
The *Weeds of Mexico* Website, Two Years after its First Publication El Sitio Web *Malezas de México* a Dos Años de su Primera Publicación

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Abstract

The Spanish-language Weeds of Mexico website project was initiated in 2000. The first version was published in April 2006 at www.malezasdemexico.net with photographs and factsheets for 450 species; another 400 species had followed by October 2007. Today, the site receives about 200 pageviews/species/month (the large and multilingual site Fishbase has about 800 pageviews/species/month). The distribution of the pageviews shows that content (number of species in website/per family/level of coverage) drives use, together with placement in Google, and time. A cost-benefit analysis under Mexican conditions, considering only time saved for information procurement, shows an amortization in terms of public benefit within 1–2 years.

Resumen

El proyecto sitio web Malezas de México en español inició en el año 2000. La primera versión se publicó en Abril de 2006 en www.malezasdemexico.net con fotografías y fichas informativas de 450 especies; otras 400 especies se añadieron hasta octubre de 2007. Actualmente, el sitio registra aproximadamente 200 accesos/mes/especie (el sitio Fishbase, muy grande y multilingüe recibe aproximadamente 800 accesos/mes/especie). Los accesos muestran que el contenido (número de especies/especies por familia/nivel de cobertura) promueve el uso, junto con la ubicación en Google, y el tiempo. Un cálculo de costo-beneficio del sitio web bajo las condiciones de México, considerando solamente el tiempo ahorrado para obtener información, muestra una amortización en términos de beneficios públicos en 1–2 años.

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Introduction

Mexico has a highly diverse weed flora, most of it native. It has the lowest proportion of exotic species of any of the North American Free Trade Agreement (NAFTA) countries (2.8 %) and the lowest proportion of exotic weeds among weedy species (22 %) (Espinosa et al. 2004, Villaseñor and Espinosa 2004). The absolute number of exotic vascular plant species (638 reported; Villaseñor and Espinosa 2004 and some unpublished data) is much lower than for the state of California (1025; Rejmanek and Randall, 1994). It is the area of origin for a high proportion of tropical weeds that are invasive world-wide (e.g., *Prosopis* spp., *Parthenium hysterophorus* L., *Bidens pilosa* L., *Amaranthus hybridus* L., *Cosmos sulphureus* Cav., *Argemone mexicana* L., *Lantana camara* L., *Mikania micrantha* Kunth, *Chromolaena odorata* (L.) King & H. Rob.).

Despite these conditions, there are some serious invasive species problems (March-Mifsut and Martínez-Jiménez 2008, Vibrans 2008). Examples are *Eichhornia crassipes* (Mart.) Solms or various tropical forage grasses, which were and are being introduced systematically and bred for better productivity and resistance. There are some advances in prevention and controlling the entrance of new species; a national strategy for invasive organisms is in a discussion stage and Mexico is participating in the drafting of the North American Plant Protection Organization (NAPPO) standards. Various other regulations are being discussed at government levels. Awareness and infrastructure challenges exist, as Francisco Espinosa describes in his contribution (Espinosa 2008).

However, the second step of an invasive species management program, rapid detection and response, is much less developed. There is little awareness of the problem in the general and professional public, and very few specialists exist who would note a new weed or invasive species when it appears **and** have the tools or the connections to identify and publicize the discovery — probably not much more than about a dozen individuals in the whole country. This contrasts with the network of weed scientists that exist in both Canada and U.S.A.

The response infrastructure is not yet functional, though the legal foundation does exist. The recent discovery and publication of two known and serious invasive species with limited distributions and large potential impact, *Senecio inaequidens* DC. (Rzedowski et al. 2003) and *Polygonum nepalense* Meisn. (Vibrans and Hanan-Alipi 2008), has yet to elicit an official response.

Until recently, new invasive species were found occasionally by specialists reviewing herbarium material. In general, herbarium revisions and the description of new species continue at an even pace in Mexico, so the taxonomists at the institutions are continuing their work. However, recently I revised the subtribe Brassicinae of the Brassicaceae (in Mexico, this subtribe contains the exotic genera *Brassica*, *Raphanus*, *Eruca*, *Hirschfeldia*, *Diplotaxis*, *Erucastrum* and *Sinapis*). This group is a relatively good indicator of the intensity of general plant collection activity that does not involve specialists. The species grow exclusively in disturbed places, which more specific biodiversity projects do not include. About 1600 specimens were consulted, which corresponded to about 1300 individual records. Figure 1 shows the numbers of collections per decade.

Collections of Brassicinae in Mexico



Figure 1. Number of collections of Brassicinae by decade. Brassicinae is a subtribe of Brassicaceae (= Cruciferae) and contains only species that are exotic for Mexico, e.g., *Brassica*, *Raphanus*, *Eruca*.

Some of the collections from 2000 to present probably have not yet been incorporated into the herbarium collections. But, the data seem to indicate that this venue of discovery is closing; general collection has practically collapsed in the last 15 years and is now below the level of the 1960's. This may be a reflection of: the phylogenetics boom that has students working on specific groups and known species, not on general floristics; biodiversity inventories are not as popular anymore; there are no large collection initiatives; and, collection permits are now required. Perhaps some areas are considered to be sufficiently collected. All of these factors probably play a role in the drop of the collection activity.

The purpose of the Weeds of Mexico website was to encourage taxonomic literacy in the interested public, raise consciousness particularly for the problem of exotic introductions, and to ameliorate the early detection problems. The web format was chosen because the internet is much more accessible today to the target population (rural inhabitants, students as well as professionals) than any written matter (Figure 2).

The first public version of the website was launched in April of 2006. At the last meeting of Weeds across Borders in Hermosillo in May of 2006 I spoke about it; this time, I would like to report on the lessons of the two years since, and on the perspectives.



Figure 2. An internet café in Santa Catarina Ecatlán, a Totonac Indian community with a population of 800 in the Sierra Norte de Puebla, one of the poorest regions of Mexico (March 2008).

Origin of the Data

The data shown below are based on the visitor and pageview (hit) data of the website provided monthly by CONABIO (Comisión Nacional para el Conocimiento y Uso de la Biodiversidad; www.conabio.gob.mx); these data show number of hits per family, and proportion of visits (more than 3 minutes) for a whole month. It does not provide data on individual users (number, geographical origin). Data on variation among days of the week and on the geographic origin of the users is taken from a proxy, a blog (jehuite.blogspot.com) that accompanies the website and presumably is visited by the same type of users as the website. Also, some data stem from a workshop on the website at the Mexican Botanical Congress in Zacatecas, 2007, which was combined with interviews of the participants, mainly students.

Results

Evolution of the Website

The time-line of the website evolution has been the following:

- 2000: First project (images and collections)
- July 2005: Prototype
- April 2006: First public version with 450 species at www.malezasdemexico.net
- Versions: September 2006 (660 species), March 2007 (760 species) and June 2007 (850 species); October 2007 (only with corrections)

So, at present, the site has images and extensive factsheets on 851 species; the images are vouchered. The images, the morphological descriptions and the distribution data for Mexico and the world have been a priority. For identification, the site includes comparative tables by flower color; interactive keys had been a goal, but are difficult to make because baseline data for many species are lacking. We also have an introduction in the Yucatecan Maya language; eventually we hope to include other important native languages of Mexico.

Coverage of the Website

The site now includes the most common weeds of the center and north of the country; it generally covers 70–90% of the species in surveys and weed lists (Table 1). The least represented biome is the humid tropics.

Pageview Data

The number of hits per month (Figure 3) has increased more or less steadily. Relative use falls: 1) during vacations (particularly Christmas and Easter); and, 2) after about four or five months without updates, because apparently Google lowers the priority of the search results. The drops of March and April, 2008, are probably caused by Easter. The fact that the site is used primarily for work (and school) related issues is apparent from these drops; this is confirmed by data from the blog, which show sharp decreases on weekends.

A graph (Figure 4) relating the average number of species in the site to the number of daily pageviews shows that there is a close relationship between use and number of species included in the site.

There is also a close relationship between number of hits and number of species of a family represented in the website (Figure 5). Poaceae are consulted slightly more frequently than Asteraceae, probably because of their utility, but the difference is not large (there is one useful family with one species that reliably has 2000 hits per month — Cannabaceae). The degree of coverage of a treatment appears to have a certain influence; Brassicaceae (more than half of the weedy members of the family and all of the common ones are covered) is consulted more than the Solanaceae where a similar number of species are treated, but for which the proportion of species covered is lower.

Table 1. How complete is the Weeds of Mexico site? (Version June/October 2007)

Source	Number of species	Proportion
Common weeds of Mexico (De Ita Gómez 1992)	21 of 22	95%
Weeds of the valley of México (Espinosa and Sarukhan 1997)	142 of 159	89%
Urban weeds of Mexico City (Vibrans 1998)	207 of 256	81%
Agrestal weeds of maize, Puebla-Tlaxcala (Vibrans 1998)	219 of 317	69%
Weeds in cotton, Comarca Lagunera (Agundis and Rodríguez 1978)	30 of 39	77%
Weeds of Buenavista, Coahuila (Villareal, 1983)	101 of 135	75%
Weeds of Salvatierra, Guanajuato (Calderón and Rzedowski 2004)	190 of 260	73%
Agrestal weeds of Aguascalientes (De la Cerda Lemus 2002)	107 of 149	72%
Prevalent weeds, Central America (García et al. 1975)	101 of 277	36%

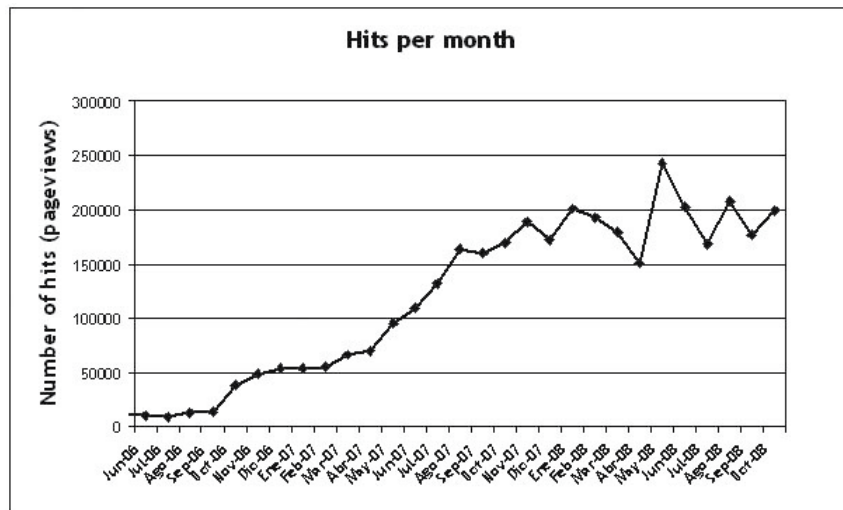


Figure 3. Hits per month at the Weeds of Mexico website.

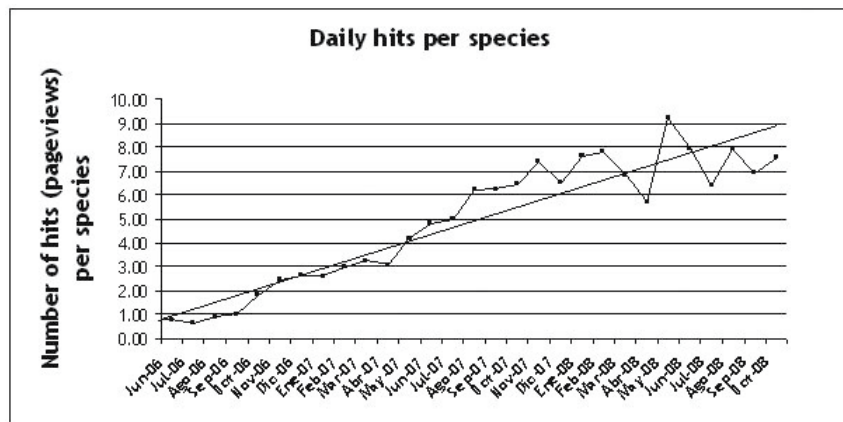


Figure 4. Monthly averages of hits per species included in the website.

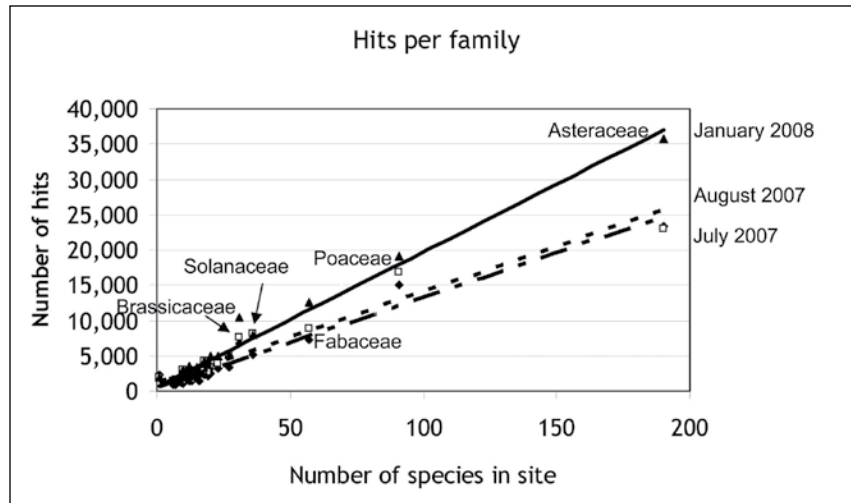


Figure 5. Averages of hits per family in three different monthly periods.

The average number of hits per species is about 200 per month. The much larger, and multilingual, website Fishbase (www.fishbase.org), which has comparable purposes and users as Weeds of Mexico, has about 800 hits per species per month. Considering that Weeds of Mexico is mainly in Spanish, the level of use appears to be quite good.

Approximately half of the users of the blog have Mexican IP-addresses; most of the rest are from the USA and Canada (mainly Spanish-language), from Latin America and from Spain. This is probably similar for the website. Few visitors use the translation functions of Google and other search machines.

User Feedback

User feedback is by e-mail (an e-mail address is prominently displayed on the site), as well as personal comments received during scientific events and during workshops that I organize occasionally. At first I thought e-mail correspondence might prove time-consuming, however, it has been rather limited (about one mail per week on the average) and is often on topics not covered by the site, for example on the identification of ornamental plants. General comments frequently remark on the lack of maps at the site.

At a workshop during the Mexican Botanical Congress in Zacatecas in fall of 2007, I carried out a survey of the 23 participating students. The questions were on the features they considered priorities for the further work. The results are the following (ordered from most desired to less important):

1. Include more species with photographs **and** factsheets
2. Add information on diagnostic characters for all species
3. Include keys
4. Include more species with photographs (without factsheets)

5. Include distribution maps
6. Include a glossary

Therefore, maps are not really the highest priority for many users and adding to the coverage appears to be more important. Moreover, the rather extensive factsheets are appreciated, particularly the information on practical aspects, such as control and use. Users clearly want more content than just pictures and id information.

Labor Investment and Costs

Each species treatment requires approximately the following labor investment:

- 1.5 h by the photographer (this includes traveling time)
- 2 days by a technician (plant processing, image processing, building pages, adapting morphological descriptions, inserting standard information into fact sheet)
- 1 day by a qualified botanist (field work, selection of images, editing of fact sheet, general supervision).

Additionally each species treatment requires about \$20 of travelling money, and some equipment (computers, digital camera).

Under Mexican conditions this translates to grant requirements of about \$200 per treated species if the qualified botanist draws a wage elsewhere; if this cost is included, it comes to about \$300. On the average, I have dedicated about half of my paid time to this project in the last eight years. The web page is hosted by CONABIO, a government institution with a very extensive web infrastructure, so the hosting costs are marginal.

Costs and Benefits

From these data a cost-benefit analysis can be attempted, based on the following:

- The calculations are on the basis of 160,000 hits per month
- About 25% of the hits (40,000) are visits of more than 3 minutes, with the assumption that the user found information of interest
- A second (conservative) assumption supposes that every 3 minutes of useful information represents 6 minutes of bibliographic research, which would be the main alternative, at least for a Spanish-speaking population. It thus saves 3 min; $40,000 \times 3 \text{ min} = 200,000 \text{ min} = 3333 \text{ h}$
- An hour is priced at 40 pesos (about \$3.80), which is about the starting salary of a professional.

Then, the general economic benefit would be 80,000 pesos (\$7,600) per month or 960,000 (\$91,500) per year. The project amortizes in less than 2 years, if only the time saved in obtaining information is considered. This is of course an underestimation, since it does not consider the fact that often the site would be the only information available to many users, or the savings that result from the actions taken upon identification, both of which are difficult to quantify.

Future Work

We plan to focus on increasing the number of species pages, especially for weed species of the humid tropics. Other short-term plans include:

- a useful links page;
- an interactive glossary
- a tutorial for creating species pages for beginners
- a tutorial on plant collection

Longer-term aims are the inclusion of:

- images of seeds and seedlings;
- professional editing
- interactive keys
- distribution maps
- texts in languages other than Spanish (English, Nahuatl, Yucatec Maya, Zapotec, Mixteco)

Conclusions

The Weeds of Mexico website has developed a satisfying acceptance in the Spanish-speaking world. Content is a strong driver of usage. The site can be shown to recoup the public investment in a very short time, even if only time-saving for information retrieval (not prevention) is estimated under very conservative assumptions. We hope it will raise public awareness for preventive measures and fast reaction to cross-border migrations of weeds and invasive plants.

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