

THE IMPACT OF BRAZIL'S VIRTUAL HERBARIUM IN E-SCIENCE

IDENTIFYING OUTCOMES FROM ON-LINE DATA SHARING

One of the project's objectives is to identify possible drivers that motivate herbaria to openly share their data through an e-infrastructure and possible outcomes of this participation. One of the central research questions of this project is "Has data sharing through the Brazilian Virtual Herbarium (BVH) led to more recognition and support for data providers?" The Brazilian Virtual Herbaria is one of the country's National Institutes of Science and Technology, a program of the Ministry of Science, Technology, and Innovation.

Methodology

Together with the BVH's steering committee, we elaborated a semi-structured questionnaire with both open and multiple-choice questions concerning possible outcomes from sharing data on-line.

We also carried out a SWOT analysis, requesting of each curator the Strengths, Weaknesses, Opportunities, and Threats concerning the Brazilian Virtual Herbarium.

The questionnaire was sent by email by the project's coordinator to curators of all 99 herbaria associated to the network. We received 39 answers. Each herbaria was classified in 5 separate groups, according to the size of its holdings:

1. Up to 10 thousand vouchers;
2. Between 10 and 50 thousand vouchers;
3. Between 50 and 100 thousand vouchers;
4. Between 100 and 200 vouchers; and,
5. With more than 200 thousand vouchers.

The purpose of this "classification" was to evaluate if there were issues specifically related to the size of the herbarium.

All answers were tabulated and a report with the analysis of the answers was prepared and discussed with BVH's steering committee and presented at the evaluation and strategic planning meeting held in Belo Horizonte on April 14 and 16, 2015¹.

Thirty five herbaria were present at the meeting, and a new round of discussions was carried out in smaller groups and were presented in plenary. All this material was handed in and used to produce this report.

This report is the result of the opinions of 17 herbaria that answered the questionnaire and participated at the meeting in Belo Horizonte, 22 herbaria that answered the questionnaire but were not present at the meeting, and 18 herbaria that did not answer the questionnaire but took part of the meeting. Therefore, this study includes the opinion of curators from 57 herbaria, which at the time represented 58% of all associated herbaria of the network.

¹ See program in Portuguese at http://cria.org.br/eventos/inct_2015/program

Results and Discussions

Outcomes

Table 1 presents the answers given by curators concerning possible outcomes derived from sharing their data through the e-infrastructure BVH.

Size		< 10.000	10.001 - 50.000	50.001 - 100.000	100.001 - 200.00	>200.000	All
Number of Herbaria	No.	27	39	17	9	7	99
	%						
Number of Answers	No.	12	12	7	5	3	39
	%	44%	31%	41%	56%	43%	39%
Greater institutional recognition	No.	11	10	3	5	3	32
	%	92%	83%	43%	100%	100%	82%
Greater involvement with graduate courses	No.	9	8	5	2	2	26
	%	75%	67%	71%	40%	67%	67%
Increase in the Number of Visits	No.	10	12	6	2	3	33
	%	83%	100%	86%	40%	100%	85%
Increase of the holdings	No.	11	8	6	2	3	30
	%	92%	67%	86%	40%	100%	77%
Increase amount of grants	No.	6	6	3	2	3	20
	%	50%	50%	43%	40%	100%	51%

39% of all herbaria associated to the BVH answered the questionnaire. Outcomes derived from sharing data through a public e-infrastructure included (1) greater institutional recognition; (2) greater involvement with graduate courses, (3) increased number of visits to the herbaria; (4) increase of the holdings; and, (5) increase of grants.

As to being recognized or acknowledge by their own institution, the answers show that larger institutions are fully recognized. This makes total sense as the costs are much greater and an annual budget must be secured. This is not necessarily true for small herbaria, mostly in universities, that do not even have a position for curators. The lack of recognition of the work or even of the existence of these herbaria by the host institution was always presented as a mayor problem of smaller collections. Therefore, the result of the survey indicating that 92% of herbaria with holdings of up to 10 thousand vouchers stated that sharing their data through the e-infrastructure gave them more visibility and institutional recognition is an important outcome of the project.

An important aspect of the network is that 95% of the participating herbaria are associated to graduate courses. The use of data and tools available in the Virtual Herbaria have become a routine in graduate courses such as botany, taxonomy, and ecology. By organizing and publicizing data of its holdings, herbaria have become more involved with graduate programs. Once again, looking at the smaller herbaria with up to 10 thousand vouchers, one can see that their involvement with the graduate courses increased. Many also indicated that by exposing the data of small, but geographically specific holdings, they attracted the interest of students and specialists. With this, the number of visitors increased as did the number of new samples

deposited in their herbaria. These are important outcomes directly influenced by sharing data through the e-infrastructure.

Another major problem for smaller herbaria is external funding. With greater visibility and, in many cases, by submitting proposals as a network, 50% of the smaller herbaria with holdings under 50 thousand vouchers were successful in receiving external grants. However, not only did the small herbaria benefit from sharing the data of their holdings in an open platform, larger herbaria also acknowledged a great impact in the number of visits, holdings, and grants. Larger herbaria also manifested that their internal organization was improved and overall planning and setting goals to be achieved was also enhanced as data was made available on-line. By sharing their data on-line and by using all tools available for analysis, herbaria could work on data quality and plan future collecting efforts.

The increase of the holdings (77% of the herbaria) can be attributed to its greater visibility, its increased involvement with graduate students, and the increased interest of specialists in visiting the area where the herbaria is based. Some herbaria answered that besides the increase of the number of visitors, these are more diverse – both from different fields of knowledge and from different geographic areas.

SWOT Analysis

Curators were requested to indicate what they considered were strengths, weaknesses, opportunities and threats concerning the Brazilian Virtual Herbarium. Strengths and weaknesses referred to actions within the control of the network and opportunities and threats referred to external factors that are not within the control of the network but are important elements that must be monitored.

STRENGTHS

All herbaria emphasized as strengths the social network, the value of data sharing, and the financial, technical and scientific support offered through the project.

Social Network

The social network established and strengthened throughout the project promoted increased interaction between curators and technicians from different institutions. Answers indicated that there was a change in the mindset of the professionals involved that now feel more valued and part of the achievements of the project. Increased self-esteem and a constant search for improvement was also noted. The increased geographic coverage of the network, with the participation of small herbaria, was emphasized, as many of these are regional collections, whose copies are underrepresented in other collections. Curators also indicated increased collaboration with students and researchers from other courses and institutions, and the visit of foreign researchers.

Data Sharing

Open sharing of textual data and images was viewed as a strength due to the greater visibility and acknowledgement of the role and importance of herbaria. Outcomes such as greater institutional recognition and deposits of new material (graduate students and researchers) were once again mentioned. On-line organization of data and the availability of tools to help find errors and inconsistencies were also mentioned and contributed to the improvement of the quality of the data that is being shared. An important observation mentioned was that data organization and on-line sharing also increases the knowledge curators have of their own

holdings and enables better planning and the elaboration of strategies to increase and improve these holdings.

Project Support

The existence of the project with the support of the Brazilian government (CNPq²) with funds for grants, materials, equipment, and for courses and visits of specialists was pointed out as being fundamental for the organization, digitization, and improvement of the holdings.

The fact that the project was developed from existing initiatives was considered a strength. These initiatives are the Brazilian Network of Herbaria of the Brazilian Botanical Society; the speciesLink network developed by CRIA; and, the Brazilian National Research and Educational Network (RNP).

WEAKNESSES

The most important weakness cited by all curators refers to human resources. Not only are they insufficient, but specialists that are retiring are not being replaced. Even though the grants to hire students and technicians to work on the organization and digitization of the collections were mentioned as a strength of the project, here they state that these grants are transitory and for limited periods.

The same applies to infrastructure and the necessity of more training programs. The project promoted yearly meeting at the Congress of Botany and also held 2 general meetings (the first with representatives of 70 herbaria and the second with 35) to present and evaluate what was done and to help plan the future. Many herbaria indicated that it would be important to hold more such meetings and this way guarantee a more participatory process.

OPPORTUNITIES

The possible continuation of the federal government's program of National Institutes of Science and Technology is seen as an opportunity for continuity.

Making data freely and openly available on-line is seen as an opportunity for new research insights and for the advancement of e-taxonomy, valuing the role of herbaria.

The possibility of hiring professionals that were trained throughout the project is also seen as an opportunity to ensure the transfer and multiplication of acquired knowledge.

The advancement of information and communication technology is also seen as an opportunity to enhance the quality of the content shared on-line and to increase the interaction between herbaria and data users.

THREATS

Perhaps the greatest threat mentioned was the discontinuity of the project. Within this line, another point was the duplicity of similar projects, as opposed to collaborating and networking with existing initiatives.

The economic situation of the country and the lack of long-term public policies to support such e-infrastructures were considered threats.

² National Council for Scientific and Technological Development (*Conselho Nacional de Desenvolvimento Científico e Tecnológico*)

Final Comments

This document synthesizes the opinion of curators from 57 herbaria associated to the Brazilian Virtual Herbarium. According to the vision of these professionals, this initiative brought great benefits and should continue.

The human network that was established is considered the project's most important asset. The "visiting specialists program" that used on-line data to identify the herbaria to be visited and specialists required, the courses and technical visits and remote support given were actions that strengthened this human network with a sense of being part of the group.

The capillarity of the network, with the participation of at least one herbaria from every state of the country, including small and regional herbaria, and the involvement with graduate courses are an important contribution of the project.

Therefore, returning to our central research question "Has data sharing through the Brazilian Virtual Herbarium (BVH) led to more recognition and support for data providers?" the answer is yes.