

Information systems as a resource for bee conservation in Brazil

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Abstract. Pollinators are important for the maintenance of ecosystem services, participating in the process of reproduction of flowering plants. Current assessments of pollinators show the innumerable benefits they bring to humans, including their participation in improved production and quality of fruits and seeds that are part of human diet. The Brazilian Bee Studies Association (A.B.E.L.H.A., acronym in Portuguese) was created to promote the conservation of bees and other pollinators in Brazil. A.B.E.L.H.A., in partnership with the Reference Center for Environmental Information (CRIA, acronym in Portuguese), developed two free and open online information systems with the objective of providing knowledge about bees in a fast way, becoming a source of reliable consultation for all stakeholders. The first system is the Scientific Information System on Neotropical Bees that aims to facilitate access to scientific knowledge about bees in Brazil, integrating information available in different online systems. The second one is the Information System on Bee - Plant Interactions that aims to gather existing information on interactions between bees and plants to facilitate decisions on pollination of agricultural crops and bee and plant conservation. With these systems we hope to reinforce the importance of knowledge and conservation of bees for the maintenance of biodiversity and food production.

Key Words: platform, e-Science, beekeeping, native, environment, tropical region.

Main theme: Biodiversity.

1. Introduction

Pollinators represent a key component of global biodiversity because they play a role in the maintenance of most natural ecosystems and add value to global agriculture. While in nature pollinators participate in the process of reproduction of flowering plants, in agriculture they are responsible for enhancing the production and quality of fruits and food crop seeds [1]. Inasmuch as food production directly affects society, much of the recent international focus on animal pollination has been on the benefits to food production.

Globally, animal pollination directly affects the yield and/or quality of approximately 75% of food crops [2]. In Brazil alone, approximately 60% of food crops depend, at

least in part, on animal pollinators, including most fruits, seeds and several high-value commodity crops such as Brazil nut, cocoa bean and coffee. The economic contribution of pollinators in Brazil totals 30% (US\$12 billion) of the total annual agricultural income of the dependent crops [3]. Bees are the most important group of pollinators and represent 87% of all pollinators that provide part of the Brazilian diet [4]. Nevertheless, a growing number of studies have reported declines in pollinator species in different regions of the globe. Pollinator declines can result in loss of pollination services which have negative impacts on the maintenance of wild plant diversity and ecological interactions, crop production, food security and human wellbeing [2].

In 2012 the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) was created with the objective of providing Governments, private sector, and civil society with scientifically credible and independent up-to-date assessments of available knowledge to make informed decisions at local, national and international level. One of the IPBES actions is assess the state of biodiversity and of the ecosystem services it provides to society, in response to requests from decision makers. The first completed IPBES thematic output was the assessment of pollinators, pollination and food production, released in March 2016. This report covered the value of pollination and pollinators, status, trends and threats to pollinators and pollination, and policy and management response options. The fact that pollinators and pollination have been the first assessment to be carried out shows the importance of this theme worldwide.

In Brazil, the Brazilian Bees Studies Association (A.B.E.L.H.A.) was created to disseminate information in order to promote the conservation of bees and other pollinators in Brazil. A.B.E.L.H.A. is a nonprofit civil association composed by 11 associates including companies and associations of agricultural producers. Its main mission is collecting, producing and disseminating science-based information aimed at the conservation of Brazilian biodiversity and the harmonious and sustainable coexistence of agriculture with pollinators.

The Brazilian Bees Studies Association established a partnership with the Reference Center for Environmental Information (CRIA), whose aim is the dissemination of electronic scientific knowledge as a tool to contribute to the conservation and sustainable use of Brazil's natural resources. This partnership resulted in the development of two free and open on-line information systems with the objective of providing knowledge about bees in a fast way, becoming a source of reliable consultation for all stakeholders.

2. Scientific Information System about Neotropical Bees ¹

The *Scientific Information System about Neotropical Bees* (Sistema de Informação Científica sobre Abelhas Neotropicais in Portuguese) is a research platform that aims at facilitating the access to scientific knowledge available on-line, using Moure's Bee Catalogue⁴ as its primary source to integrate information on bee species that occur in Brazil. The platform presents as a search option both the scientific and common

¹ Scientific Information System about Neotropical Bees - <http://abelha.cria.org.br>

names. The information is presented in one page and allows users to access original information sources (Figure 1). Currently the system integrates data from the following information systems: *Moure's Bee Catalogue* – over one thousand accepted bee species; *Cristiano Menezes' photo library* – 2.912 images of 57 bee species; *Flickr* – online photo management and sharing application; *speciesLink network* – a distributed information system that integrates primary data from over a thousand biological collections. The network has more than 200,000 Apidae family records; *Information system on Brazilian Bee-Plant Interactions* – a system that presents the interaction of more than 900 species of bees with more than two thousand species of plants; *Checklist of bees and melittophilous plants in São Paulo, Brazil* – 276 bee species that visited 433 plant species to collect floral resources; *Open source Brazilian scientific publication system (oasisbr)* – a multidisciplinary search engine that allows free access to the scientific work of authors linked to Brazilian universities and research institutes; *Encyclopedia of Life (EOL)* – a system that facilitates global access to knowledge about life on Earth; *Biodiversity Heritage Library (BHL)* – a consortium of natural history and botanical libraries that cooperate to digitize the legacy literature of biodiversity held in their collections; e *Bioline International* – a not-for-profit scholarly publishing cooperative committed to providing open access to quality research journals published in developing countries. All these information systems offer web services, allowing the search and retrieval of information in real time. Other online information sources that do not permit a previous verification whether data exists for a specific bee species can be accessed on a link page.

The screenshot displays the A.B.E.L.H.A. website interface. At the top, the logo 'A.B.E.L.H.A.' is accompanied by the text 'sistema de informação científica sobre abelhas neotropicais'. Below the logo is a search bar containing the text 'jatahy'. A navigation menu includes links for BHL, Bioline, EOL, FCM, Flickr, speciesLink, oasisbr, interação, and Moure. The main content area is titled 'Catálogo de Abelhas Moure' and features the scientific name 'Tetragonisca angustula (Latreille, 1811)'. It lists other names such as 'Trigona angustula Latreille, 1811' and 'Trigona jaty Smith, 1863', along with a list of popular names in various languages. Below this, the 'Fototeca Cristiano Menezes' section shows '84 imagens disponíveis para Tetragonisca angustula em 25-Abr-2016' and a grid of 18 thumbnail images of the bee. A 'veja mais' button is visible next to the image grid.

Fig. 1. Scientific Information System about Neotropical Bees.

The information system also presents a tool that facilitates the access to the natural occurrence of Brazilian bee fauna through the generation of lists according to geographic distribution of bee species for each state of Brazil. When selecting a Brazilian state, the system retrieves a list of species known to occur in that specific state separated by subfamilies and tribes (Figure 2). By clicking on the species of interest, all information available in this platform for that species is presented.

The platform is mainly intended to researchers and university students that require fast and efficient access to information to support their studies. However, the system is open to all those interested.

A.B.E.L.H.A.
Associação Brasileira de Estudos das Abelhas

sistema de informação científica sobre abelhas neotropicais

English
A.B.E.L.H.A. * fontes de informação * como usar * outros links

nome científico ou nome comum

Abelhas no Brasil

Apresenta-se aqui a lista de espécies de abelhas de acordo com a distribuição geográfica nos estados do Brasil. É importante ressaltar que estes registros de distribuição geográfica foram retirados apenas do Catálogo de Abelhas Moure, o qual é utilizado como fonte primária por este sistema. Para a composição do catálogo Moure, os dados de distribuição geográfica foram extraídos de artigos e revisões taxonômicas, catálogos, levantamentos faunísticos e também de espécimes depositados em coleções biológicas. As referências das publicações sobre cada espécie de abelha podem ser acessadas na versão online do catálogo. Cada um dos estados brasileiros é acompanhado pela lista de espécies de abelhas conhecidas, separadas por Subfamília e Tribo. Ao clicar na espécie de interesse, informações disponíveis nos demais sistemas que compõe esta plataforma de pesquisa poderão ser acessadas.

- Acre
- Alagoas
- Amapá
- Amazonas
- Bahia
- Ceará
- Distrito Federal
- Espírito Santo
- Goiás
- Maranhão
- Mato Grosso
- Mato Grosso do Sul
- Minas Gerais
- Pará
- Paraíba
- Paraná
- Pernambuco
- Piauí
- Rio de Janeiro
- Rio Grande do Norte
- Rio Grande do Sul
- **Rondônia**
- Roraima
- Santa Catarina
- São Paulo
- Sergipe
- Tocantins

Rondônia

Andreninae » Protandrenini

- *Parapsaenythia inornata* Moure, 1998

Apinae » Bombini

- *Bombus (Fervidobombus) pauloensis* Friese, 1913
- *Bombus (Fervidobombus) transversalis* (Olivier, 1789)

Apinae » Centridini

- *Centris (Aphemisia) plumipes* Smith, 1854
- *Centris (Centris) bakeri* Cockerell, 1912
- *Centris (Hemisiella) dichrotricha* (Moure, 1945)
- *Centris (Ptilotopus) denudans* Lepeletier, 1841
- *Epicharis (Anepicharis) dejeanii* Lepeletier, 1841
- *Epicharis (Epicharana) flava* Friese, 1900
- *Epicharis (Epicharana) pygialis* (Friese, 1900)
- *Epicharis (Epicharis) umbraculata* (Fabricius, 1804)
- *Epicharis (Epicharitides) cockerelli* Friese, 1900
- *Epicharis (Epicharitides) minima* (Friese, 1904)
- *Epicharis (Hoplepicharis) fasciata* Lepeletier & Serville, 1828
- *Epicharis (Parepicharis) zonata* Smith, 1854
- *Epicharis (Trepicharis) analis* Lepeletier, 1841

Apinae » Eucerini

- *Floriilegus (Eufioriilegus) festivus* (Smith, 1854)
- *Floriilegus (Floriilegus) condignus* (Cresson, 1878)
- *Gaesochira obscura* (Smith, 1879)
- *Lophothygater nigrita* Urban, 1999
- *Trichocerapis chaetogastra* Moure, 1967

Fig. 2. List of bee species according to states of Brazil.

3. Information System on Brazilian Bee-Plant Interactions²

The *Information System on Brazilian Bee-Plant Interactions* (Sistema de Informação sobre Interações Abelhas - Plantas no Brasil in Portuguese) aims at facilitating the access to information on Bee-Plant interactions in Brazil. The comprehension of the structure of bee communities and its association with particular habitats is especially useful to evaluate the potential of different bee species for use in sustainable agriculture as well as for bee and plant conservation.

All interaction data were obtained from surveys of bees on flowers and from researches that used pollen analysis as a tool for identification of floral sources used by bees. These surveys were carried out in many different regions of the country and the results are available in dissertations, thesis, and articles that were gathered by the project “*Evaluation of the current status of plant-pollinator interactions*”, coordinated by Prof. Dr. Astrid de M. P. Kleinert of the Institute of Biosciences of the University of São Paulo³ – Brazil. The system presents the following search options: by scientific name of bees or plants. The result when searching for a specific bee (or plant) will retrieve all plants (or bees) with which an interaction has been documented. The final information presents the results of the interaction sought, listing the information from surveys or pollen analysis that document the interaction (Figure 3).

The screenshot displays the 'ABELHA' website interface. At the top, there is a navigation bar with 'Principal', 'Busca', 'Fonte de Informação', 'Como usar', 'English', and 'Interações Abelhas-Plantas'. Below this is a search box with the prompt 'Digite o nome científico da abelha' and a dropdown menu for 'Nome científico'. There are two radio buttons: 'busca por nome de abelha' (selected) and 'busca por nome de planta'. The main content area is divided into two columns. The left column, titled 'Lista de plantas que são visitadas por', lists various plant families and species, including Bignoniaceae (*Pithecoctenium echinatum*), Boraginaceae (*Heliotropium cf. leiocarpum* and *Moritzia ciliata*), Cactaceae (*Opuntia brunneogemmia* and *Opuntia viridrubra*), Fabaceae (*Adesmia riograndensis*, *Crotalaria* spp., and *Cesneriaceae*), Malpighiaceae (*Simplingia allagophylla*), Janusia guaranitica, and Scrophulariaceae (*Angelonia integerrima*). The right column shows search results for 'Abelha: *Centris tricolor* Friese, 1899' and 'Planta: *Pithecoctenium echinatum* (Jacq.) Bail.'. It includes a map of Brazil with a red dot indicating the location of interactions in the southern region. To the right of the map are sections for 'Localidade das interações' (listing 'Guaritas (Municípios de Caçapava do Sul, Santana da Boa Vista, Lavras do Sul e Bagé) - RS') and 'Filofisionomia / Ambientes' (listing 'Mata Secundária'). Below the map, there are sections for 'Levantamentos' and 'Teses / Dissertações', with a reference to 'Schindwein, C. 1995 - Wildbienen und ihre Trachtpflanzen in einer südbrazilianischen Buschlandschaft. Fallstudie Guaritas. Bestäubung bei Kakteen und Loasaceen - tese de doutorado - Verlag Ulrich E. Grauer - Stuttgart - 148 pp.'

Fig. 3. Information System on Brazilian Bee-Plant Interactions.

² Information System on Brazilian Bee-Plant Interactions - <http://abelhaseplantas.cria.org.br>

³ This work was part of the project “*Biodiversity and sustainable use of pollinators with emphasis on bees*”, FAPESP n° 04/15801-0.

The platform is intended for researchers and professionals that require information about interactions between bees and the plants that they visit to collect pollen and nectar. It can be useful aiming at a more friendly landscape to pollinators and to enrichment of areas where beekeepers keep their honey and stingless bee colonies.

4. New projects

A new information system focusing in Beekeeping and Environment is being developed in collaboration with beekeepers and researchers. The platform aims to improve beekeeping practices and honey production, promoting the role of bees and beekeeping in biodiversity conservation and the harmonious and sustainable coexistence with agriculture. In this platform we intend to promote the interaction with the two systems described above, as well as to provide information that is especially useful to beekeepers and to the conservation of biodiversity. It will be a free and open online system that will seek to respond the beekeepers demands.

5. Conclusion

The rich diversity of bee species in Brazil and their role in environmental conservation and food production are important issues that should be freely provided to the entire society using techniques facilitated by information and communication technology. The information systems about bees presented here are highly valuable, since they offer a shorter and more efficient way to increase our understanding about native species, where they live, and the current situation of bee studies in Brazil, integrating, through information technology tools, previously dispersed databases. Besides, once the systems disseminate science-based information, they can be useful in the development of public policies to protect bee species, their habitats and the associated flora.

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