

# Designing and developing a Bioresource Information Centre for Floral Resources of Himachal Pradesh, Western Himalaya

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*Recognizing the need of information-sharing and its implications, development of on-line plant databases has been advocated. The present article provides details on the development of web-enabled Bioresource Information Centre for Floral Resources of Himachal Pradesh, Western Himalaya. It is a MySQL database that presently houses information on ~1500 plant species. This information pertains to distribution, life form, population, local name, taxonomy, image, use, conservation status and alien species. Twelve tables form the backbone of this repository. In website creation, the database interface has been implemented using wordpress CMS written in PHP. The designing of graphic user interface has been done using HTML, CSS, PHP, JavaScript and jquery. The site allows for basic and guided search, and is compatible with all major browsers and operating systems. It is dynamic and provides the user with an option of sharing of information.*

**Keywords:** Plant database, floral resources, information-sharing.

THE recent developments in web-based information and techniques have brought a paradigm shift in the way we manage and share information<sup>1</sup>. Its implications are visible in almost all spheres of life, and biodiversity is no exception to this<sup>2</sup>. Recognizing the fact that biodiversity is the mainstay of our livelihood and at the same time it is facing tremendous pressure, subjects like 'bioinformatics' and 'biodiversity informatics' have recently come up<sup>3,4</sup>. These subjects utilize information technology for maximizing the reach and analyses of data pertaining to biodiversity<sup>5,6</sup>.

Earlier, these data were stored in hard-copy formats that limited their reach. Further, the data were not easily searchable and updating them was a tedious task<sup>7</sup>. As opposed to this, on-line databases have global presence and are more interactive. Thus, they provide flexibility of use and can be easily managed.

Owing to these, development of on-line databases is a contemporary global priority<sup>8-10</sup>. This is evident from the number of databases that have been developed in the past, for example, on amphibians (<http://www.amphibiaweb.org/>), birds (<http://www.birdlife.org/datazone/home>), insects (<http://www.brc.ac.uk/dbif/homepage.aspx>), microbes (<http://mbgd.genome.ad.jp/>), plants (International Plant Name Index; <http://www.ipni.org/>), and bioresources in general ([www.ibin.gov.in](http://www.ibin.gov.in)). In addition to taxa-specific

databases, region-specific on-line databases like Flora of Nepal (<http://padme.rbge.org.uk/floraofnepal/>), China (<http://flora.huh.harvard.edu/china/>) and Pakistan ([http://www.efloras.org/flora\\_page.aspx?flora\\_id=5](http://www.efloras.org/flora_page.aspx?flora_id=5)) are also being developed.

Himalaya is a global biodiversity hotspot with more than 33% of the plant species being endemic to the region<sup>11,12</sup>. Unmanaged developmental activities have threatened the survival of many of these species in the Himalaya<sup>13,14</sup>. Developing databases on bioresource of this region has, therefore, been advocated<sup>15,16</sup>. It is with this background that an on-line database 'Bioresource Information Centre for Floral Resources of Himachal Pradesh, Western Himalaya' has been developed. This article provides details on the data and designing of this repository. The link is made available at [www.ihbt.res.in](http://www.ihbt.res.in).

## The database architecture

Name – Bioresource Information Centre for Floral Resources of Himachal Pradesh, Western Himalaya (BRIC).

Focus taxa – Flowering plants.

Type – Web-enabled.

Geographical coverage – The western Himalayan state of Himachal Pradesh laying between 30–33°N and 75–79°E, and covering an area of 55,673 sq. km.

Data sources/collection – The data have primarily been collected through field surveys, interaction with local people and screening of the literature.

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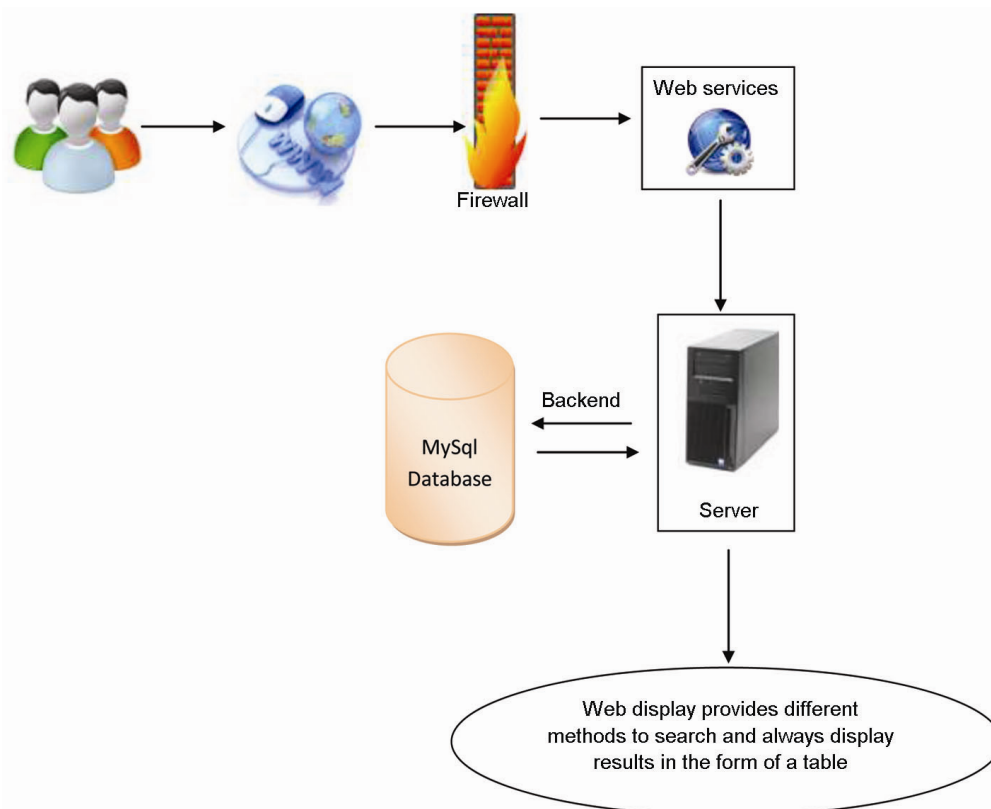


Figure 1. The database design.

## Data holding

Presently, the database has information on ~1500 plant species. Majority of the plants in the database are herbs (72.6%), followed by shrubs, trees and climbers. These plants belong to a total of 106 families, with Asteraceae being the dominant one. Basics of the data housed has been provided elsewhere<sup>16</sup>. However, in addition to being web-enabled, this repository also has information on alien species. Out of the total 1500 species housed in the database, 497 are alien species. Information on nativity, time of introduction and their status has also been provided in this database.

## The database design

BRIC is a MySQL database. MySQL is a structured query language designed for managing data stored in a relational database management system (RDBMS). Figure 1 shows the designing of the database. Data field is the main repository of all data (i.e. distribution, life form, population, local name, taxonomy, image, uses, conservation status and alien species). When a user searches for any species, the server starts processing the request and fetches the required data from the MySQL database. It then displays the results in form of a table.

## Linkage of tables

The database consists of 12 tables that comprise the entire BRIC data. These tables carry the relevant information and are linked to one another by one-to-one, one-to-many and many-to-many relationships (Table 1). The BRIC table is the main one containing important details of plants, which is interrelated with other tables. It collects information from all the other tables and then displays it on the browser (Figure 2). As an example ‘\*Distribution’ in the BRIC table links to wp1\_distribution table that has information on data fields, namely latitude, longitude and name of the locality from where the species was recorded. The asterisk symbol (\*) in the originating table indicates that further information is stored in different tables. All plants have their unique id called primary key constraint for a table. This means that every species is identified with a unique number. The database engine automatically creates unique id for primary key column. There is no repetition of an id as each is exclusive to a particular species. Throughout the database, this id refers to a particular plant species. Using primary key in queries helps in faster access of data. Linkages between data in tables are done using foreign key column (Figure 2). Primary key of one table becomes foreign key of the other table and helps in fetching relevant data on the said plant species. Each field in the table has its own

**Table 1.** Name and characteristics of data tables

Name	Characteristics
Alien species	Provides information on exotic plant species that have been, intentionally or accidentally, introduced into the state.
BRIC	Contains details of all the major fields like distribution, taxonomy, vernacular names, population, conservation status, uses image and alien species.
Conservation status	Contains information on threat categorization of a species (CR, EN, VU), year of assessment and justification.
Distribution	Provides information about the localities where the plant species was recorded during field surveys.
Life form	Provides categorization according to growth form of plant species.
Local name	Provides details on plants according to their vernacular name.
Paper	Provides access to freely available papers, sorted according to year of publication.
Population	Provides information on density and frequency of plant species at different localities.
Resources	Contains information of papers, proceedings and reports published by a group/institute.
Taxonomy	Provides details on hierarchical grouping of a species into genus, family, order, division and kingdom. It also carries information on synonym(s).
Uses	Provides uses in ten identified fields (antidote to poison, aphrodisiac, edible, fibre, fodder, fuel, household artifacts, magico-religious, medicinal, and others).
Use_ID	Provides information on folk utilization of plants.

data that describes the type of data stored in the column. Number in brackets following this indicates the maximum number of characters that a string can have (Figure 2).

### Data security

Security is of utmost concern. While the site provides free access to view the data, it does not allow the user to make any changes in them. It is password-protected and the administrator is its sole authority. Use of firewall adds to the security. Further, any information that is shared by an user does not get automatically added until it has been validated and approved by the administrator. Captcha feature has been incorporated to check automated frivolous information. Also, privilege to block IP addresses that appear to cause problems rests with the administrator. Option for copying and pasting information in the database has also been disabled.

### Website creation

In website creation, the database interface has been implemented using wordpress CMS (content management system) written in PHP (hypertext pre processor). This allows the database to be easily accessible and searchable via the internet. CMS facilitates content searching and

provides efficiency to regular users. The database is freely accessible to any user for searching and viewing information. It provides the user with information on any or all of the above-mentioned fields, i.e. distribution, life form, population, local name, taxonomy, image, uses, conservation status and alien species.

The graphic user interface (GUI) has been developed for display and retrieval of information on plants. GUI has been developed such that any authorized computer literate person to act as an administrator and operate the site without worrying about codes. The designing of the front end and backend of GUI has been done using HTML (hyper text markup language), CSS (cascading style sheets), PHP, JavaScript and jquery. Only an authenticated and authorized user can access the backend.

The BRIC website uses server side scripting. It means that all codes are executed on the server before data are passed onto the user's browser. The dataflow diagram (Figure 3) provides a synoptic view to working of the site. When a user seeks information at the BRIC website (step 1), the request is sent to the server (step 2). The server, consequently, displays a list of plant species (step 3). The user may then select a particular plant on which he/she wants information (step 4). This request is then processed by the server (step 5). It then collects all the information using unique id of that particular plant species and passes on the information to the user's

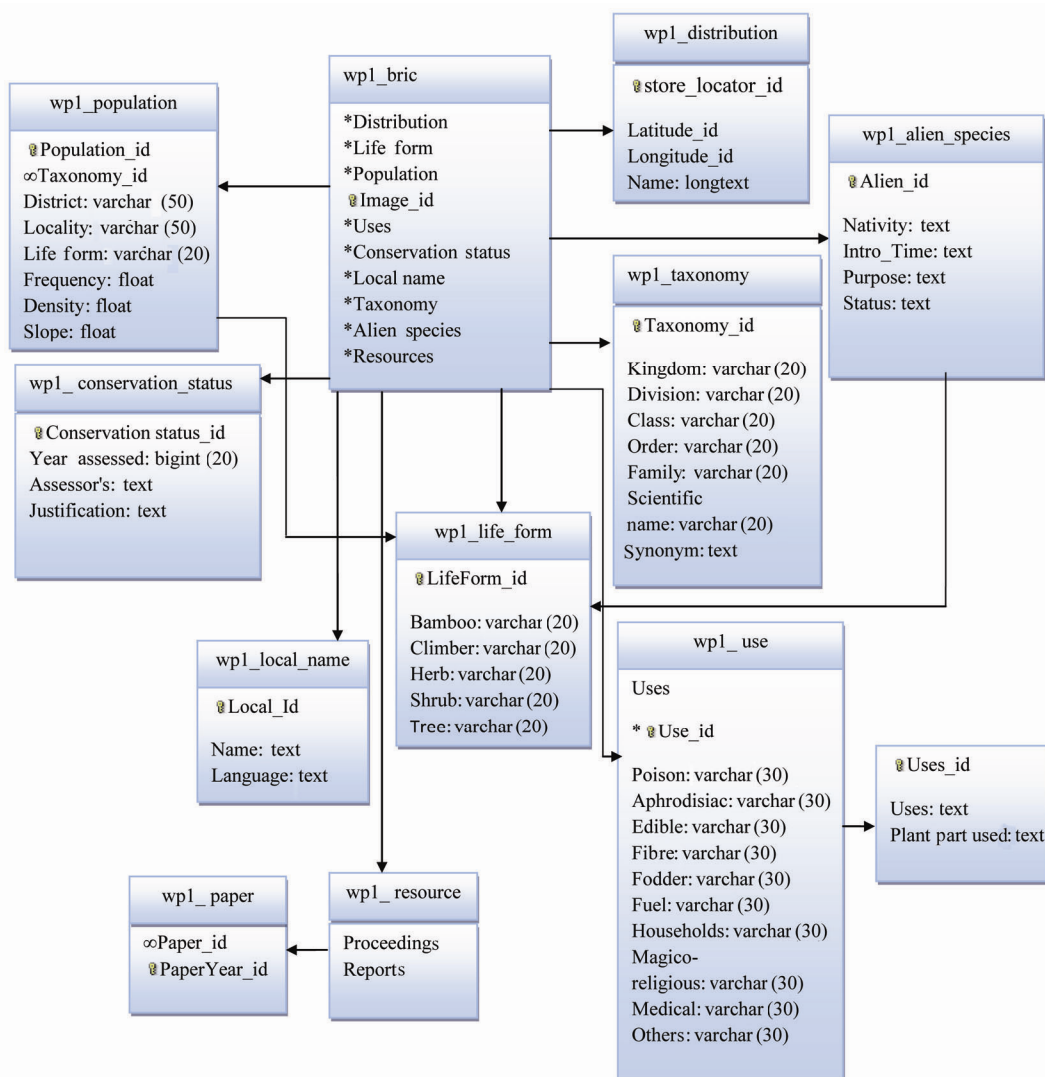


Figure 2. Linkages in the BRIC table.

browser (step 6). The information is then displayed (step 7). The site is compatible with all major browsers [Firefox (latest version), Chrome (latest version), Safari (latest version), Internet Explorer 9] and operating systems [Windows (32- and 64-bit) 2003, 2008, Windows 7, Windows 2012, Mac OS 10.7, 10.8, HP-UX 11i V3]. It is best viewed at 1027 × 768 resolution.

The site provides for both basic and advanced search options. Basic search allows the user to look for any specific information such as on life form, uses, conservation status or a combination of these. On the other hand, advanced search allows the user to choose data fields from which he/she wishes to display the results. Whenever a visitor searches for a particular plant species, the result is provided in form of a table. In advance search, the use of AJAX (Asynchronous JavaScript and XML) technology allows for faster loading of information by limiting the display of unnecessary information. Table 2

summarizes the characteristics of the output displayed on the site after a search is run for a plant species. Here ‘varchar’ denotes data stored in the form of text, ‘float’ denotes data stored in the form of decimal number and ‘longblob’ denotes images.

### View of the site

Home page of the site carries an introduction and image gallery (Figure 4). In the side bar of the home page, there is a ‘search’ option which can be used to search the desired information across the site. The ‘latest news’ column is self-explanatory and scrolls the happening and newest information. ‘New plant’ provides information on unique and noteworthy additions to the database such as plants that were not earlier reported from Himachal Pradesh, or plant species that have been recollected after a long gap<sup>17</sup>.

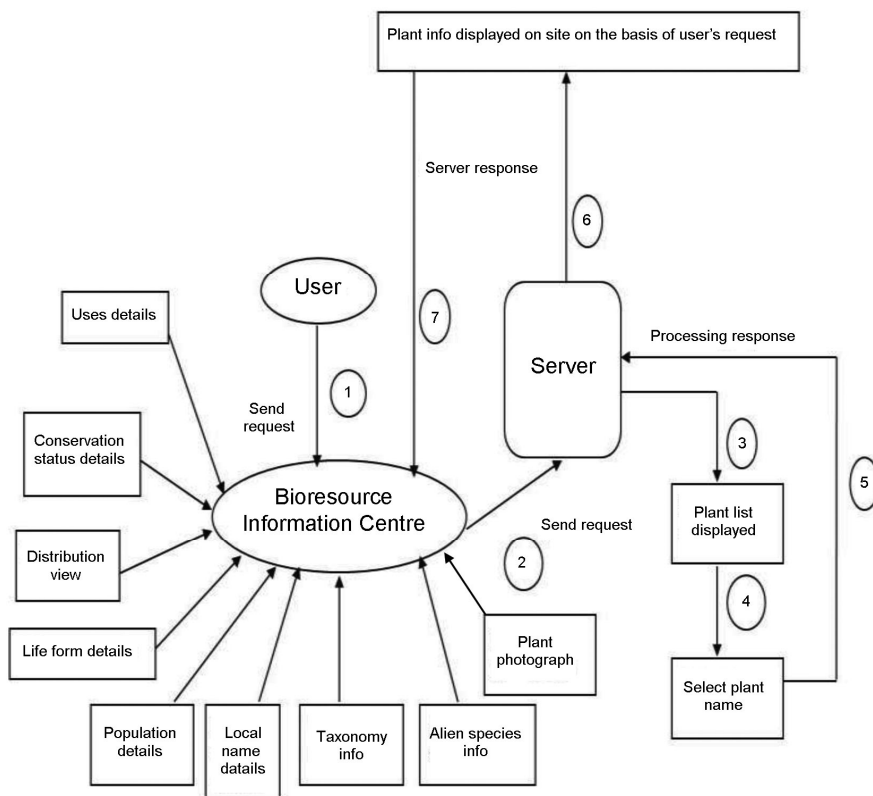


Figure 3. Data flow diagram explaining working of the site.

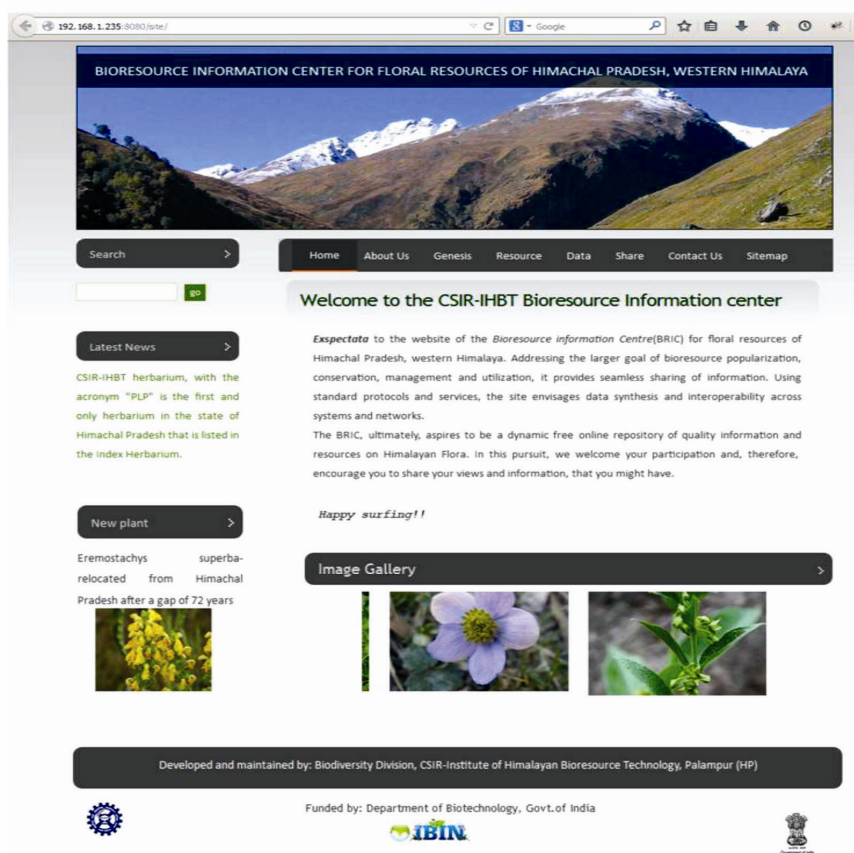


Figure 4. Screen shot of BRIC home page.






**Figure 5.** Screen shots of different pages on the website. *a*, this page allows the user to choose from the different search options; *b*, List of plants displayed once the selection is made in *a*; *c*, Localities displayed on the map, when distribution option is selected in *b*; *d*, Folk uses are displayed when ‘uses’ option is selected; *e*, Conservation status of species; *f*, Image of the species when the said options are selected.

The various menu options on the home page include ‘About Us’. This menu carries information on the mandate and activities of the host organization, i.e. CSIR-Institute of Himalayan Bioresource Technology. ‘Genesis’ provides a background to the origin, conceptualization and development of this on-line repository. ‘Resource’ contains freely accessible published papers, proceedings and reports. The page named ‘data’ is the main repository as it contains all the key information. This page contains many search options like distribution, taxonomy, vernacular names, population, conservation status, uses, image. ‘Alien species’ link has information on the alien flora of Himachal Pradesh. This page has information on nativity, introduction and status of alien species.

A user can choose from any of the options listed above. As an example, when an user clicks on distribution, a list

of plant species housed in the database is displayed (Figure 5 *a*). Then user selects a plant species on which information is desired. In this case it is *Picrorhiza kurroa* (Figure 5 *b*). As soon as a particular plant species is selected, its spatial distribution on the map is displayed (Figure 5 *c*). These are the various localities where the species was recorded during our field surveys. At the same time, below this map, options are available to look for taxonomy, local name, population, conservation status, uses and image of the selected plant species. When ‘uses’ option is selected, the output displays folk use of the said species (Figure 5 *d*). The user can select any of the options such as ‘conservation status’ (Figure 5 *e*) or image (Figure 5 *f*) to get the relevant information. This is a dynamic site which is planned to be updated on a fortnightly basis.

**Table 2.** Examples of the data design format used

Field	Data type	Example
Kingdom	Varchar	Plantae
Division	Varchar	Tracheophyta
Class	Varchar	Magnoliopsida
Order	Varchar	Dipsacales
Family	Varchar	Linnaeaceae
Scientific name	Varchar	Abelia triflora R.Br. ex Wall
Local name	Varchar	Gogti
Synonym(s)	Varchar	<i>Zabelia buddleioides</i> (W.W. Sm.) Hisauti & H. Hara
District	Varchar	Kinnaur
Life form	Varchar	Herb
Frequency	Float	8.3333%
Density	Float	0.0833/sq. m
Slope	Float/integer	28 (degrees)
Uses, plant part used	Varchar	Leaf, fodder
Image	Longblob	

Additionally, the site allows for two-way communication. The user can share any information on a species with the BRIC using the 'share' menu on home page. This menu opens up a small form. Filling up this form transfers information to the administrator of BRIC. The data are then validated/authenticated. In addition to available floras, validation is done using Integrated Taxonomic Information System (<http://www.itis.gov/>) and The Plant list (<http://www.theplantlist.org/>). 'Contact us' form is also available on the site for queries and suggestions. The 'sitemap' menu provides information on the structuring and location of pages. This helps in directly accessing all the links. In the near future, we aspire to complete, enrich and populate the site using the relevant floras. Flora of Himachal Pradesh will be the starting point<sup>18</sup>. Expanding its scope and geographical coverage is also being looked into.

Thus BRIC aims to be a comprehensive on-line repository on the flora of Himachal Pradesh. It is expected that it will serve the goal of seamless sharing of data/information such that all interested are benefitted.

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