Neotoma: A Multiproxy Community Database for the Pliocene and Quaternary

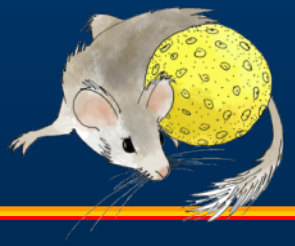
Eric C. Grimm, Illinois State Museum, USA

Whence Neotoma?

Neotoma collects multiproxy paleodata!

Neotoma (packrat, woodrat) collects plants, bones, and other materials, which it deposits in middens, which can be preserved for thousands of years. The middens are cemented and preserved by *amberat* (dried urine), which contains pollen.

Neotoma



- **Originally Funded by the U.S. National Science Foundation Geoinformatics Program (2 years)**
- **Lead Institutions**

  Pennsylvania State University

  Illinois State Museum
- **Principal Investigators**

  Allan Ashworth – Beetles

  Russell Graham – Mammalian Fauna (FAUNMAP)

  Eric Grimm – Pollen

  Stephen Jackson – Plant Macrofossils

  Jack Williams – Tools/Power User

Neotoma Development Plans

New proposal has been funded by the NSF Geoinformatics Program for a five-year duration

Principal Investigators

Pennsylvania State University
Russell W. Graham (Penn State)
Allan A. Ashworth (NDSU)
Robert K. Booth (Lehigh University)
Douglas A. Miller (Penn State)
John (Jack) W. Williams (Univ Wisconsin)

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Collaborators

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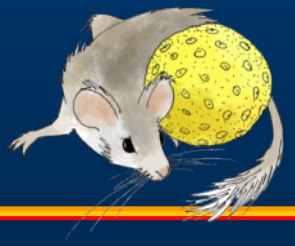
Paul D.M. Hughes (University of Southhampton, UK)
Anne-Marie Lézine (Laboratoire des Sciences du Climat et de l'Environnement, Gif-sur-Yvette, France)
Cathy Manduca (Carleton College)
Michael Märker (Univesität Tübingen, Germany)
Katherine McCarville (Upper Iowa University)
Chengyu Weng (Tongji University, Shanghai, China)

Geologic Time Frame



Holocene, Pleistocene, and Pliocene
Last 5.3 million years of geologic time

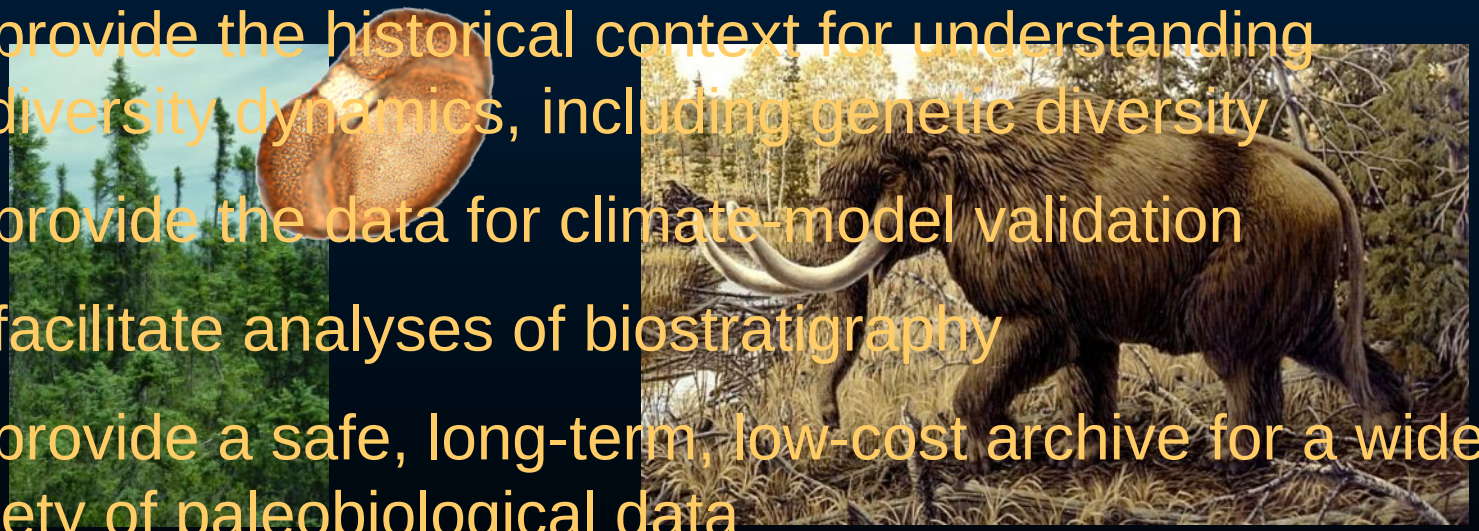
Time during which:

- Continents have had their current configuration
- Modern ecosystems developed
- Humans evolved
- Late Pleistocene extinctions occurred across most continents

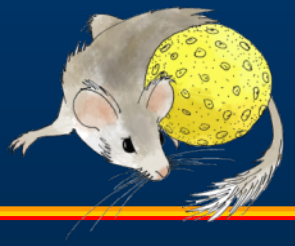
It is a time, therefore, particularly relevant for evaluating global change.

Purposes of Neotoma

- To facilitate studies of ecosystem development and response to climate change
- To enable joint analysis of multiproxy datasets to address paleoenvironmental questions that transcend those possible with single-proxy databases.
- To provide the historical context for understanding biodiversity dynamics, including genetic diversity
- To provide the data for climate-model validation
- To facilitate analyses of biostratigraphy
- To provide a safe, long-term, low-cost archive for a wide variety of paleobiological data
- To lower the overall cost of paleodata management



Neotoma Merges Existing Databases



Initially:

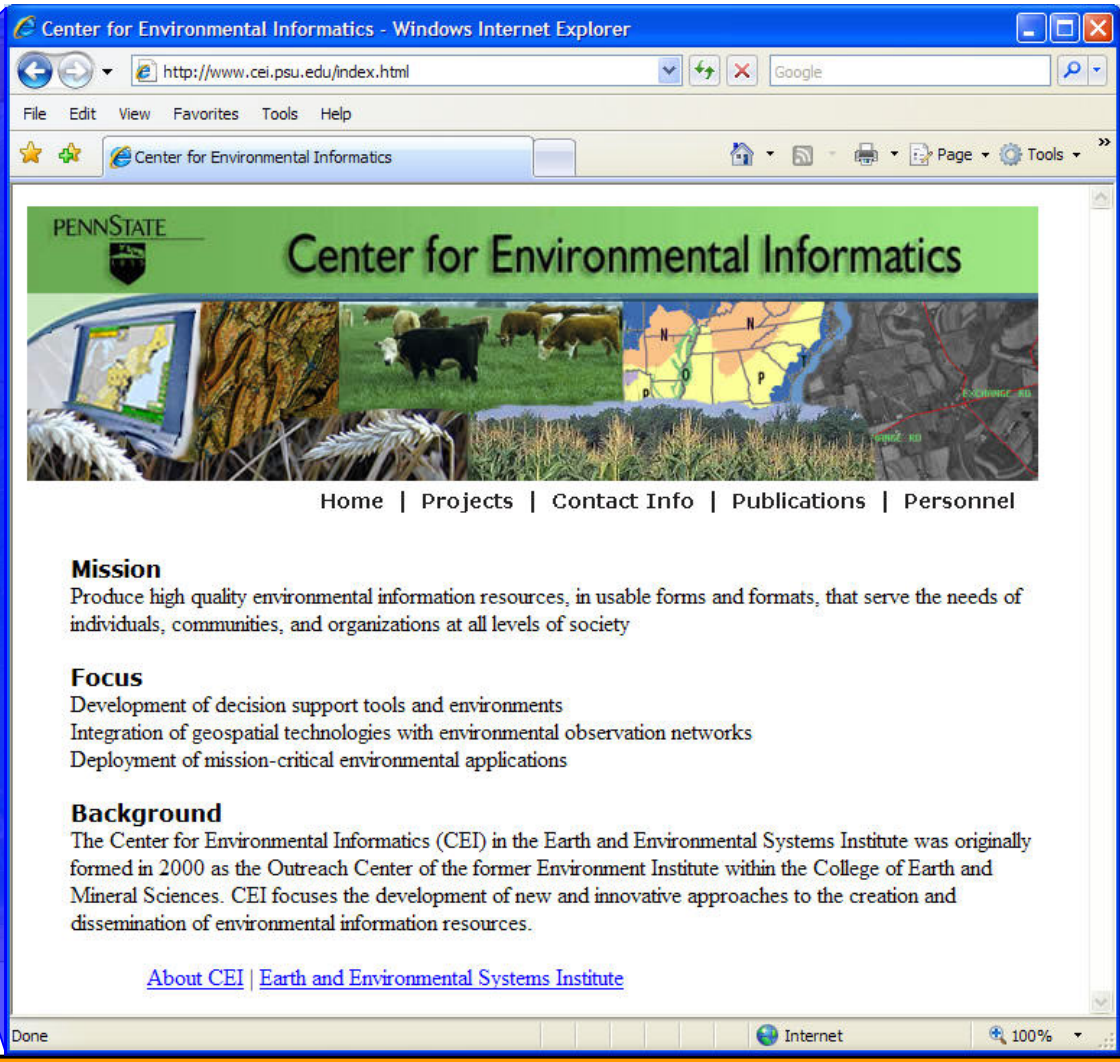
- FAUNMAP Database
- Global Pollen Database
- North American Plant Macrofossil Database
- Allan Ashworth’s Beetle Database

Neotoma Design Concepts

- Partnership between domain scientists and information technology specialists; wherein the science is driving the IT.
- Neotoma offers database infrastructure to specialists in various taxonomic groups, who will not need to develop or even necessarily understand the core information technology, but who can learn to input, update, and extract data through a user-friendly interface and to have control over disciplinary taxonomic issues.
- Neotoma can accommodate virtually any type of fossil data
- Neotoma is a centralized database with virtual *constituent* databases *(*e.g. North American Pollen Database, FAUNMAP)
- Constituent database cooperatives may develop individualized websites to frontend the database if they so desire
- Capability for “data stewards” to remotely input and update data
- Access to the data by anyone with an Internet connection

NEOTOMA: Physical Location

Center for Environmental Informatics, Pennsylvania State University



Neotoma Development Plans

- New constituent databases

Diatom Paleolimnology Data Cooperative

North American Non-Marine Ostracode Database (NANODe)

North American Packrat Midden Database

European Pollen Database

African Pollen Database

Chinese Pollen Database

Northern Eurasian Palaeoecological Database

Strategic Environmental Archaeology Database (SEAD)/Bugs Database

Role of Culture in Early Expansions of Humans/Roceeh Out of Africa Database (ROAD)

Peatlands

Neotoma Development Plans

- New constituent databases
- Data steward tools

Software interface that allows data stewards to upload and update data remotely over the Internet

Neotoma Development Plans

- New constituent databases
- Data steward tools
- Web services

Read-only server components that:

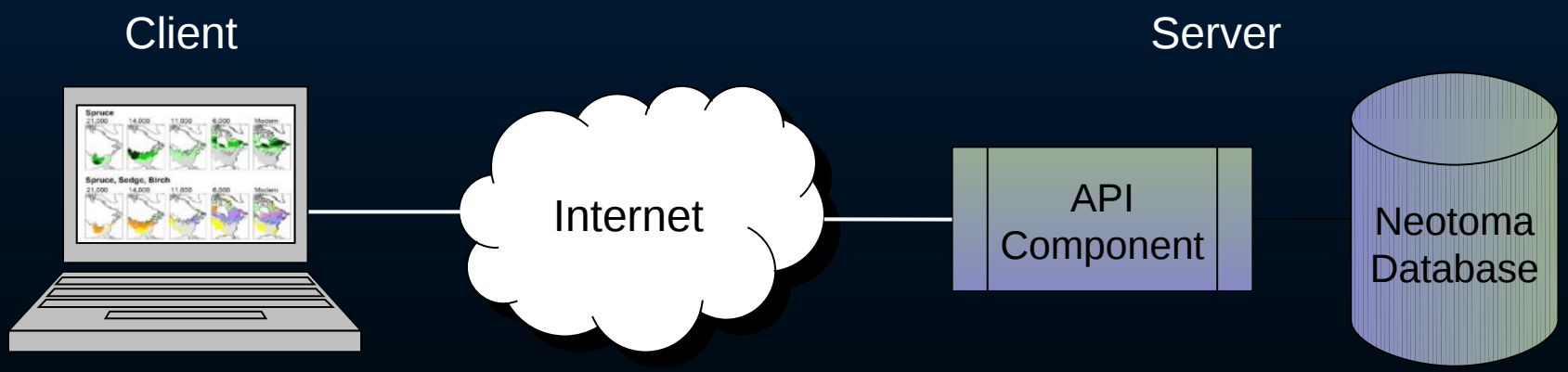
- Retrieve specific data from the database
- If necessary, perform additional operations on the data (e.g. summarization, unit conversion, advanced computation)
- Format and transmit data back to the requesting application

Neotoma Development Plans

- New constituent databases
- Data steward tools
- Web services
- Application Programming Interfaces (APIs)
  - A set of methods and properties for programmatically retrieving data from the database through web services
  - The APIs will allow standalone programs or web sites to remotely access the Neotoma database

Neotoma Development Plans

- New constituent databases
- Data steward tools
- Web services
- Application Programming Interfaces (APIs)



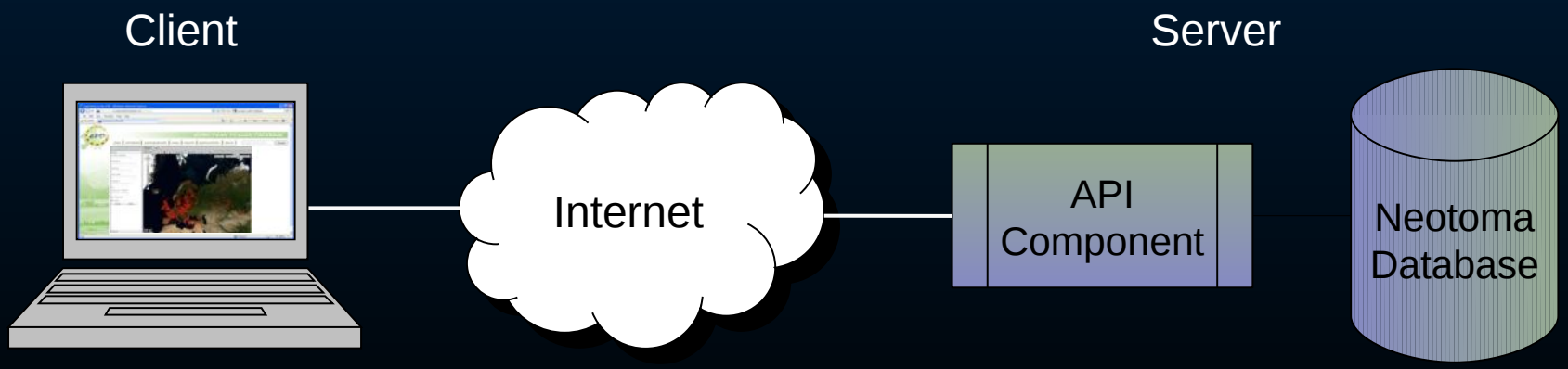
Neotoma Development Plans

- New constituent databases
- Data steward tools
- Web services
- Application Programming Interfaces (APIs)
- Software Development Kit (SDK)

Pre-built (“out of the box” programming assets that save developers time by encapsulating common data access, manipulation, and presentation tasks into modular reusable application building blocks. Example: a map control.

Neotoma Development Plans

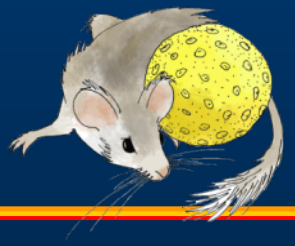
- New constituent databases
- Data steward tools
- Web services
- Application Programming Interfaces (APIs)
- Software Development Kit (SDK)



Neotoma Development Plans

- New constituent databases
- Data steward tools
- Web services
- Application Programming Interfaces (APIs)
- Software Development Kit (SDK)
- Neotoma Explorer plug-ins and enhancements

Neotoma Working Groups



- Tools Working Group
- Age-Model Working Group
- Packrat Midden Working Group
- Peatlands Working Group

Neotoma Website www. neotomadb .org

Neotoma - Windows Internet Explorer

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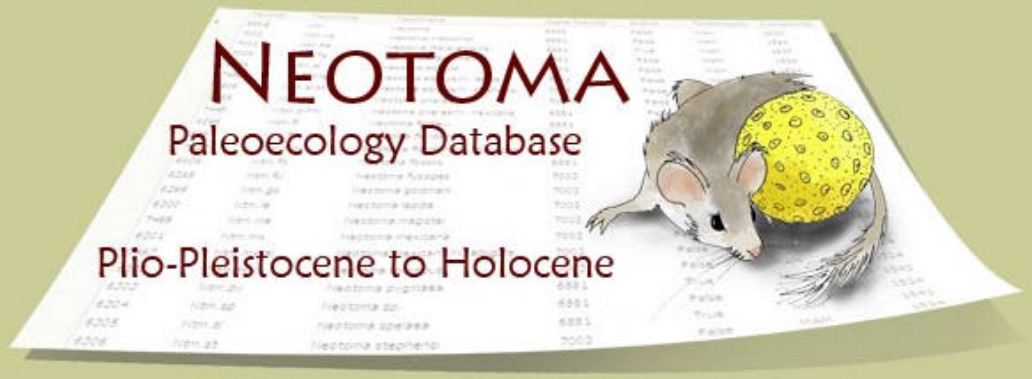

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Neotoma is a multiproxy database that includes fossil data for the past 5 million years, the time during which modern species, including humans, and modern ecosystems appeared. The initial database aggregates the Global Pollen Database, FAUNMAP, the North American Plant Macrofossil Database, and a fossil beetle database into a single integrated database. These databases have become critical infrastructure for paleobiological research. They are used for almost every aspect of this research--from broad-scale synoptic studies to understanding the context of local site studies to using the database as a taxonomic standard. They are also widely used as teaching tools. Their integration facilitates new lines of research and even more use of these data.

Purposes:

- Facilitate studies of ecosystem development and response to climate change.
- Provide the historical context for understanding biodiversity dynamics, including genetic diversity.

Done

Internet

100%

NEOTOMA Manual

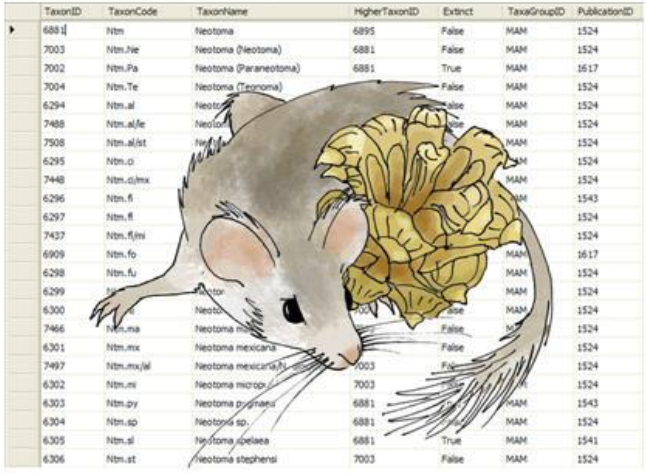
Neotoma

An Ecosystem Database for the Pliocene, Pleistocene, and Holocene

Eric C. Grimm

DRAFT

6 August 2008



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6881	Ntm	Neotoma	6895	False	MAM	1524
7003	Ntm.lve	Neotoma (Neotoma)	6881	False	MAM	1524
7002	Ntm.Pa	Neotoma (Paraneotoma)	6881	True	MAM	1617
7004	Ntm.Te	Neotoma (Teonoma)		False	MAM	1524
6294	Ntm.al	Neoto		alse	MAM	1524
7488	Ntm.al/le	Neoto		alse	MAM	1524
7508	Ntm.al/st	Ne			MAM	1524
6295	Ntm.ci				M	1524
7448	Ntm.ci/mx				MAM	1524
6296	Ntm.fi				M	1543
6297	Ntm.fl					1524
7437	Ntm.fl/mi					1524
6909	Ntm.fo				MAM	1617
6298	Ntm.fu				MAM	1524
6299		Neotor			MAM	1524
6300		Neoto		alse	MAM	1524
7466	Ntm.ma	Neotoma m		False	M	1524
6301	Ntm.mx	Neotoma mexicana		False		1524
7497	Ntm.mx/al	Neotoma mexicana/a	7003	Fal		1524
6302	Ntm.mi	Neotoma micropt	7003			1524
6303	Ntm.py	Neotoma p	6881		MAM	1543
6304	Ntm.sp	Neotoma sp.	6881		MAM	1524
6305	Ntm.si	Neotoma solaea	6881	True	MAM	1541
6306	Ntm.st	Neotoma stephensi	7003	False	MAM	1524

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3.9.2 SQL Example

The following statement produces a list of the ChronControls for the Default Chronology from Wolsfeld Lake in Calibrated radiocarbon years BP:

```
SELECT ChronControls.Depth, ChronControls.Age, ChronControls.AgeLimitYounger, ChronControls.AgeLimitOlder,
    ChronControlTypes.ChronControlType
FROM ChronControlTypes INNER JOIN ((AgeTypes INNER JOIN ((Sites INNER JOIN CollectionUnits ON Sites.SiteID =
    CollectionUnits.SiteID) INNER JOIN Chronologies ON CollectionUnits.CollectionUnitID =
    Chronologies.CollectionUnitID) ON AgeTypes.AgeTypeId = Chronologies.AgeTypeID) INNER JOIN ChronControls
    ON Chronologies.ChronologyID = ChronControls.ChronologyID) ON ChronControlTypes.ChronControlTypeID =
    ChronControls.ChronControlTypeID
WHERE (((Sites.SiteName)="Wolsfeld Lake") AND ((Chronologies.IsDefault)=True) AND
    ((AgeTypes.AgeType)="Calibrated radiocarbon years BP"));
```

Result:

Depth	Age	AgeLimitYounger	AgeLimitOlder	ChronControlType
650	-25	-25	-25	Core top
662	-13	-8	-18	Interpolated, corrected for compaction
670	0	-5	5	Interpolated, corrected for compaction
680	22	17	27	Interpolated, corrected for compaction
690	46	41	51	Interpolated, corrected for compaction
702	72	67	77	Interpolated, corrected for compaction
715	100	80	120	Biostratigraphic, pollen
750	335	120	492	Radiocarbon, calibrated
785	433	310	517	Radiocarbon, calibrated
975	2242	2063	2433	Radiocarbon, calibrated
1065	3402	3261	3556	Radiocarbon, calibrated
1135	3776	3585	3973	Radiocarbon, calibrated
1345	5836	5662	5992	Radiocarbon, calibrated
1415	6910	6730	7160	Radiocarbon, calibrated
1520	8268	8022	8443	Radiocarbon, calibrated
1640	11636	11264	12027	Radiocarbon, calibrated
1725	13864	13646	14218	Radiocarbon, calibrated

3.10 Table: CollectionTypes

This table is a lookup table of for types of Collection Units, or Collection Types. Table is referenced by the CollectionUnits table.

Table: CollectionTypes			
CollTypeID	Long Integer	PK	
CollType	Text		

CollTypeID (Primary Key): An arbitrary Collection Type identification number.

Colltype: The Collection Type. Types include cores, sections, excavations, and animal middens. Collection Units may be modern collections, surface float, or isolated specimens. Composite Collections Units include different kinds of Analysis Units, for example a modern surface sample for ostracodes and an associated water sample.

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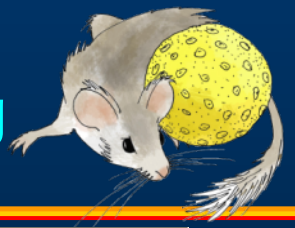

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Samples | Diagram | Site

Number of Sample Records: 82 Copy

Name	Group	Element	Units	Context	Modif					
AnalysisUnitNam										
Depth						2053	2060	2070	2080	20
Thickness										
Sample Name										
Sample ID						27907	27909	27911	27913	27
Chron:Allen et a		Age	Radio			1	77	184	292	40
Chron:Allen et a		Age Younger	Radio							
Chron:Allen et a		Age Older	Radio							
Alnus	TRSH	pollen	NISP			2		2	2	4
Amaranthaceae	UPHE	pollen	NISP					1		
Apiaceae	UPHE	pollen	NISP			12	1	8	13	10
Armeria	UPHE	pollen	NISP						1	
Artemisia	UPHE	pollen	NISP				3	1		5
Asteraceae subf.	UPHE	pollen	NISP			7	1	1	2	
Asteraceae subf.	UPHE	pollen	NISP			4	1	4	2	1
Betula/Corylus/N	TRSH	pollen	NISP			2				
Betula	TRSH	pollen	NISP			66	195	180	83	80
Brassicaceae	UPHE	pollen	NISP			1			1	1
Buxus	TRSH	pollen	NISP							
Campanula	UPHE	pollen	NISP							
Cannabis sativa	UPHE	pollen	NISP							
Caryophyllaceae	UPHE	pollen	NISP			2		1		
Castanea	TRSH	pollen	NISP			3	1			
Corylus	TRSH	pollen	NISP			5	5	2	3	10
Cyperaceae	UPHE	pollen	NISP			6	3	3	6	5
Cystopteris	VACR	spore	NISP			1				
Diphasiastrum a	VACR	spore	NISP							
Dipsacaceae	UPHE	pollen	NISP							
Dryopteris	VACR	spore	NISP				1	1	1	1
Ephedra	TRSH	pollen	NISP							

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Samples | Site

Number of Sample Records: 6 Copy

Depth	Thickness	GeochronType	Age	ErrorOlder	ErrorYounger	Delta13C	LabNumber	Mate
2160	10	Carbon-14: conv	3840	110	110		Beta-9154	Brown
2435	10	Carbon-14: conv	6800	90	90		Beta-9155	Brown
2470	10	Carbon-14: conv	9650	120	120		Beta-9156	Orga
2480	10	Carbon-14: conv	9780	80	80		Beta-6739	Orga
2610	10	Carbon-14: conv	12610	90	90		Beta-9157	Orga
2660	10	Carbon-14: conv	14270	180	180		Beta-6740	Orga

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Samples | Diagram | Site | Chronology

Site Metadata

SiteName	Lago de Ajo
Longitude	-6.150000095367432
Latitude	43.04999923706055
SiteDescription	Lake dammed in 1915 for hydroelectric. Physiography: On limestone at the head of the valley. Surrounding vegetation: Pasture, Quercus scrub, beech woodland.
Altitude	1570
Contacts	Watts, William A.
Notes	

Publications

Allen, J.R.M., B. Huntley, and W.A. Watts. 1996. The vegetation and climate of northwest Iberia over the last 14,000 years. Journal of Quaternary Science 11:125-147.

McKeever, M.H. 1984. Comparative palynological studies of two lake sites in western Ireland and northwestern Spain. Thesis. Trinity College, Dublin, Ireland.

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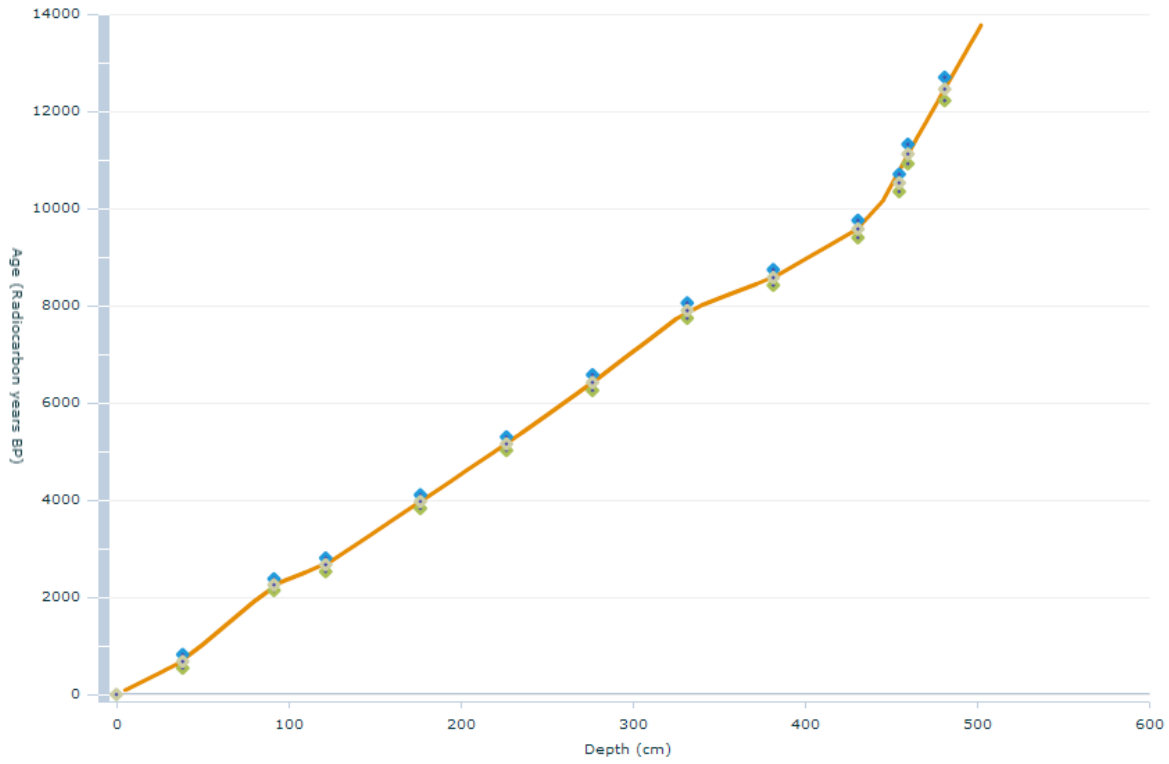
Samples Diagram Site Chronology

Default Chronologies: Radiocarbon years BP



Chronology Name	Oak default
Date Prepared	
Age Model	Linear Interpolation
Younger Age	80
Older Age	13770

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Samples | Diagram | Site | Chronology

Number of Sample Records: 82 Copy

Name	Group	Element	Units	Context	Modif				
AnalysisUnitNam									
Depth						2053	2060	2070	2080
Thickness									
Sample Name									
Sample ID						27907	27909	27911	27913
Chron:Allen et a		Age	Radio			1	77	184	292
Chron:Allen et a		Age Younger	Radio						
Chron:Allen et a		Age Older	Radio						
Alnus	TRSH	pollen	NISP			2		2	2
Amaranthaceae	UPHE	pollen	NISP					1	
Apiaceae	UPHE	pollen	NISP			12	1	8	13
Armeria	UPHE	pollen	NISP						1
Artemisia	UPHE	pollen	NISP				3	1	
Asteraceae subf.	UPHE	pollen	NISP			7	1	1	2
Asteraceae subf.	UPHE	pollen	NISP			4	1	4	2
Betula/Corylus/N	TRSH	pollen	NISP			2			
Betula	TRSH	pollen	NISP			66	195	180	83
Brassicaceae	UPHE	pollen	NISP			1			1
Buxus	TRSH	pollen	NISP						
Campanula	UPHE	pollen	NISP						
Cannabis sativa	UPHE	pollen	NISP						
Caryophyllaceae	UPHE	pollen	NISP			2		1	
Castanea	TRSH	pollen	NISP			3	1		
Corylus	TRSH	pollen	NISP			5	5	2	3
Cyperaceae	UPHE	pollen	NISP			6	3	3	6
Cystopteris	VACR	spore	NISP			1			
Diphasiastrum a	VACR	spore	NISP						
Dipsacaceae	UPHE	pollen	NISP						
Dryopteris	VACR	spore	NISP				1	1	1
Ephedra	TRSH	pollen	NISP						

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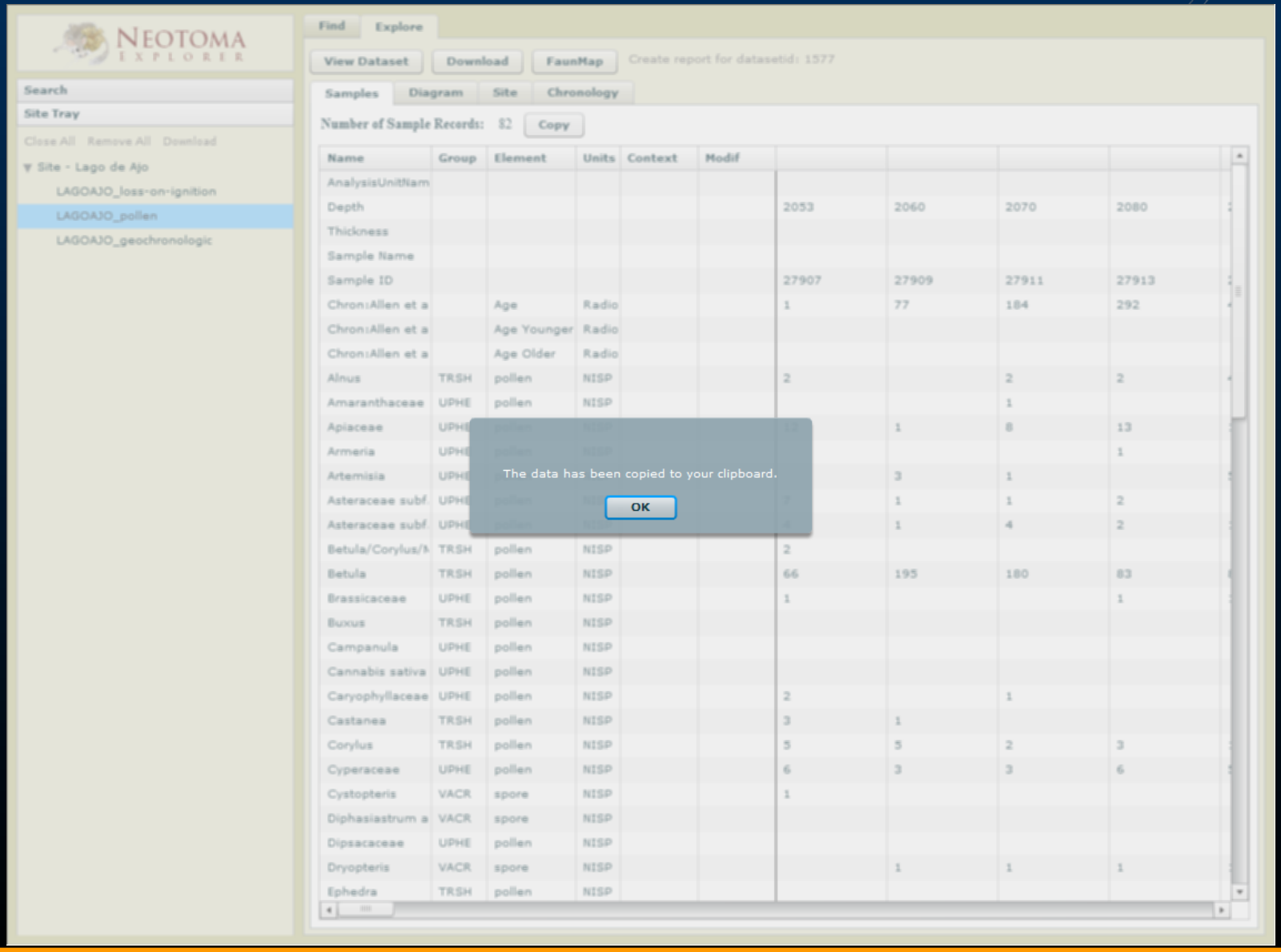

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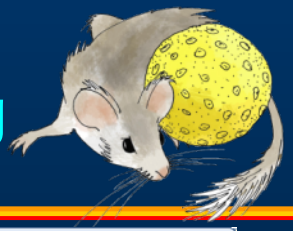

Book1 - Microsoft Excel

Home | Insert | Page Layout | Formulas | Data | Review | View | Developer | Add-Ins | Acrobat

Cut | Copy | Format Painter | Paste | Clipboard

Calibri | 11 | Font

Wrap Text | Merge & Center | Alignment

General | Number

Conditional Formatting | Format as Table | Cell Styles | Styles

Insert | Delete | Format | Cells

AutoSum | Fill | Clear | Sort & Filter | Find & Select | Editing

A1 | Name

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1	Name	Group	Element	Units	Context	Modif	1	2	3	4	5	6	7	8	9	10	11	12	1
2	AnalysisUnitName																		
3	Depth						2053	2060	2070	2080	2090	2100	2110	2120	2130	2153	2160	2170	218
4	Thickness																		
5	Sample Name																		
6	Sample ID						27907	27909	27911	27913	27915	27917	27919	27921	27923	27925	27927	27929	2793
7	Chron:Allen et al. 19		Age	Radiocarbon years BP			1	77	184	292	400	507	615	722	830	1078	1153	1261	136
8	Chron:Allen et al. 19		Age Young	Radiocarbon years BP															
9	Chron:Allen et al. 19		Age Older	Radiocarbon years BP															
10	Alnus	TRSH	pollen	NISP			2		2	2	4	4	1	2		4		2	
11	Amaranth	UPHE	pollen	NISP					1				1	2	2			1	
12	Apiaceae	UPHE	pollen	NISP			12	1	8	13	10	2	6	1	3				
13	Armeria	UPHE	pollen	NISP						1									
14	Artemisia	UPHE	pollen	NISP				3	1		5	4		1	9	1	2	4	
15	Asteracea	UPHE	pollen	NISP			7	1	1	2		2	1	2	3				
16	Asteracea	UPHE	pollen	NISP			4	1	4	2	1	2	2	2	1	2		2	
17	Betula/Co	TRSH	pollen	NISP			2						1	1				1	
18	Betula	TRSH	pollen	NISP			66	195	180	83	80	55	96	61	26	58	60	29	2
19	Brassicace	UPHE	pollen	NISP			1			1	1	1		1	2			1	
20	Buxus	TRSH	pollen	NISP															
21	Campanul	UPHE	pollen	NISP															
22	Cannabis	UPHE	pollen	NISP										1	1				
23	Caryophyl	UPHE	pollen	NISP			2		1			1	2		1	1	1		
24	Castanea	TRSH	pollen	NISP			3	1				3			1	1	1		
25	Corylus	TRSH	pollen	NISP			5	5	2	3	10	10	13	26	4	16	7	12	1
26	Cyperacea	UPHE	pollen	NISP			6	3	3	6	5	9	2	11	6	4	1	2	
27	Cystopter	VACR	spore	NISP			1												
28	Diphasias	VACR	spore	NISP															
29	Dipsacace	UPHE	pollen	NISP									1						
30	Dryopteri	VACR	spore	NISP				1	1	1	1			1					
31	Ephedra	TRSH	pollen	NISP															
32	Epilobium	UPHE	pollen	NISP							1								

Sheet1 | Sheet2 | Sheet3

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Samples | Diagram | Site | Chronology

Number of Sample Records: 82 Copy

Name	Group	Element	Units	Context	Modif				
AnalysisUnitNam									
Depth						2053	2060	2070	2080
Thickness									
Sample Name									
Sample ID						27907	27909	27911	27913
Chron:Allen et a		Age	Radio			1	77	184	292
Chron:Allen et a		Age Younger	Radio						
Chron:Allen et a		Age Older	Radio						
Alnus	TRSH	pollen	NISP			2		2	2
Amaranthaceae	UPHE	pollen	NISP					1	
Apiaceae	UPHE	pollen	NISP			12	1	8	13
Armeria	UPHE	pollen	NISP						1
Artemisia	UPHE	pollen	NISP				3	1	
Asteraceae subf.	UPHE	pollen	NISP			7	1	1	2
Asteraceae subf.	UPHE	pollen	NISP			4	1	4	2
Betula/Corylus/N	TRSH	pollen	NISP			2			
Betula	TRSH	pollen	NISP			66	195	180	83
Brassicaceae	UPHE	pollen	NISP			1			1
Buxus	TRSH	pollen	NISP						
Campanula	UPHE	pollen	NISP						
Cannabis sativa	UPHE	pollen	NISP						
Caryophyllaceae	UPHE	pollen	NISP			2		1	
Castanea	TRSH	pollen	NISP			3	1		
Corylus	TRSH	pollen	NISP			5	5	2	3
Cyperaceae	UPHE	pollen	NISP			6	3	3	6
Cystopteris	VACR	spore	NISP			1			
Diphasiastrum a	VACR	spore	NISP						
Dipsacaceae	UPHE	pollen	NISP						
Dryopteris	VACR	spore	NISP				1	1	1
Ephedra	TRSH	pollen	NISP						

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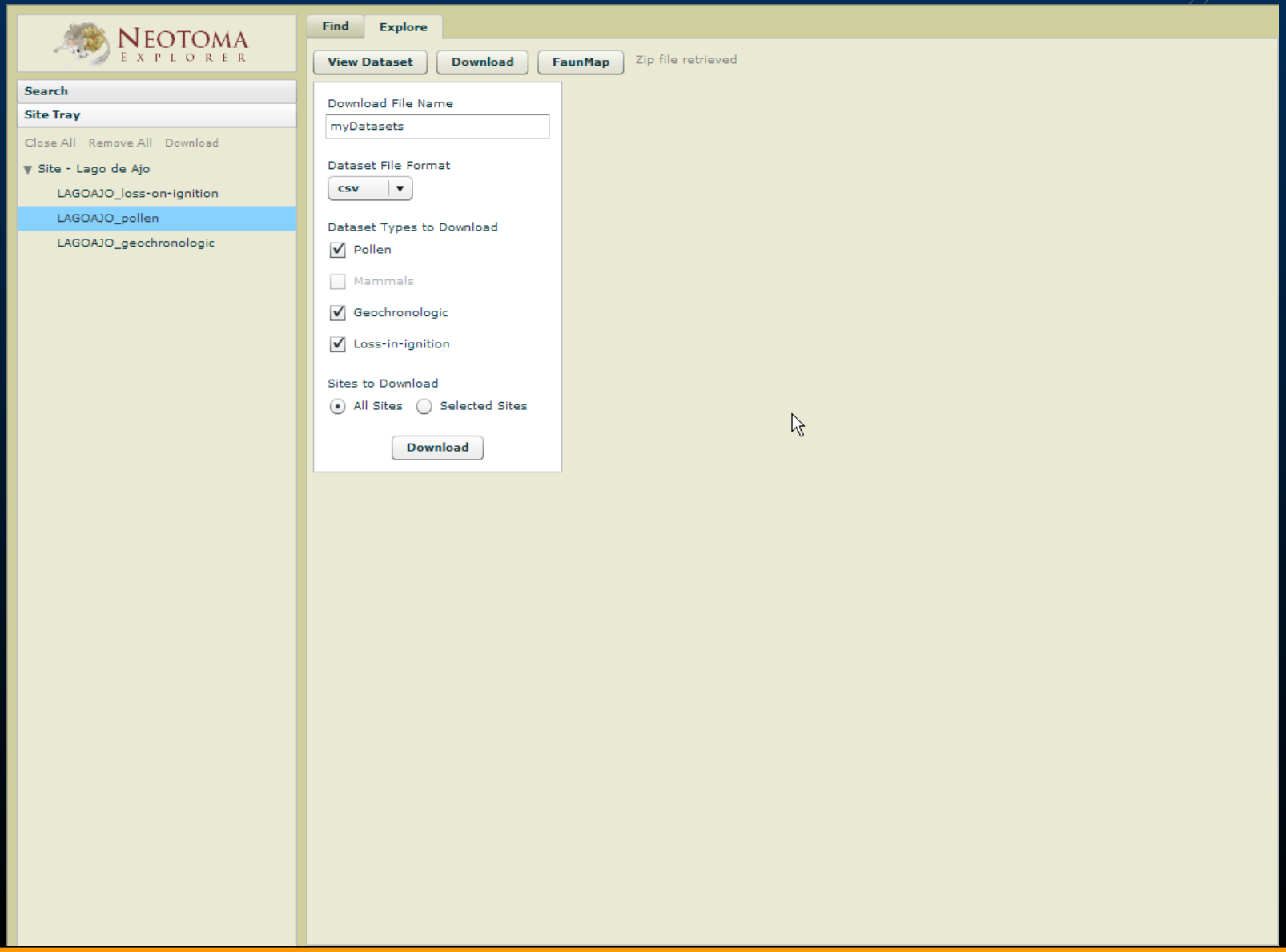

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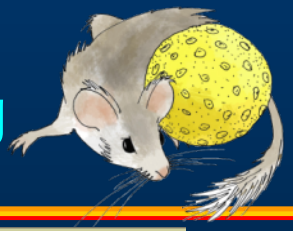

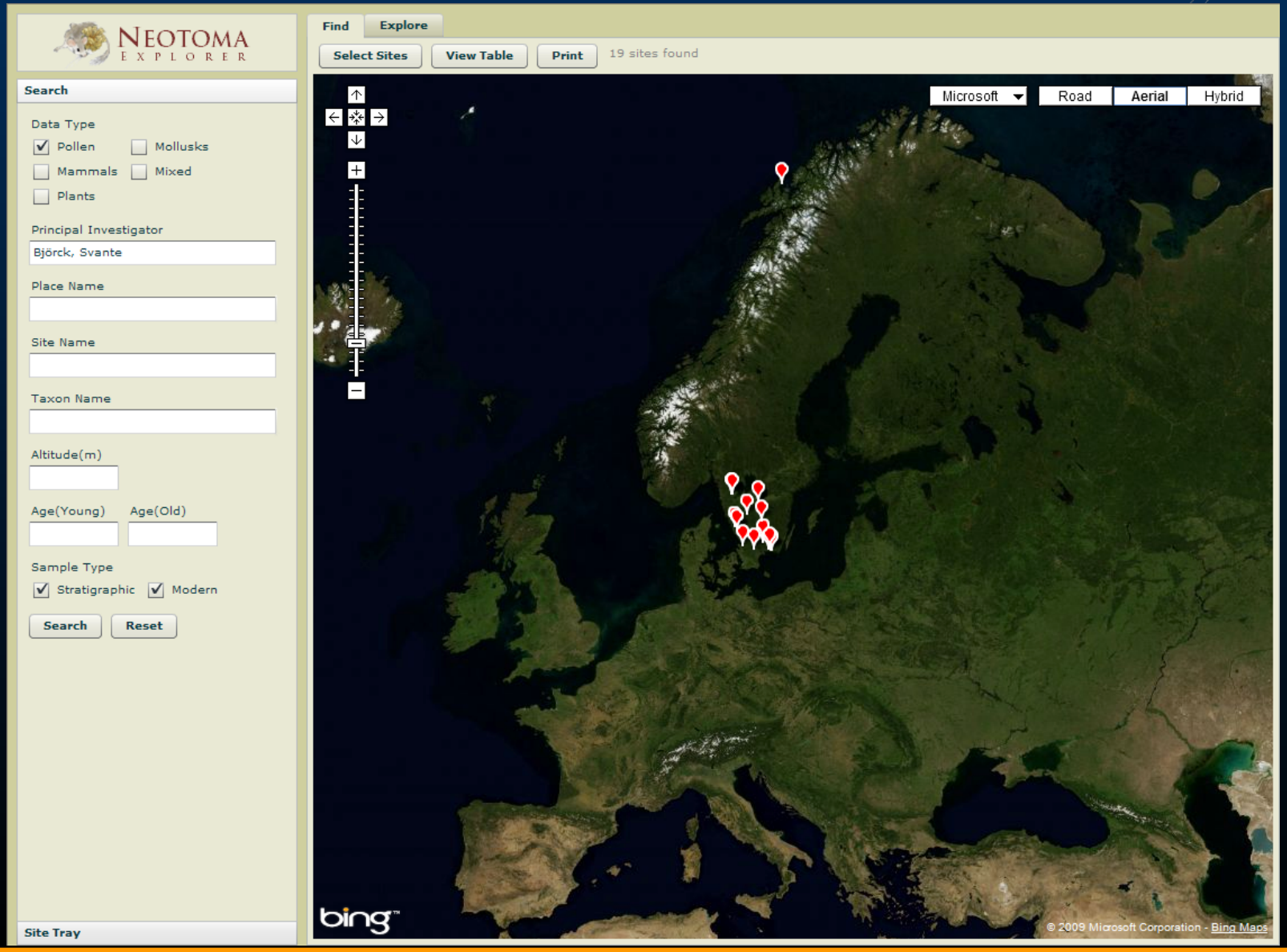

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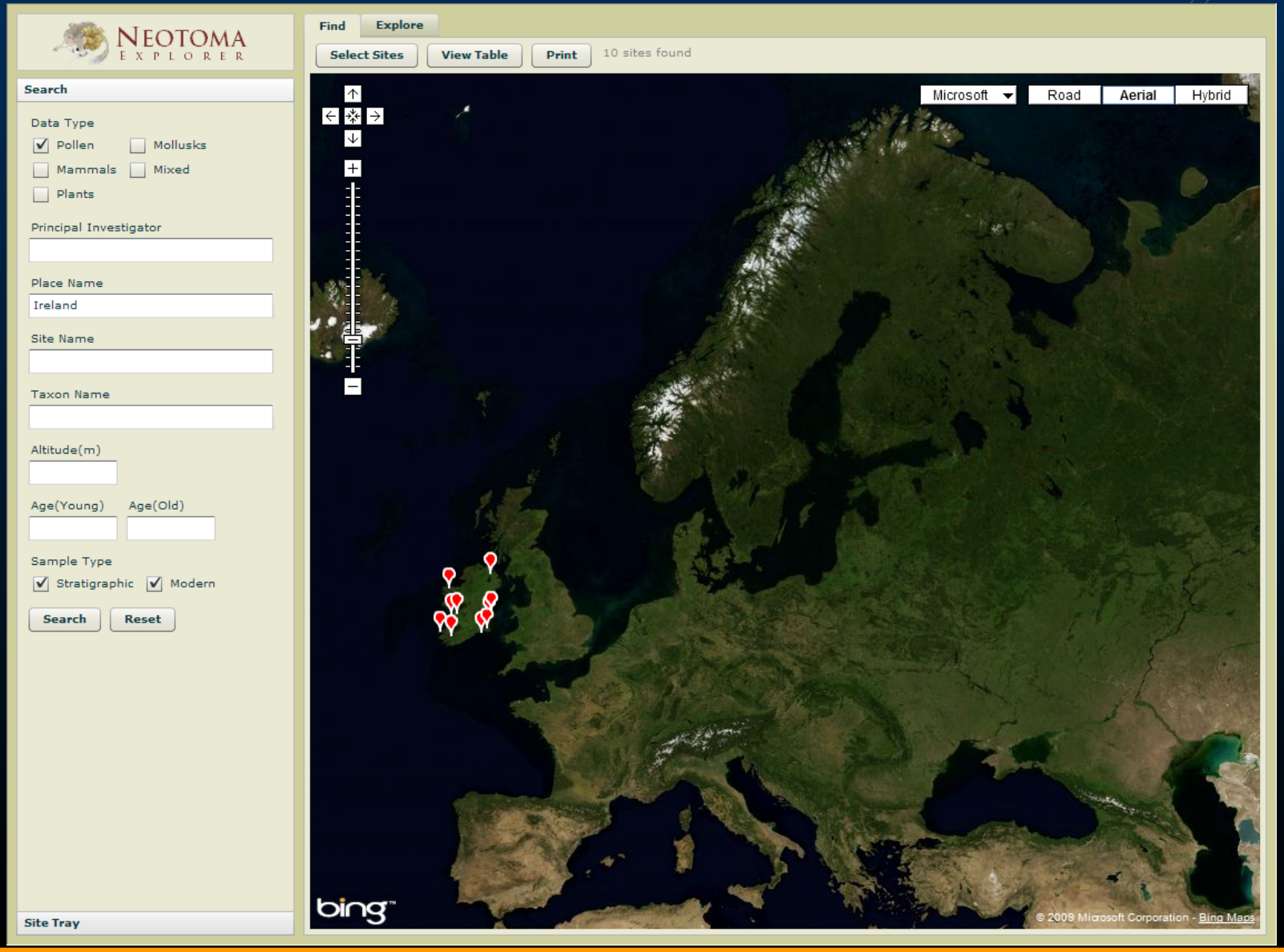

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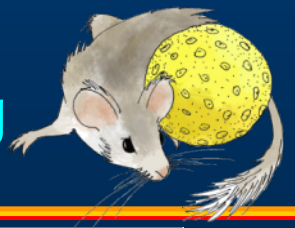

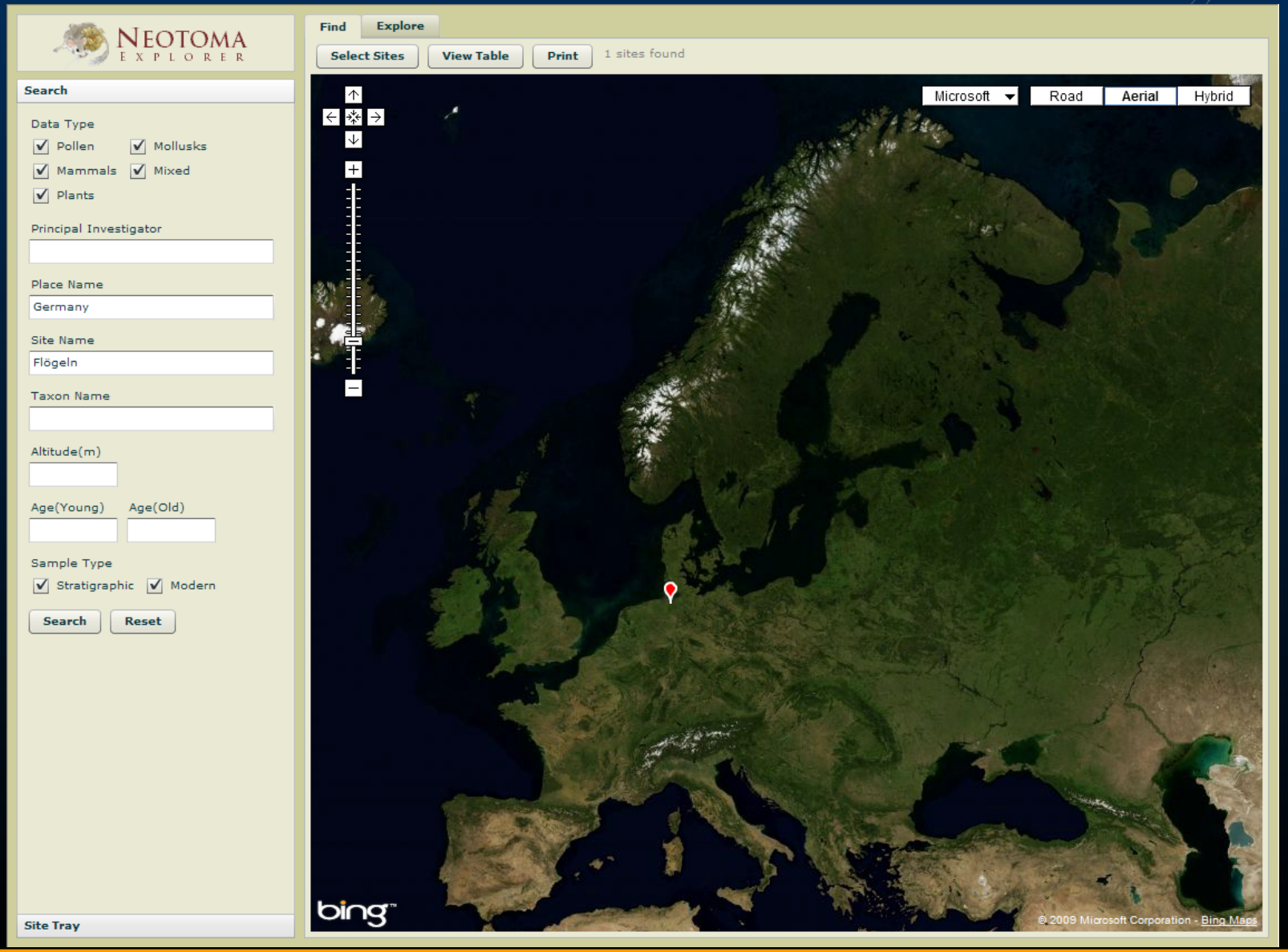

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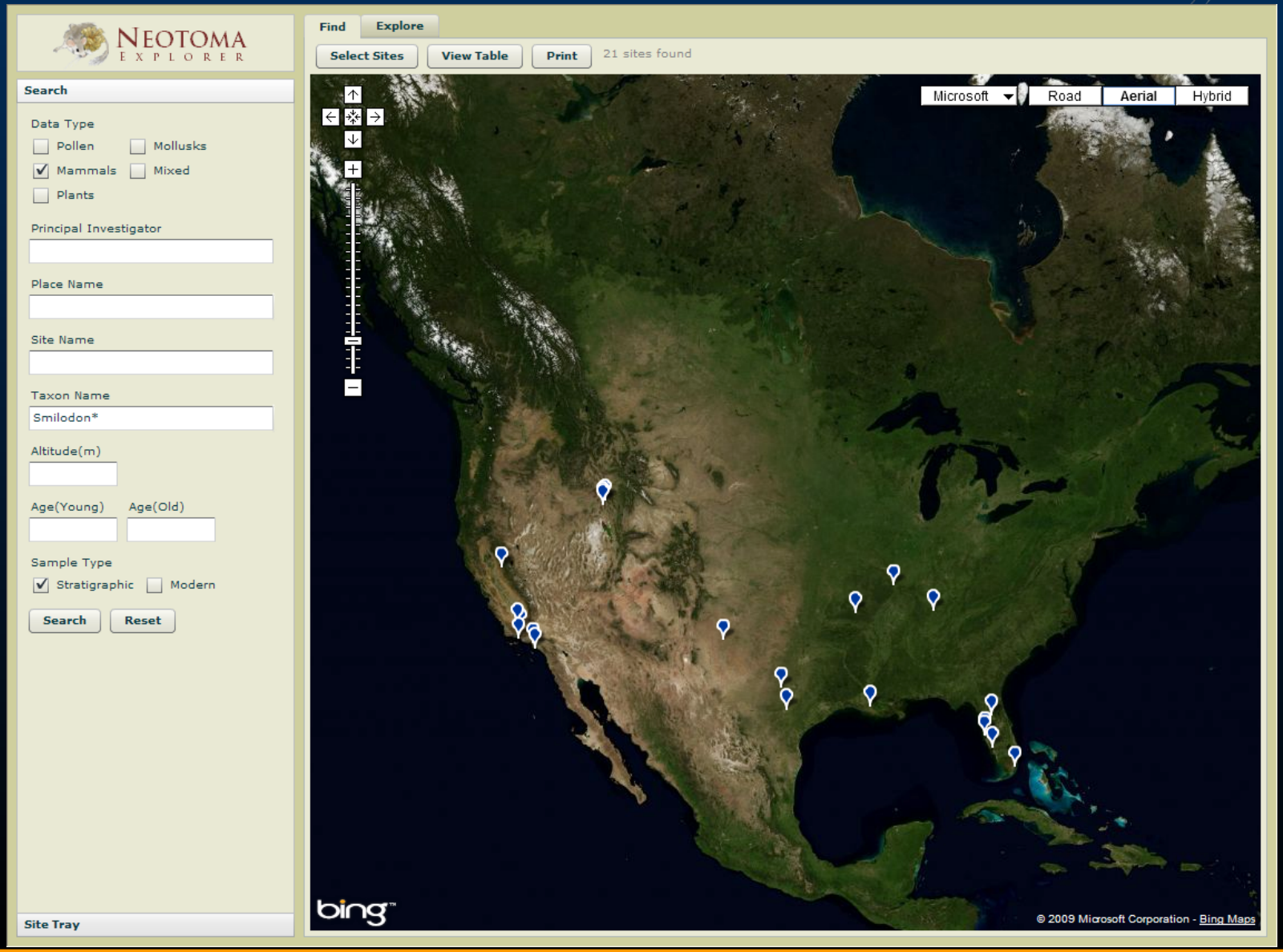
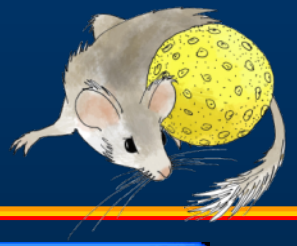


Data Steward Tools: Input



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Data | Metadata

	A	B	C	D	E	F	G	H	I	J	K	L
1	Pollen			650	662	670	680	690	702	710	714	
2												
3	#Analyst	Analyst		Grimm, E.C	Grimm, E.C	Grimm, E.C	Grimm, E.C	Grimm, E.C	Grimm, E.C	Grimm, E.C	Grimm, E.C	Grimm
4	#DateAnal	Date analyzed		4/1/1978	5/16/1978	2/27/1978	11/16/197	4/3/1978	4/16/1978	3/18/1978	4/25/1978	5/1/1
5	#Thick	Sample thickness		0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
6	#Chron1	Sample age (COHMAP chror		0	21	36	54	71	93	336	571	
7	#Chron2	Sample age (NAPD 1)		-25	-13	0	22	46	72	87	97	
8	Abi	Abies	TRSH	0	0.5	0	0	1.5	0	0	0	
9	Ace.sa-t	Acer saccharum-type	TRSH	26	16	8	30.5	16	15	18	29.5	
10	Ace.ne	Acer negundo	TRSH	9	6	4	9	1	1	2	5	
11	Ace.ru	Acer rubrum	TRSH	0	1	0	1	0	0	3	1	
12	Ace.sc-t	Acer saccharinum-type	TRSH	3	3	3	0	2	0	0	0	
13	Adi	Adiantum	VACR	0	0	0	0	0	0	0	0	
14	All	Allium	UPHE	0	0	0	0	0	0	0	0	
15	Aln.i-t	Alnus incana-type	TRSH	6	7	4	3	9	5	8	6	
16	Aln.vi-t	Alnus viridis-type	TRSH	2	0	0	0	0	0	2	2	
17	Aln.ud	Alnus undiff.	TRSH	1	0	0	0	0	0	0	0	
18	Amb-t	Ambrosia-type	UPHE	83	112	109	100	103	79	29	25	
19	Amo-t	Amorpha-type	UPHE	0	0	0	0	1	0	0	3	
20	Art	Artemisia	UPHE	12	12	6	17	13	7	13	19	
21	Ath	Athyrium	VACR	0	0	0	1	2	0	3	2	

Counts | Percents

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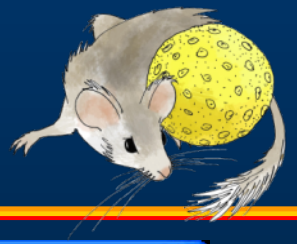

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Data | Metadata

Site | Collection Unit | Dataset | Geochronology | Age Models | Lithology | LOI | Contacts | Publications

±1 Sigma | Older/Younger

Method	Age Units	Depth (cm)	Thickness (cm)	Lab Number	Age	SD	>	Delta13C	Material Dated	Publication
*	Click here to add a new row									
Carbon-14: pr...	Radiocarbon years B.P.	715	10	WIS-1002	630	55	☐	-28.5	silty gyttja	
Carbon-14: pr...	Radiocarbon years B.P.	750	10	WIS-1033	800	60	☐	-29.8	silty gyttja	
Carbon-14: pr...	diocarbon years B.P.	785	10	WIS-1003	920	60	☐	-31.4	gyttja	
Carbon-14: pr...		975	10	WIS-1005	2790	65	☐	-29.4	gyttja	
Carbon-14: pr...		1065	10	WIS-1006	3705	60	☐	-27.4	gyttja	
Carbon-14: pr...		1135	10	WIS-1007	4030	75	☐		gyttja	
Carbon-14: pr...		1345	10	WIS-1008	5640	70	☐	-25.1	silty gyttja	
Carbon-14: pr...	Radiocarbon years B.P.	1415	10	WIS-1623	6580	80	☐		silty gyttja	
Carbon-14: pr...	Radiocarbon years B.P.	1520	10	WIS-1624	7990	110	☐		silty gyttja	
Carbon-14: pr...	Radiocarbon years B.P.	1640	10	WIS-1625	10600	110	☐		silty gyttja	
Carbon-14: pr...	Radiocarbon years B.P.	1774	8	WIS-1034	12060	125	☐	-27.2	wood, needle...	

Calendar years AD/BC
Calendar years B.P.
Calibrated radiocarbon years B.P.
Radiocarbon years B.P.
Varve years B.P.

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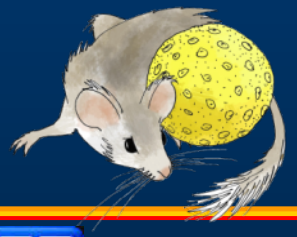
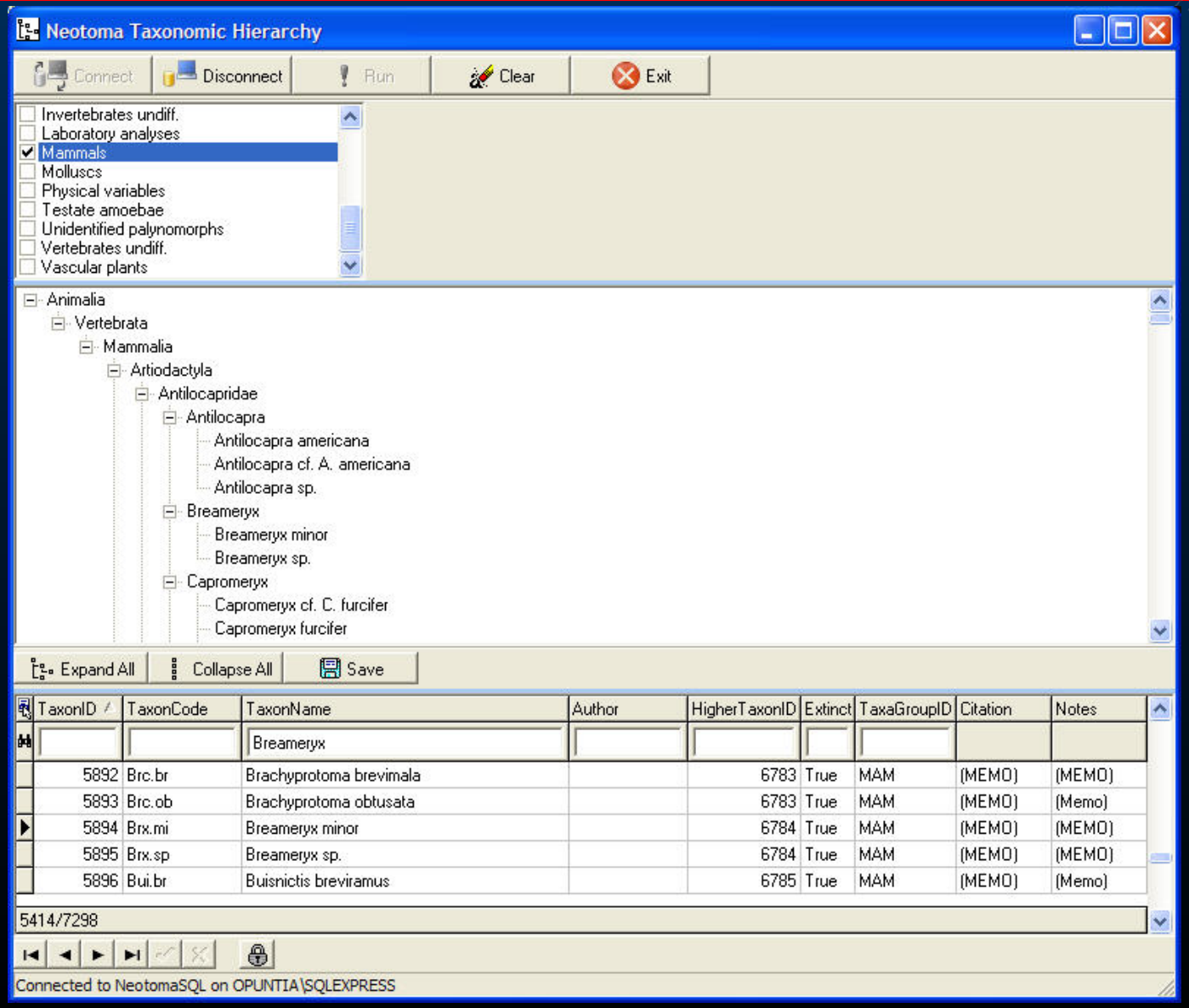
Data Steward Tools: Update





The Holy Grail

A multiproxy paleodatabase assessable programmatically via the Internet, so anybody can build desktop or web-based software tools to securely access the central up-to-date database, and independent data stewards from various database cooperatives can upload and update data.