

Title:

**REVIVING THE LATIN AMERICAN POLLEN DATABASE (LAPD):
Completion of the pollen site list of Latin America, update of the LAPD
website and promoting new pollen data contributions.**

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REPORT

INTRODUCTION

The Research group Palaeoecology and Landscape Ecology of IBED is one of the main contributors of the palynological science in Latin America, and specifically in Colombia where up to today most Latin American pollen sites are found (Van Boxel and Flantua, 2009). The group supported and contributed to the launch of the Latin American Pollen Database (LAPD) in 1994 with a corresponding website where palynologists were encouraged to share their data and many indeed have. However, the website and related database lacked updates since 2003, due to lack of maintenance. Thanks to a grant of the Hugo de Vries Fonds (van Boxel & Flantua, 2009) a preliminary list of all Latin American pollen sites, "LAPD 2009", became available, which was completed with a second HdV-grant resulting in the LAPD 2010 list of pollen sites. As was already observed when composing the LADP 2009, many pollen sites have been published throughout Latin America, but that the lack of maintenance of the LAPD website have made it a "static" source of information where no new sites were admitted since 2003.

AIMS OF THE PROJECT

The stated aims of this project were:

- 1) Complete the list of pollen sites of Latin America 2009;
- 2) Revise, update and reopen LAPD website;
- 3) Promote the collective pollen data base of the LAPD website and information sharing on palynological project advances and other activities.
- 4) Submit data to the LAPD site

First of all the list of pollen sites per country was completed, with the list of corresponding references / publications during 1956-2010. Results are presented below.

During the preparations of this project, IBED was informed that the LAPD website had been retaken by the initial founder of the database, namely Eric Grimm. The LAPD was now being introduced into a new database, called NEOTOMA with its corresponding website and supporting scientific and technical team. The objectives 2, 3 and 4 of this project therefore became entangled with the activities of the NEOTOMA project. In continuation a brief overview of the history of LAPD will be provided in which NEOTOMA will be introduced. Secondly, the results will be described of the final update of the LAPD pollen list, version 2010. After that the advances and activities of the IBED researcher S. Flantua within the NEOTOMA project will explained. The report will be finished with a set-up plan for the future activities and requirements of the LAPD within the NEOTOMA website to guaranty its continuity.

HISTORY OF THE LAPD 1994-2010

LAPD 1994-1997

The LAPD was initiated by Vera Markgraf and Eric Grimm (Markgraf et al., 1997) following funding from the NOAA Paleoclimatology program in August 1994. An organizing workshop brought together a number of scientists to develop the database that was constructed with the help of John Keltner at the World Data Center-A (WDC-A) for Paleoclimatology, Boulder, Colorado. By mid-1997, the list of Latin American pollen sites reached a total of 463 sites from which the data of 93 sites had been submitted to the LAPD.

LAPD 1997-2003

The coordinator's torch was then passed to Robert Marchant and Guido Van Reenen at the University of Amsterdam. Database tables of the different sites were made available online (last update July-1998). Several newsletters were written (Volume 1-3: 2001-2003) and international workshops were organized. However, after 1997 no new pollen sites or publications were added to the LAPD *pollen list*. The last update of the LAPD *website* occurred in September 2003.

LAPD 2003-2009

No further updates for the LAPD were done during this period. However, Dr. J.C. Berrio at the University of Leicester (also previously employed at the University of Amsterdam) and Dr. R. Marchant (currently at the University of York) continued to work with pollen data, having information on the meta data of several new sites with access to additional data.

Eric Grimm (the founder of the LAPD) started in 2007 as one of the main developers of a 2-year development project called NEOTOMA, lead by the Illinois State Museum Society and the Pennsylvania State University. The NEOTOMA was aimed to be an interactive, multiproxy database for a wide variety of paleo data types, designed with the adequate cyberinfrastructure to manage large datasets with overall easy access and analysis tools to explore, visualize and compare data.

LADP 2009

Thanks to a grant of the Hugo de Vries Fonds (van Boxel & Flantua, 2009), a first update could be accomplished on the LAPD, enlarging the number of pollen sites of the 1997 list from 463 to 773, representing a 67% increase.

In the meantime, NEOTOMA had become an international collaborative effort among individuals from 23 institutions worldwide and was now the new foundation of the Global Pollen Database and the FAUNMAP I Database. The LAPD however was only introduced partially due to the lack of an organized database cooperative. The NEOTOMA website was launched (<http://www.neotomadb.org/>) in which the NEOTOMA explorer provides a map-based interface to the data. During 2009 a 5-year project proposal for the continuation of NEOTOMA was granted by National Science Foundation. During the next phase, several new constituent database cooperatives from North America, Europe, Africa, and Asia join NEOTOMA, and several new data types are incorporated, including diatoms, ostracodes, insects, and testate amoebae.

LADP 2010

Thanks to a grant of the Hugo de Vries Fonds (Flantua & Van Boxel, 2010), a second LAPD update was concluded, gaining another 201 pollen sites to the database and achieving a total of 947 sites in Latin America. This final recorded number of pollen sites represents a doubling of the LAPD list since the last 1997 listing.

A first workshop is organised in September 2010 by the NEOTOMA group (Blois et al. 2011) to define tool development and data acquisition while focusing on the scientific and educational application of the integrated database. The LAPD 2010 is presented by S. Flantua in the workshop. In the specific case of the LAPD, the lack of original pollen data (counts) to the database, the different ways to stimulate contributions and copyright of the data are discussed.

RESULTS

OBJECTIVE 1: Complete the list of pollen sites of Latin America 2009;

By searching for new publications in the Digital Database of the University of Amsterdam, and the follow-up of references within publications, the total number of recorded pollen sites increased to 974. Table 1. shows the list of pollen sites per country for the different versions of the LAPD. The majority were found in Colombia and Brazil.

Of the 22 countries in Latin America, 9 countries are from Central America and the Caribbean while the remaining 13 are from South America. A total 81% of all sites are found in the southern hemisphere.

Eleven pollen sites are from the United Kingdom. These sites are found on islands in the South Atlantic, like the Falkland Islands and South Georgia. Although some of them are in the direct proximity of Argentina and Antarctica (and therefore claimed by Argentina), they are administrated by the UK.

Country	1997	2009	2010
Antarctica	0	1	2
Argentina	61	120	144
Belize	1	1	3
Bolivia	18	44	59
Brazil	30	83	149
Chile	83	99	115
Colombia	136	156	164
Coste Rica	12	59	68
Cuba	0	0	1
Dominican Republic	0	0	4
Ecuador	22	41	44
El Salvador	0	0	2
French Guayan	0	0	1
Guatamala	5	11	13
Guyana	3	3	4
Haiti	0	0	2
Mexico	30	48	61
Panama	7	21	30
Peru	18	45	63
United Kingdom	11	11	11
Uruguay	0	0	1
Venezuela	26	30	33
Total	463	773	974

Table 1. Pollen sites per country and per LAPD version. Countries are in alphabetic order.

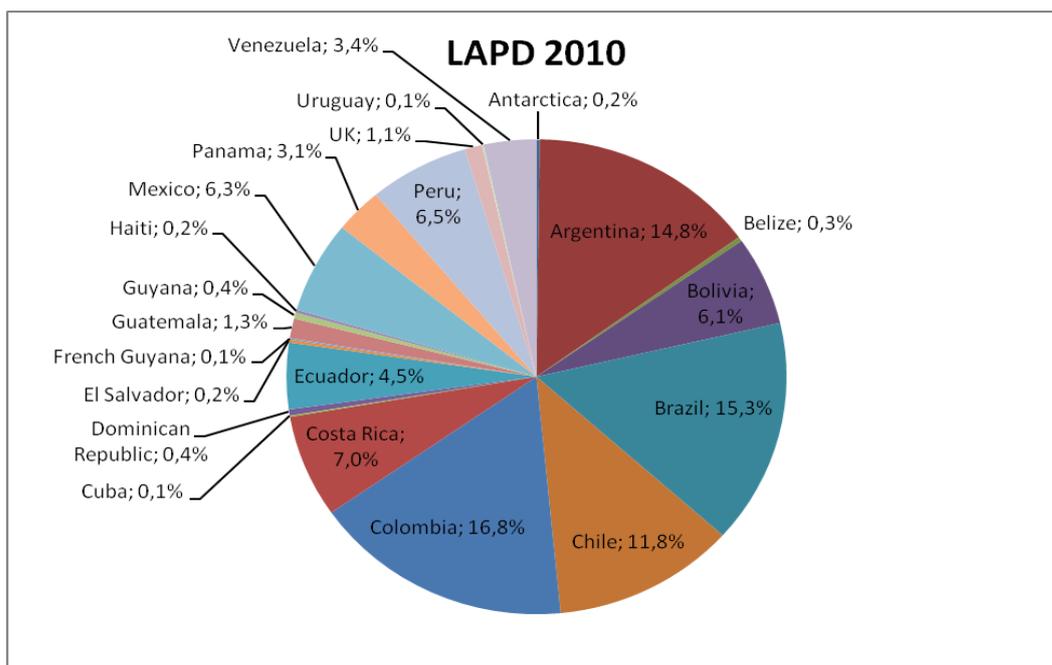


Figure 1. LAPD 2010: Distribution of the pollen sites per country represented in percentages

Figure 1. shows the distribution of the pollen sites per country. The country with highest number of pollen sites still is Colombia with 17% of the sites, although much more pollen sites from Brazil and Argentina have been recorded through the 2009 and 2010 updates. One of the countries of highest increase has been Brazil were a total of 66 new publications were found from the past decades, along with 24 for Argentina and 18 for Peru (Figure 2). Brazil now is the country with the second highest amount of most pollen sites, taking over this second position from Argentina (Van Boxel & Flantua 2009). For the first time pollen sites from Cuba, Dominican Republic, El Salvador, French Guyana, Haiti and Uruguay have become available.

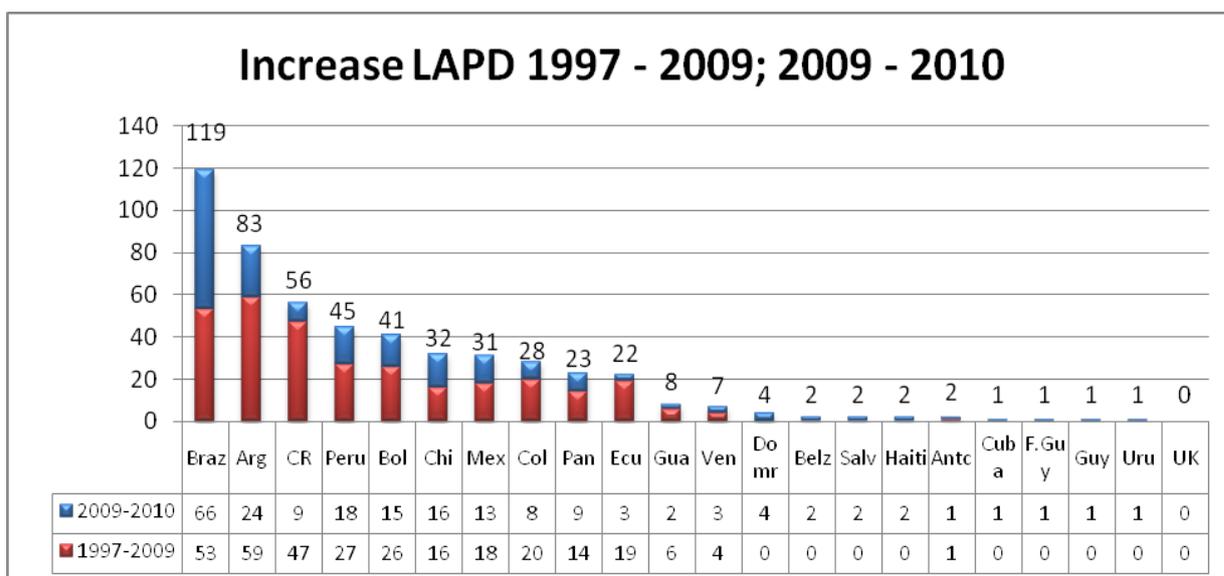


Figure 2. Number of pollen sites added to the LAPD 1997 thanks to 2009 update (First HdV grant) and the 2010 update (Second HdV grant). Countries are in order of number of newly acquired pollen sites.

BRAZ: Brazil; ARG: Argentina; CR: Costa Rica; CHI: Chile; MEX: Mexico; COL: Colombia; PAN: Panama; ECU: Ecuador; GUA: Guatamala; VEN: Venezuela; DOMR: Dominican Republic; BELZ: Belize; SALV: Salvador; HAITI: Haiti; ANTC: Antarctica; CUBA: Cuba; F.GUYA: French Guayana; GUY: Guayana; URU: Uruguay; UK: United Kingdom.

The main difference between the LAPD 2009 and 2010 has been the discovery of a series of pollen studies on the Caribbean islands, such as Haiti and Cuba. Most studies were published in the last five years and could indicate a tendency of exploring new areas in the Caribbean region. Largest relative increases in number of pollen sites through the 2009 and 2010 updates, are seen for Costa Rica (quadrupling of number of sites) and Brazil (tripling of number of sites).

OBJECTIVE 2: Revise, update and reopen LAPD website

Although the LAPD website under NOAA's management is still active and accessible (<http://www.ncdc.noaa.gov/paleo/lapd.html>), the NEOTOMA project, in which a part of the LAPD already has been imported, has been developed with an greatly improved database structure and corresponding website (<http://www.neotomadb.org/>). The data base and its NEOTOMA map Explorer are aimed to simplify cross-disciplinary multiproxy analyses and common software tools have been developed for data ingest, display, discovery, analysis and distribution. As part of this IBED-project was updating and promoting the LAPD website, it was decided to become an active member of the NEOTOMA working groups for coordination, planning, and conceptual development of the NEOTOMA database and website. The five-year project is currently in its first year and is in the phase of ingesting new individual datasets, development of Analysis/visualization tools/plugins and enhancing the NEOTOMA Explorer (map representation of the database), among others. For this purpose in September 2010, S. Flantua participated in a Database workshop (Blois et al., 2011) which aimed to set priorities for tool development and data acquisition and furthermore focused on scientific projects that exploit the power of the integrated database. The four-day workshop at the Penn State Conference Center at the University of Madison, USA, include breakout sessions for various taxonomic groups, constituent database cooperatives, and working groups, as well as plenary sessions for database-wide issues. The workshops furthermore included software training sessions for database developers and users. Along with the responsible researchers for the Programming Interfaces, the information technology (IT) professionals and the initial collaborators of the project, other key persons from constituent database projects were present, such as the Pollen Data Base of North-America, Europe and Japan.

Currently S. Flantua is an active member of the Geospatial group, and Tools and Visualization Development group, aiming to enhance the NEOTOMA Explorer interface and NEOTOMA website. Although both active and accessible, they do not represent the entire NEOTOMA database as data is still being prepared for input and the mentioned groups are continuously in process of improving analysis tools, data contribution facilitation and data visualization. S. Flantua aims to continue her contribution in discussions on database and website improvements, and the development of open forums for researchers and student communities.

OBJECTIVE 3: Promote the collective pollen database of the LAPD website and information sharing on palynological project advances and other activities

During the workshop contact was established with two Latin American researchers in the paleoecology, namely José Prado from Argentina and Claudio LaTorre from Chile. Although professionals in other area of paleoecology namely mammals and rodents, the overall representation of the paleo-data of Latin America was thoroughly discussed. In the case of Pollen, the possibilities of organizing a NEOTOMA workshop were considered for the coming year 2011. For now, the countries considered to be able to provide the start-up of a new LA-NEOTOMA (pollen) workgroup were Colombia and Argentina, assuming a shared responsibility in leading and promoting the NEOTOMA database and website focusing on the

Latin American contribution of paleo-data. IBED has a vast share in the Pollen database of Colombia and as such can be of significant importance to the start-up of the LA NEOTOMA workgroup. Therefore a meeting was organized with the Colombian University Los Andes that has shown the interest, scientific knowledge and logistic capacity to be the base institute for the NEOTOMA LA Pollen Database. In this meeting the principal researcher of the Paleocology and Landscape Ecology Research Group of IBED, namely H. Hooghiemstra, C. Gonzalez, who is in charge of the Palynology and tropical Paleocology of the University Los Andes, and S. Flantua have discussed the needs and future prospects of a joint partnership to lead the NEOTOMA Latin America Paleocology Group. To be able to be this leading group, first of all a capacitating workshop in managing the NEOTOMA database must be completed. This component will be discussed in the following section.

OBJECTIVE 4: Submit data to the LAPD site

As several working groups were set up during the workshop, S. Flantua took part in the Pollen and Data Stewards/ Tilia group. The latter group is a fundamental part of NEOTOMA as it is meant to enable community data stewardship. Stewards chosen by the various constituent database projects will be able to enter new data into the database and update existing data over the Internet. A first introduction to the use of the program Tilia was provided in the workshop as data are currently prepared in this interface for input into the NEOTOMA database. A more detailed workshop on Tilia for Data Stewards took place in January 2011, in which S. Flantua received the training to manage and upload pollen data in the NEOTOMA database.

As part of the Pollen group, the necessities and data base priorities for the LAPD were discussed. It was suggested by S. Flantua that although of many Latin American pollen sites the raw data (pollen counts) are not (yet) available, they should still be present in the NEOTOMA Database and Explorer (map-interface within NEOTOMA). An adequate representation of pollen studies in Latin America on the map interface can be an excellent way to stimulate researchers to contribute their data while other researchers and students can become aware of existing pollen sites for project developments. Furthermore was suggested that the leading NEOTOMA institutions provide baseline material on NEOTOMA, such as information on database advantages and PowerPoint presentations, which can be used for NEOTOMA initiatives in other countries, congress presentations and future project proposals.

DISCUSSION

The final version of the LAPD, here presented as the “LAPD 2010”, is a rich list of almost 1000 pollen sites spread out over a total of 22 Latin American countries. The newly acquired pollen sites of Caribbean islands have been an interesting contribution to the database along with a significant input of Brazilian sites. The share of Colombia in the database remains the highest although more new pollen sites have been found in other countries. This list of sites with their corresponding metadata and original publications in digital format is essential for scientific research from broad-scale synoptic studies to understanding the context of local site studies. The importance of this database cannot be underestimated. Over the past 20 years, a number of different databases have been developed for different kinds of Pliocene-Quaternary fossil data, including databases for pollen, plant macrofossils, vertebrate fauna, beetles, ostracodes, and diatoms. As a consequence hundreds of scientific papers have utilized them; papers have been written about them, such as Finkelstein et al. (2006), Grimm et al. (2007), Gajewski (2008), Fyfe et al. (2009) and Marchant et al. (2009). This newly assembled LAPD 2010 database should therefore definitely be presented in a publication for general awareness of the richness of Latin American Palynology.

Nonetheless, many of the paleo-databases have typically been established with either one-time or sporadically funded projects. Typically, these projects have assembled legacy data and incorporated newly available data, have become accepted and recognized archives for particular kinds of data, but have not had continued support after initial funding periods to incorporate newly generated datasets and to modernize software support. Therefore the established initial collaboration of IBED in the NEOTOMA development groups is essential. The NEOTOMA is much more than an archive; it is an essential cyberinfrastructure for paleoenvironmental research. The database facilitates integration, synthesis, and understanding of the paleorecord, and it promotes information sharing and collaboration. By integrating these databases including the LAPD and by simplifying the contributor interface, NEOTOMA reduces overall IT overhead for community-wide database maintenance, while enhancing capabilities for data ingest, display, discovery, analysis, and distribution. For the continuation of the LAPD, an active participation of the IBED-group in NEOTOMA is essential and will provide an enrichment of the Latin American pollen data use and analysis, as have been already shown in the past pilot study for the application of the LAPD in Plant Funcional Types (Van Boxel & Flantua, 2009). From the Paleoecology and Landscape Ecology Research Group of IBED, data on non-pollen palynomorphs from peatlands from studies by Bas van Geel (2006) have already been incorporated. It is now important that IBED continues its contribution to this global initiative to enable joint analysis of multiproxy datasets to address paleoenvironmental questions that transcend those possible with single-proxy databases.

CONCLUSIONS

LAPD 2010:

- A total of 201 new sites were added to the pollen list of LAPD 1997, providing a total of 974 pollen sites;
- Most new pollen sites originated from Brazil and Argentina, respectively 66 and 24. For the first time pollen sites from Cuba, Dominican Republic, El Salvador, French Guyana, Haiti and Uruguay have become available.
- Of the 22 countries in Latin America, 9 countries are from Central America and the Caribbean while the remaining 13 are from South America.
- Most Latin American pollen sites are found in South America, namely 81%;
- Most pollen sites are published from Colombia (17%), Brazil (15%) and Argentina (15%). The relative contribution of Colombia in number of pollen sites has decreased during the throughout the last decade, namely from 29% in LAPD 1997 to 20% in LAPD 2009, and a 17% in 2010. Most significant increases of number of pollen sites have been observed for Costa Rica (factor 4.7) and Brazil (factor 3.9).
- The former LAPD website under NOAA's system and its corresponding database has been introduced into a new Global Paleoecology Database with the name of NEOTOMA.
- NEOTOMA aims to provide an essential cyberinfrastructure for paleoenvironmental research. The database facilitates integration, synthesis, and understanding of the paleorecord, and it promotes information sharing and collaboration. By integrating these databases including the LAPD and by simplifying the contributor interface, NEOTOMA reduces overall IT overhead for community-wide database maintenance, while enhancing capabilities for data ingest, display, discovery, analysis, and distribution.

RECOMMENDATIONS

- It is considered relevant to publish the results obtained from the LAPD 2009 and 2010 updates with thanks to the Hugo de Vries Fonds. The list is thought to be able to make the palynological research community aware of the continuous enrichment in the Latin America in Paleoeological studies.
- A continuous participation in the NEOTOMA database and workgroups can greatly enrich the international contribution of IBED of their palynological knowledge and data.
- The amount of data that will become available can offer a platform for many different projects ranging from projects for students to complete PhD-proposals. It is recommended that IBED collaborates in the continuous update of the LAPD to encourage collaboration of international researchers, to promote and persuade new use of the pollen data.
- IBED should play an important role in the formation of the NEOTOMA group of Latin America, in collaboration with José Prado of Argentina, and Catalina Gonzalez of Colombia, in which the rich use of the NEOTOMA database, new international cooperation and innovative data analysis, can provide an appealing new scientific and international working group.

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