Digital Tools in the Botanical Garden of Madrid

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Abstract — This paper describes the different roles of the Real Jardin Botanico of Madrid in the creation and use of digital tools related to biodiversity. The strongest point of this historical institution is the large amount of scientific data and items in its possession, which makes an excellent starting point for the creation of digital tools. The involvement of the Jardin Botanico in the creation of digital tools is centered on data providing, but some original tools have been developed as well, such as *E-Flora Iberica*, an ambitious system based on Flora Iberica. Another important role of the Botanical Garden of Madrid is that of testing the digital identification tools with users, since it receives about 500.000 visitors yearly, 50.000 of which are involved in formal education activities.

Index Terms — data provider, digital tools, dichotomous keys, education, Flora Iberica, wiki, workshops.

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1 INTRODUCTION

The Botanical Garden of Madrid [1] has been involved in the use and creation of digital tools related to the identification of organisms during the last 3 years, as a partner of the European project *KeyToNature*. On one hand, it has created its own tools, on the other hand, it has served as a test-bed for identification tools developed in other contexts.

2 DATA PROVIDING

Being an institution with 250 years of history and a leading research center, the Botanical Garden of Madrid [1] owns an rich heritage of botanical resources: photographs, drawings, herbarium specimens, etc. Its most valuable contribution comes from *Flora Iberica* [2], a large project started in 1980, that gathers information on the flora of the Iberian Peninsula, with c. 4000 taxa described. The quality and quantity of the data produced in this project allow to create different tools for the identification of plant diversity. All of these data are freely

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available online, and thus completely accessible to the broad public. Since the Iberian Peninsula is a biodiversity hotspot in Europe, this contribution covers about 60% of the European flora.

Dichotomous keys and taxon pages for 130 families and 732 genera, for a total of 3.560 species and 940 subspecies, were submitted to the online archive of *KeyToNature*, as well as 12.978 images of the flora of the Iberian Peninsula. In total, 242.330 metadata have been submitted.
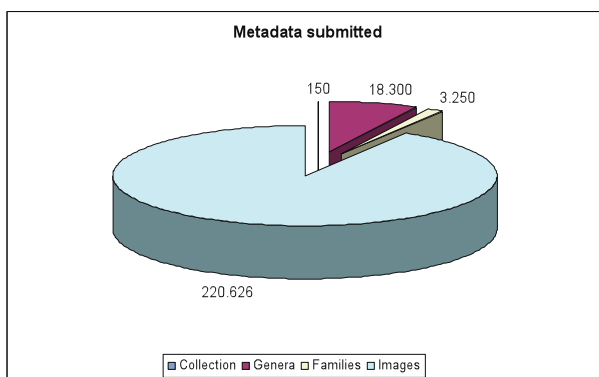
3 ORIGINAL IDENTIFICATION TOOLS

Fig. 1 – Distribution of metadata submitted to the *KeyToNature* online archive.

3.1 E-FLORA IBERICA

This is a digital identification tool which uses *Flora Iberica* as a raw material. Using *e-Flora Iberica* [3] one can obtain a long dichotomous key that includes all species, but can also create "mini identification keys" after setting up a series of filters such as province, family, etc. Another important feature is that the system can create a "minikey" out of some chosen species one wants to compare, providing a dichotomous key based on the differences among those species.

3.2. WIKI-KEYS

Using a wiki template developed in the framework of *KeyToNature*, two keys were created:

1. Wiki key of Gymnosperms of the Real Jardin Botanico - This is a dichotomous key of the gymnosperm species present in the Garden. It first leads us to genera (37 genera in the key), and for the genera that have more than one species (most of them), another subkey is shown, leading to the species. Information about the species and pictures (for most of them) are displayed in the taxon pages.

2. Wiki key for the ferns of the Flora of Equatorial Guinea [5] - Based on a modern flora of Equatorial Guinea, this wiki-key also follows a dichotomous structure ans is enriched with images.

2.3 THE VIRTUAL ASSISTANT [6]

An experimental "virtual assistant" to identify plants was developed in the late phase of the *KeyToNature* project. This is a web application created from a very simple key: *Conifers of the Iberian Peninsula,* in which a "digital lady" literally "talks" to users, which can answer back by writing free text. Images can be implemented during the "conversation" to illustrate the process. The advantage with respect to a dichotomous key is that the user can skip several steps, depending on the amount of information she or he gives through the process of identification. The virtual assistant also has the quality of being amusing and attractive for youngsters.

4 TEST BED FOR TOOLS

The Botanical Garden of Madrid [1] offers excellent conditions for tools trial and testing, since it receives about 500.000 visitors yearly, 50.000 of them are involved in public education activities.

Several workshops centered on the use of digital identification tools were held at the Botanical Garden of Madrid [1] since the beginning of *KeyToNature*. Our main interest on these workshops was to develop learning experiences based on identification processes. The workshops participants' came from all grades of secondary school. 15 years old students were the most abundant age group (4th year Secondary School in Spain), with 449 pupils.
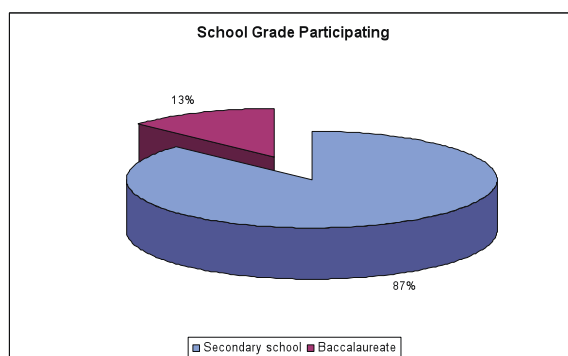
Fig. 2 – Distribution of the different school grades participating in the bioidentification workshops.

Most participants came from Madrid (65%), the rest from other municipalities (35%). 92% were from public schools, 7% from private schools and 1% from cultural centers.

4.1 Observation and Identification workshops

In total, 75 workshops took place under the framework of *KeyToNature* during 3 years. 69 of them were at the Botanical Garden of Madrid [1]. The workshops were carried with by groups of about 20 students accompanied by their teachers and assisted in the Garden by two previously trained instructors. The workshop consisted in 3 different stages: [7]

1. Brief explanation: The students were briefly introduced to the project and to the main features of the plants they would observe during the exercise: types of leaves, their disposal along the branch, whether they fall in winter or not, color and texture of tree bark.

2. Observation: Once the students knew what to pay attention at, they start drawing the plants or trees that the instructors had previously chosen. The identification tags of the plants were covered, to keep them "anonymous".

3. Identification: When sketches were finished, the group is conducted to the computer room of the Botanical Garden. There, they use an online identification key to identify the specimens. This key was produced by the *Dyades* project, the Italian branch of *KeyToNature*, for the Botanical Garden of Madrid [1], and in a simple and an advanced version [8]. The key is enriched with many images the pupils can compare with their drawings, in a didactic and entertaining process were the concepts learnt on the first two steps are efficiently fixed. This part lasts about 45 minutes.

4.2 Winter workshops

Thinking of the worst winter conditions in which the workshops could take place, a set of laminated leaves was prepared, which allowed students to have a close look at the leaves also in winter. During this exercise, even when they stood in front of a naked trunk, students had the opportunity to look at a well-preserved little branch. These waterproof resources served as a great support for the activity.

4.3 Other Workshops

Similar workshops took place elsewere: in the *Environmental Center Villaviciosa de Odón*, the *Botanical Garden of Alcalá* and in the Natural Area "*El Mesto*" near Madrid by the *Secondary Centre "San Agustín de Guadalix"*. These other centers had their own keys created especially for their needs, also in this case by the *Dryades* project [9].

Finally, the *Dryades* project also created another key for Spain: the *Key for Trees and Shrubs of Catalonia* [9], translated both in Spanish and Catalan, and posted in the web page of a public Catalan Centre of Science, the *Centre de Documentació i Experimentació en Ciències.*
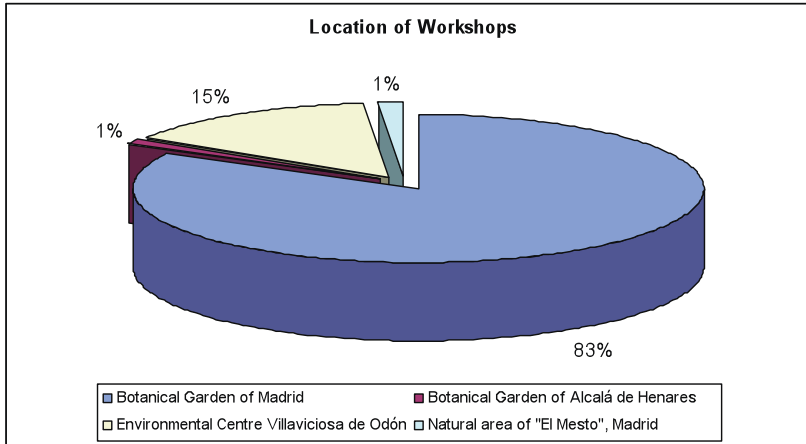
Fig.3 – Location of the workshops.

5 Keys on mobiles

We had the chance to try the *Dryades* key developed for the Botanical Garden of Madrid [1] on a PDA. This experience was carried out on the "Scientific Weekend", a science fair that took place in May 2010 at the *National Museum of Science and Technology*. An instructor was placed on a *KeyToNature* stand with two PDAs and a series of laminated leaves. The public that approached the stand (kids and adults) was able to try the key by using the mobile device. The activity attracted many visitors who found it very interesting.

6 Conclusion

The participation of the Real Jardin Botanico of Madrid [1] in the *KeyToNature* project as a data provider has put at disposal of the project the taxonomic, ecologic and biogeographical information for c. 4000 taxa of vascular plants from the Iberian Peninsula, as well as their images. This is an optimum data set for the development of digital tools for identification, due to the quality and rigour of the information generated by the Flora Iberica project along 30 years. Furthemore, the Garden has created the "e-flora" digital tool, and different identification keys in a wiki-format. It also performed as a tester of the digital tools generated under the *KeyToNature* project, with 73 experiences carried out with c. 1.400 students. The interest that these tools generate and their efficacy for the teaching of Natural Sciences was evident.

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