GPS devices use a reference datum to determine co-ordinates.

Example Values:	`WGS84`
	`NAD83`
	`AGM66`

Preferred: (Latitude/Longitude Details)

Column:	LatPreferred_tab
Darwin Core Term:	N/A
ABCD Identifier:	N/A
Description:	Where multiple locality opinions are given (that is, more than one entry in the Latitude/Longitude List grid) a `Yes` value is enabled for the *Preferred* opinion. The *Preferred* entry is used in Summary Data and preferred centroid calculations.
Example Values:	`Yes` `No`

Derive Centroid: (Latitude/Longitude Details)

Column:	LatDeriveCentroid_tab
Darwin Core Term:	N/A
ABCD Identifier:	N/A
Description:	Whether EMu should calculate the centroid value (`System`) or whether the value is entered by the user (`User`). The centroid is the weighted middle point of all the latitude/longitude pairs entered for the current opinion.
Example Values:	`System` `User`

Centroid Latitude: (Latitude/Longitude Details)

Column:	LatCentroidLatitude0
Darwin Core Term:	verbatimCoordinates and verbatimCoordinateSystem
ABCD Identifier:	DataSets / DataSet / Units / Unit / Gathering / SiteCoordinateSets / SiteCoordinates / CoordinatesLatLong / CoordinatesText and DataSets / DataSet / Units / Unit / Gathering / SiteCoordinateSets / SiteCoordinates / CoordinatesGrid / GridCellSystem
Description:	The latitude value representing the weighted middle point of all the latitude/longitude pairs provided for the current opinion. In most cases this value is calculated automatically. The value is shown in DMS format.

Example Values:	`12 34 15 N`
	`23 15 S`
	`27 32 18.45 S`

Dec: (Latitude/Longitude Details)

Column:	LatCentroidLatitudeDec_tab
Darwin Core Term:	decimalLatitude
ABCD Identifier:	DataSets / DataSet / Units / Unit / Gathering / SiteCoordinateSets / SiteCoordinates / CoordinatesLatlong / LatitudeDecimal
Description:	The centroid latitude value in decimal format.
Example Values:	`12.34267` `-27.9453765`

Centroid Longitude: (Latitude/Longitude Details)

Column:	LatCentroidLongitude0
Darwin Core Term:	verbatimCoordinates and verbatimCoordinateSystem
ABCD Identifier:	DataSets / DataSet / Units / Unit/Gathering / SiteCoordinateSets / SiteCoordinates / CoordinatesLatLong / CoordinatesText and DataSets / DataSet / Units / Unit / Gathering / SiteCoordinateSets / SiteCoordinates / CoordinatesGrid / GridCellSystem
Description:	The longitude value representing the weighted middle point of all the latitude/longitude pairs provided for the current opinion. In most cases this value is calculated automatically. The value is shown in DMS format.

Example Values:	`140 12 15 E`
	`62 15 W`
	`62 30 24.45 W`

Dec: (Latitude/Longitude Details)

Column:	LatCentroidLongitudeDec_tab
Darwin Core Term:	decimalLongitude
ABCD Identifier:	DataSets / DataSet / Units / Unit / Gathering / SiteCoordinateSets / SiteCoordinates / CoordinatesLatlong / VerbatimLongitude
Description:	The centroid longitude value in decimal format.
Example Values:	`140.9236` `-60.327656`

Notes: (Latitude/Longitude Details)

Column:	LatGeoreferencingNotes0
Darwin Core Term:	georeferenceRemarks
ABCD Identifier:	DataSets / DataSet / Units / Unit / Gathering / SiteCoordinateSets / SiteCoordinates / GeoreferenceRemarks
Description:	Any notes that apply to the overall set of latitude/longitude values or the error distance.
Example Values:	`GPS required re-calibration so readings may not be as accurate as first thought. Readings taken from version 1.2 of map. Version 1.3 may provide better values.`

Preferred Columns

The Lat/Long tab allows multiple opinions to be recorded. One of these opinions is marked as *Preferred* by having the value `Yes` recorded in the *Preferred* combo box. Only one opinion may be marked as *Preferred*. Changing *Preferred* to `Yes` for a given opinion forces all other opinions to be set to `No`.

In many cases the *Preferred* opinion is sufficient when producing reports or displaying data on the Internet. To provide easy access to the *Preferred* opinion, EMu copies most of the geo-referencing data for the *Preferred* opinion into a separate set of columns. These columns can be used for reporting, displaying on the Internet and even searching. The table below lists the names of the *Preferred* opinion columns:

Name	Column	Copied from
Preferred Latitude (DMS)	LatPreferredLatitude0	LatLatitude_nesttab
Preferred Latitude (Dec)	LatPreferredLatitudeDec	LatLatitude_nesttab
Preferred Longitude (DMS)	LatPreferredLongitude0	LatLongitude_nesttab
Preferred Longitude (Dec)	LatPreferredLongitudeDec	LatLongitudeDecimal_nesttab
Preferred Centroid Latitude (DMS)	LatPreferredCentroidLatitude	LatCentroidLatitude0
Preferred Centroid Latitude (Dec)	LatPreferredCentroidLatDec	LatCentroidLatitudeDec_tab
Preferred Centroid Longitude (DMS)	LatPreferredCentroidLongitude	LatCentroidLongitude0
Preferred Centroid Longitude (Dec)	LatPreferredCentroidLongDec	LatCentroidLongitudeDec_tab
Preferred Determination Method	LatPreferredDetermination	LatLatLongDetermination_tab
Preferred Determined By Ref	LatPreferredDeterminedByRef	LatDeterminedByRef_tab
Preferred Determination Date	LatPreferredDetDate	LatDetDate_tab
Preferred Determination Source/Description	LatPreferredDetSource	LatDetSource_tab
Preferred Datum	LatPreferredDatum	LatDatum_tab
Preferred Radius Numeric	LatPreferredRadiusNumeric	LatRadiusNumeric_tab
Preferred Radius Unit	LatPreferredRadiusUnit	LatRadiusUnit_tab
Preferred Radius Verbatim	LatPreferredRadiusVerbatim	LatRadiusVerbatim_tab
Preferred Radius Probability	LatPreferredRadiusProbability	LatRadiusProbability_tab
Preferred Geometry	LatPreferredGeometry	LatGeometry_tab
Preferred Georeferencing Notes	LatPreferredGeoreferencingNotes	LatGeoreferencingNotes0

When supplying data in Darwin Core or ABCD format, the *Preferred* values may provide sufficient information.

Computed Values

When data is entered into the Lat/Long tab a number of values are computed. In particular:

- All latitude and longitude values entered in DMS format have the equivalent decimal value computed and displayed. The computed value is displayed in red.
- All latitude and longitude values entered in decimal format have the equivalent DMS value computed and displayed. The computed value is displayed in red.
- The first opinion entered has *Preferred* set to `Yes` automatically. Setting another opinion to `Yes` results in all other options having *Preferred* set to `No`.
- For each opinion entered the centroid value is computed if the *Derive Centroid* value is set to `System`. The calculation uses the entered values, not the computed values, when determining the centroid.

The computed values are also calculated when records are inserted via the Import tool or any other insertion mechanism (e.g. web based insertions, **texload** bulk loads, etc.).

SECTION 3

Precision Changes

EMu 3.1 saw changes made to the conversion of latitude and longitude values between decimal (Dec) and Degrees / Minutes / Seconds (DMS) formats. The rule applied, as used throughout EMu, was that a calculated value should *never* imply more precision than the original value. While this rule is useful in general it does cause problems with geo-referencing data. Using the decimal representation the precision of a latitude/longitude value is 1/10, however for DMS the precision is 1/60, so when converting from DMS to decimal noticeable precision is lost. If a decimal precision of 1/100 is used, a slight gain in precision over DMS occurs.

The EMu NH SIG recommended a change in how precision should be handled when converting between latitude/longitude values in DMS and decimal formats. The recommendations were:

- If a DMS value is entered, the decimal value will be converted to two decimal places if seconds is missing, four decimal places if whole seconds is provided, five decimal places if one second decimal place is provided, six decimal places if two seconds decimal places are provided, and seven if three seconds decimal places are provided, etc.
- If a decimal value is entered, the precision of the DMS should be calculated in reverse of the above. Two decimal places round to minutes, three or four decimal places round to seconds, five decimal places round to tenths of a second, six decimal places round to hundredths of a second, seven decimal places round to thousandths of a second, etc.
- Centroid calculations should be given one degree of precision greater than the least precise latitude/longitude value in the group. Although this may be implying an increase in degree of accuracy, it is only one degree and will help lessen the skewing of the centroid values.

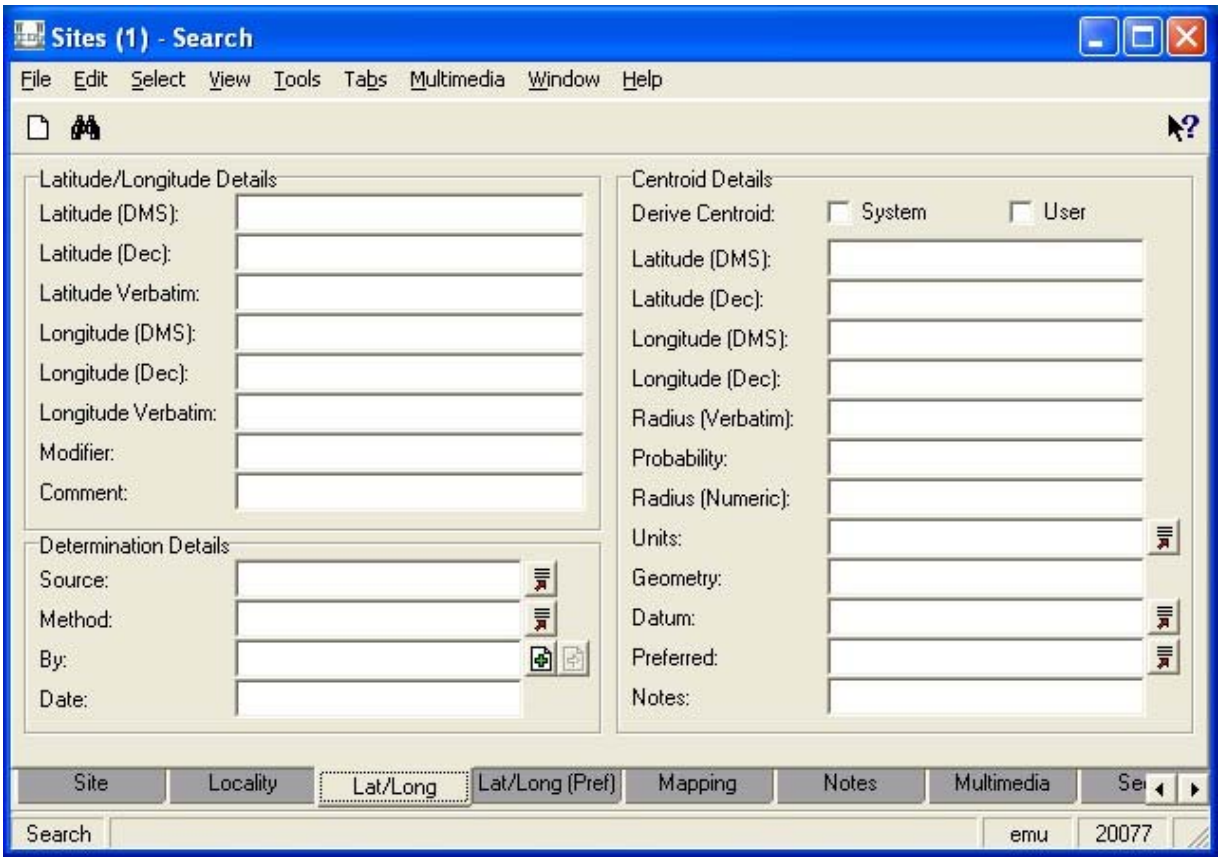
Each of the above recommendations has now been implemented.

Special thanks to Beth Gamble from National Museum of Natural History (Smithsonian) for proposing the changes.

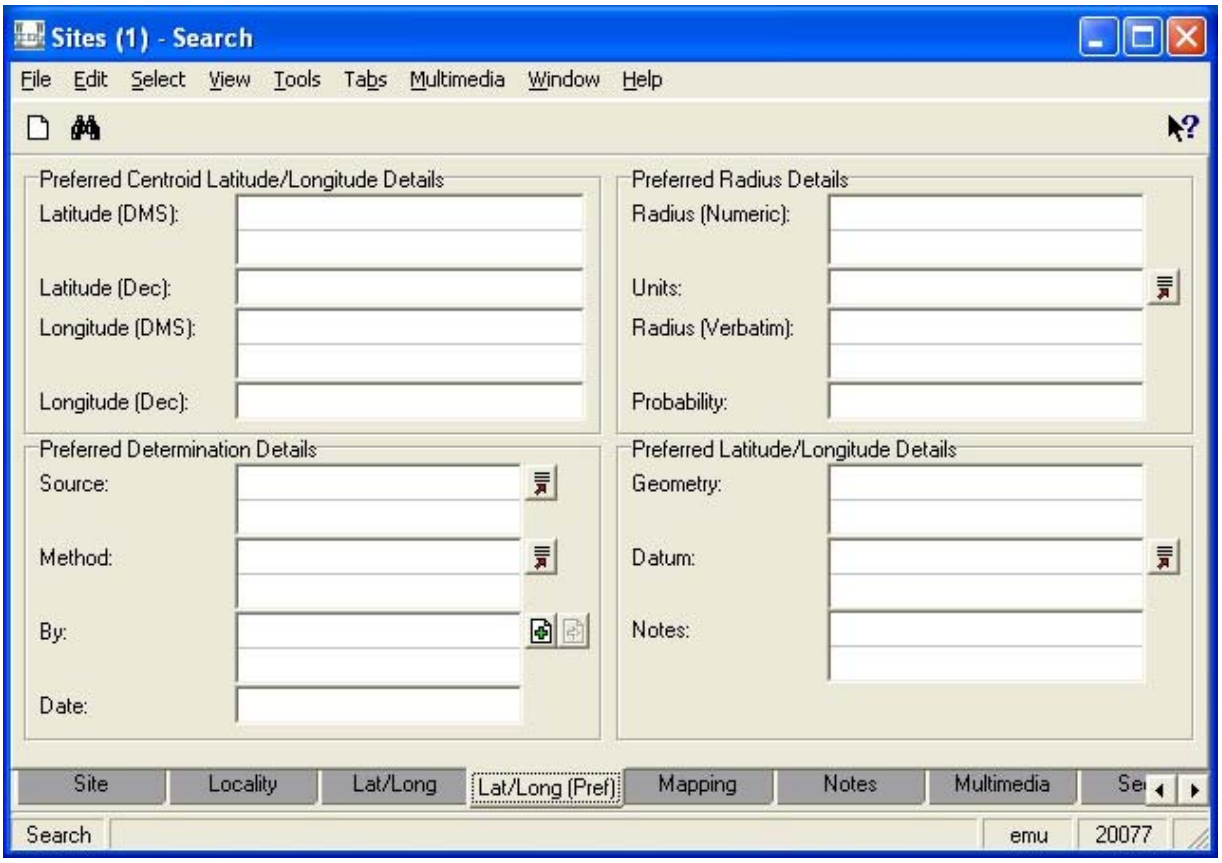
SECTION 4

Lat/Long Search Tabs

Two new tabs have been added to provide query access to geo-referencing data. The first is the Lat/Long search tab. Fields that can be searched correspond to the fields on the Lat/Long display tab:



The second tab, Lat/Long (Pref), limits searches to opinions where *Preferred* is set to `Yes`. The simplified data view provides for easier searching and reporting on the *Preferred* opinion:



Index