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Evaluation of Woody Plant Resources in Guangxi and Their Landscape Effects under the Background of HIBL

Pengbo Yan, Zhangting Chen, Lingli Zou, Xuedian Wang*

School of Tourism Management, Guilin Tourism University, Guilin, 541006, China
wxd@gltu.edu.cn
**Corresponding author*

Abstract: *Due to the support and affirmation at the national level, the popularity of Hands-on Inquiry Based Learning (HIBL) in China has gradually increased, and HIBL projects have been carried out in full swing. In this context, the construction of HIBL resources plays a prominent role in supporting the market. Taking typical cities in Guangxi (Nanning, Guilin, and Beihai) as examples, this study sorted out the data of woody plant resources, including the process of unification and naturalization of urban tree species names. The naturalization of tree species names is organized according to the latest natural classification system APG IV, and the Chinese names are reconfirmed based on Flora of China. By classifying the urban tree species data at the level of ecology and landscape (such as typical vegetation characteristics of typical cities in Guangxi, tree species in unique cities in Guangxi, introduction of urban tree species, landscape resources, and tree species with food source functions), a list of tree species suitable for the development of HIBL botanical course resources in Guangxi was obtained for the development and planning of follow-up HIBL courses. This study provides some theoretical support for the planning and development of plant resources, plant identification, and ecological HIBL projects in Guangxi.*

Keywords: *Tourism, Urban trees, HIBL course development*

1. Research background

The HIBL was first proposed to explore a brand-new educational method [1]. Since the "National Tourism and Leisure Outline (2013-2020)" put forward the "gradual implementation of HIBL for primary and middle school students", the popularity of HIBL in China has continued to heat up. China puts great emphasis on educational travel, believing that it can help students to better understand the world, broaden their horizons and cultivate their cultural literacy. The government has made great efforts to promote educational travel, providing subsidies and other support to educational travel agencies. HIBL also provides families with multi-dimensional educational methods and tourism forms, and also promotes the integration of education and tourism. China has always attached great importance to education. In addition to traditional curriculum education, art and sports interest classes that broaden horizons have also played a positive role in improving middle school children's academic performance [2]. It is important because they provide students with an opportunity to experience different cultures, explore new places, and we could learn about the history and culture of a particular region. They also help students develop important skills such as teamwork, problem-solving, and communication. Additionally, study tours could also help to build relationships between students and teachers, and can provide students with an opportunity to build self-confidence and gain a better understanding of the world. Therefore, the HIBL project has been highly praised and sought after by parents and children from all over the world since its launch, and will continue to be attractive in the future. Although the global tourism industry has been hit hard by the new crown epidemic since the beginning of 2020, the demand for tourism projects such as parent-child travel and HIBL still has a market size of 100 billion yuan. Correspondingly, the registration scale of HIBL companies has reached more than 30,000 in 2021[3]. Under the background that people have been restricted by the epidemic for a long time, being able to participate in HIBL has become the expectation and desire of countless parents and students.

The advancement of urbanization has increased the number of urban populations, and natural appreciation courses can make up for the existing urban life forms to a certain extent. Guangxi's unique geographical conditions determine that its vegetation resources also have unique advantages in

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developing HIBL courses. Woody plants are the main body of plant resources, and their landscape effects and ecological functions directly determine their application in production and life. They are very important educational content in the subject design of academic HIBL. Students' in-depth understanding of woody plants through HIBL can not only cultivate professional interest, but also cultivate sentiment, which is beneficial to body and mind. HIBL of plant is important for gaining a deeper understanding of how plants grow, interact with the environment, and how they can be used for human benefit. These trips allow students to explore and observe plants in their natural environment, which provides invaluable insight into their characteristics and behavior. Additionally, plant research trips can provide an opportunity to learn about the ecology of a particular region, as well as the cultural and historical significance of the plants in that area.

Guangxi is a beautiful region in China, with a diverse range of landscapes, from the lush tropical rainforests of the south to the majestic mountains in the north. As such, it is an ideal destination for educational and recreational trips for students, teachers and families alike. The natural scenery of Guangxi is especially appealing, with its abundance of rivers, lakes, waterfalls, caves and other natural wonders. There are a variety of national parks and reserves that offer visitors the chance to explore the region's natural beauty, as well as to observe and learn about the local flora and fauna. In recent years, the number of educational and recreational trips to Guangxi has been increasing, with more people taking part in outdoor activities such as hiking, camping, bird watching and rock climbing. There are also a number of guided tours that provide a more in-depth experience of the region's natural beauty. In addition, there are a number of other attractions in Guangxi, such as ethnic villages, ancient towns, and cultural sites, which provide a unique insight into the region's history and culture. Overall, Guangxi is a great destination for educational and recreational trips, with its stunning natural scenery and its rich cultural heritage. The design of existing natural ornamental HIBL routes usually relies on various rural science popularization demonstration bases, botanical gardens and other places with existing resources, and the design of plant courses is set around the plant learning of a specific plot [4-6]. For example, as early as 2004, the plant ecology experience HIBL course at the University of Mary Washington set up plant planting content, allowing participants to interact with plants from the perspective of cultivation techniques [7]. Since the essence of HIBL is different from other tourism lies in the embedding of knowledge and its educational function, the knowledge level is one of its important contents, but from the perspective of knowledge system construction, the existing HIBL content is not perfect enough [8]. Among them, the problem of curriculum resources is considered to be one of the bottlenecks in the promotion of HIBL [9]. With the development and practice of HIBL courses, the industry has gradually realized that the curriculum system is the soul of HIBL projects [10]. In this regard, there are still some deficiencies in the existing HIBL projects at home and abroad, and the HIBL content of the knowledge system dimension is relatively weak [8].

At present, the resources of study tour courses are mainly divided into two categories: physical resources and digital resources. Physical resources refer to the resources that can be seen and touched, such as textbooks, teaching materials, classroom facilities and equipment, etc. Digital resources refer to the resources that can be accessed through the Internet, such as online courses, videos, resource data, and audio materials. In terms of physical resources, study tour courses are mostly based on textbooks and teaching materials, supplemented by relevant classroom facilities and equipment. However, there are still some shortcomings, such as the lack of teaching materials, the outdated teaching materials, and the lack of equipment. In terms of digital resources, study tour courses are very rich. There are many online courses, videos, and audio materials on the Internet. In addition, various online study tools, such as online quizzes and interactive games, are also available. Overall, the resources of study tour courses are quite abundant, but the quality of digital resources is indeed very important. A larger range of resources can support a larger range of HIBL activities. This study collected and sorted out the typical woody plant resources in Guangxi cities, starting from the perspective of plant attributes, sorted out the types of plant resources and the specific content of the support for HIBL courses. This study intends to provide theoretical support for HIBL woody plant resources in Guangxi, and provide systematic materials for the course construction of HIBL industry.

2. Research objects

This study takes the flora, landscape and ecological perspectives of urban woody plants in Guangxi as the research object, and sorts out the typical woody plant resources in Guangxi cities. Due to the relatively mature infrastructure in the city, it can become an important carrier for HIBL projects. In this study, typical cities in Guangxi are selected as data analysis sample points, and the range of urban built-up areas in Guangxi and woody plant species in urban parks are used as HIBL courses. Supporting

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resources for content construction. According to the principle of vegetation zonality, there are similar plant species in similar climatic conditions. This study selected the typical cities Guilin and Nanning and the coastal city Beihai according to the TNC (The Nature Conservancy) climate division [11].

3. Research methods

Since the beginning of 2020, China has been suffering from the impact of the new coronavirus, and various places and units are often in a closed and semi-closed state. Based on this background, data collection adopts the method of publishing data on the Internet and citizen science as a way to assist field research and obtain research data.

After collecting the literature data, survey data and social science source data, data naturalization and flora classification are carried out, and the ecological attributes and landscape characteristics of each plant are evaluated, and then the total data that can be used for the design of HIBL courses are obtained.

3.1. Data Collection

(1) Collect and summarize tree resources within the built-in urban areas of cities in Guangxi through public literature data. In the study of urban green spaces, landscape scientists have investigated the state of greening in different cities. Among these, survey data showing the types of trees used by the city were collected in this study as part of the typical flora of the city. During the collection process, the search terms of city name + tree species/greening/trees were used to search the documents containing the content of urban green space survey on CNKI (China National Knowledge Infrastructure), and then extract the tree type data; (2) Conduct field surveys on typical cities in the form of typical sampling, Record the plants within the reach of roads, parks, commercial areas, residential areas, etc., and record the plant species; (3) Collect and use citizen science data. Share the obtained data with the mobile application UTrees platform in exchange for public data.

Based on the accessibility of tourism, this study selects the areas that tourists can enter as the judgment standard for whether to collect data, that is, collects the list of tree species in cities, scenic spots, scenic spots and other areas in Guangxi that are generated through field surveys from the published data. After the initial screening of the data, the data that meet the following selection criteria are retained: (1) The list of tree species mentioned in the data needs to be collected based on field surveys, that is, the data of tree species that actually exist in the city; (2) The scope of the survey is mainly within the city or Botanical gardens with high accessibility and openness around the city, etc.

3.2. Data naturalization

In different surveys, different authors used different plant naming methods, and the plants' Latin names also adopted different plant classification systems, so the naming of the same plant was slightly different in different documents. Here, we spent a lot of time in domesticating the Latin names of these plants with different plant classification systems. In response to this problem, this study summarizes the tree species data in the list, and then confirms the tree names one by one according to the APG IV system. Plant names are unified in accordance with the International Code of Nomenclature for algae, fungi, and plants[12], and cultivar names are unified in accordance with the International Code of Nomenclature for Cultivated Plants[13]. Arranged to the level of species, the Chinese name of the species name is sorted into the corresponding Latin name based on the full-text electronic version website of FRPS "Flora of China".

In the process of data naturalization, the original text names, common names, and scientific names named after different classification systems were proofread and unified into the Latin names of the APG IV system.

3.3. Flora data

The floristic data is judged by the APG IV system as the family, genus and species. According to climate divisions, the characteristics of plant species composition in different climate zones were judged. Among them, the determination of the natural distribution range of tree species is based on the records of "Atlas of Woody Plants in China" [14].

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3.4. Plant functional data

The plant function data come from China Online Flora, "Dirr's Encyclopedia of Trees and Shrubs" (Dirr, 2011), Hoticopia, The Encyclopedia of Life (V3), Select Tree, the PLANTS Database, etc. Plants are essential to life on Earth, providing oxygen, food, and habitat for countless species. They are also a source of medicine, fuel, and fiber. Plants absorb carbon dioxide from the atmosphere and release oxygen, helping to regulate the Earth's climate. They also help to purify the air, reduce soil erosion, and provide a home for animals and insects. Woody plants are important components of the environment. They provide food and shelter for wildlife, prevent soil erosion, and improve air quality. Woody plants also provide shade, reduce noise pollution, and help to regulate water flow in watersheds. In addition, they can be used to create habitats for a variety of species and can be used to restore damaged ecosystems. Woody plants also play a role in carbon sequestration, which helps to reduce the effects of climate change. The data mainly includes the landscape functions of plants: viewing flowers, leaves, fruits, postures, etc.; ecological functions: water conservation, species diversity, symbiosis, etc.; food source functions: urban tree seeds can provide survival for small animals in the city necessary food source. But for cities, urban residents prefer to have rich bird diversity in cities, so the food source functions considered in this study are mainly those that can provide food sources for birds.

4. Results

Through the above process, this study collected a total of 1965 urban tree species survey data in Nanning, Guilin and Beihai. After the collected data were naturalized, there were 319 genera and 635 species in 105 families, including 194 exotic tree species. Rich tree species data can be used to support the design and development of various types of HIBL courses.

Among the three selected typical cities, the types of green space trees showed certain differences in terms of diversity. Among them, Nanning City has the highest number of urban tree species, which is a good choice for HIBL destinations. Among the three cities, although Beihai has the best hydrothermal conditions, the number of common tree species in its green space is relatively small. The three cities show their own uniqueness, and they all have advantages as HIBL destinations. Different HIBL courses can be designed according to the characteristics of each city. As shown in Figure 1.

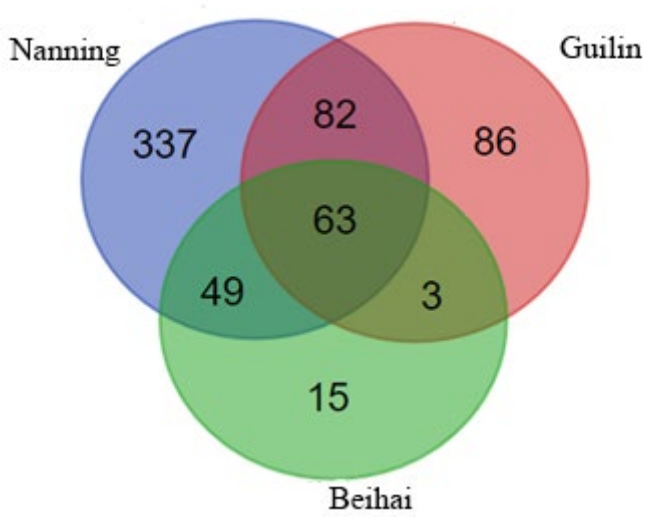

Figure 1: Comparison of tree types (including cultivated species) in typical urban green spaces in Guangxi.

The development of urban HIBL courses relies on existing urban resources, such as parks and public green spaces, and the implementation of courses is relatively easy. Therefore, the plant resources here are summarized and sorted out. As the content that can support the HIBL woody plants in Guangxi, the urban tree species data can be divided into the following categories:

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4.1. Characteristics of typical vegetation in typical cities in Guangxi

The unique flora formed under the unique geographical and climatic conditions of Guangxi. In cities, although the richness of plant species is far from the level of natural distribution, it has also formed resources with unique local characteristics. In this statistics, the common tree species in Guangxi are mainly native plants, among which 355 are native species (that is, the species whose origin is local in Guangxi). Generally speaking, the vegetation in Guangxi presents obvious subtropical vegetation zonal characteristics, but a large number of tropical and subtropical regional plants have also been introduced as a supplement to urban greening. Therefore, it embodies the obvious characteristics of suitable trees in the local area, that is, to use trees suitable for the local climate conditions as the main material of urban green space. The typical plants in Guangxi are mainly sub-tropical plants, characterized by lush foliage, strong vitality, and rich species. There are many rare and precious plants, such as dragon's blood tree, bamboos, palms, loquat, etc., which are of great scientific and ornamental value.

4.2. Species of unique urban trees in Guangxi

The species of trees in this group are mainly native species in Guangxi, that is, the original habitat range is native species in Guangxi. In the existing urban green space, due to the long-distance transportation of seedlings, the phenomenon of homogeneity has appeared in the landscape construction of each city, especially in areas with similar climatic conditions, this phenomenon is more obvious, such as sheep hoof beetle, banyan tree. There are many applications in cities in South China. The plants of Guangxi are unique in their high species diversity, with a wide variety of tropical and subtropical plants. The region is home to many rare and endangered species, including the Chinese yew, Chinese mahogany, and the Canton lily. The region also has a large number of endemic species, including the endangered Chinese white pine, and it is also the birthplace of dawn redwood and so on.

4.3. Introduction of urban tree species

In the construction of urban green space, many excellent tree species from abroad have been introduced into China. For example, exotic tree species such as white orchid and lotus magnolia, which are widely used in cities, provide cities with olfactory and visual landscape effects, and gradually become indispensable members of cities. Although the influx of exotic tree species from various places provides landscape resources for urban green spaces, sometimes there are ecological risks in this process. For example, the introduction of the coconut wood moth (*Opisina arenosella* Walker) specifically harms plants of the palm family and Musa family [15]. Urban trees are trees that are planted in urban areas such as cities, towns, and suburbs. They provide many benefits to the environment, such as reducing air pollution, providing shade, and increasing the aesthetic value of the area. They also provide habitat for wildlife, help to reduce noise, and can help to reduce the urban heat island effect. Urban trees come in many varieties, such as evergreens, deciduous, flowering, and fruit trees. For the youth, knowing and understanding the plants around them can stimulate their enthusiasm for nature, environment and life.

4.4. Summary of landscape resources

Table 1: Summary of landscape resources of common woody plants in typical cities of Guangxi.

Serial number	Door	Viewing flowers	Foliage	Observing fruit	View attitude	Typical plant
1	Angiosperm	357	26	34	58	Caryota *ochlandra* Hance., *Osmanthus fragrans* Lour., *Delonix regia* (Hook.) Raf., etc.
2	Hydephyta	3	3	2	11	*Cycas micholitzii* Dyer, *Taxus chinensis* var. *mairei* (Lemée & H.Lév.) WCCheng & LKFu), *Taxodium distichum* (L.) Rich., etc.

Landscape resources mainly include tree species related to vision and smell. Among them, the flower viewing resources mainly include sweet-scented osmanthus, sheep's foot beetle, kapok, etc. The foliage viewing resources are mainly divided into colorful-leaf tree species resources and special-shaped leaf tree species resources, such as the colorful-leaf tree species Chinese tallow tree, and the violin-like banyan leaf. The concept of posture is mainly reflected in the unique shape of trees, such as the tall and straight palms and Nanyang colors, and the collocation of vines such as twig and the building.

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Ornamental plants are mainly fruit with bright colors or strange shapes, such as Japanese Ardisia (*Ardisia japonica* (Thunb) Blume) and jackfruit. See Table 1.

4.5. Urban Ecological Status

In addition to being important producers in the urban ecosystem, existing urban trees also serve as the main support to provide symbiotic and epiphytic environments for other plants, allowing these plants to grow under the shade of trees or directly attached to tree trunks to form a unique local ecology system. The types of trees that can provide an environment for epiphytes are not specific. Except for deciduous species such as ginkgo and Chinese tallow tree and semi-deciduous species such as kudzu, evergreen species such as camphor and jujube are more suitable as epiphytes. Appendages refer to the attachment environment of mosses, oak ferns, epiphytic orchids, and some endives. Urban plants play an important role in the urban ecosystem, providing food and shelter for wildlife, improving air quality, reducing urban heat island effects, and beautifying the cityscape. They also help to reduce noise pollution, and improve the quality of life for city dwellers. Epiphytic plants are plants that grow on trees, often without causing any harm to the tree. They use the tree as a support to reach sunlight and obtain nutrients and water, but they do not take away resources from the tree. This is quite different from strangulation plants (Figure 2).

Figure 2: Symbiosis of trees and herbs in cities (Photo by YAN Pengbo).

4.6. Food source function

Plants have the ability to provide food for other organisms through their photosynthetic process. Through this process, plants are able to convert light energy from the sun into chemical energy in the form of carbohydrates. This energy is then available to be consumed by other organisms, such as animals, fungi, and bacteria. Birds play an important role in cities by helping to maintain the balance of the local ecosystem. They provide natural pest control, pollinate plants, disperse seeds, and consume insects that can spread disease. Birds also provide a source of beauty and pleasure, bringing life and color to urban areas. Trees in cities provide a source of food for birds, such as nuts, berries, and insects. They also provide shelter and nesting sites for birds, as well as a place to perch and rest. As a food source for small urban animals such as urban birds and small animals, urban trees also participate in the construction of urban ecological environment. It is precisely because of the shelter and food source functions provided by urban trees that people can experience the chirping of insects and birds in the city, making urban life more vivid. The extensive use of camphor and kudzu trees in various cities provides a large number of

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fruits as food for urban small animals, which is an important support for ecological diversity in cities.

5. Discussion

For the summary of native woody plants, there is no significant difference within the city limits. Although most areas of Guangxi are located in the subtropical zone, the types of vegetation are very rich, but the types of green trees in Chinese cities are greatly affected by human factors. In most urban green spaces in China, there are only more than one hundred species of urban trees. Compared with the species of woody plants in urban green spaces in China, Guangxi's typical urban woody plant resources are still relatively rich [16]. The main difference between a city tree species and a natural distribution tree species is that the former is planted and maintained by humans, while the latter is naturally occurring in the wild. City tree species are usually chosen for their aesthetic value, while natural distribution tree species are chosen for their ability to survive in the local climate and environment. City tree species may also be chosen for their ability to provide shade, reduce air pollution, or provide other benefits to the local environment. Therefore, when we choose urban tree species according to human preferences, the distribution of tree species in cities is quite different from that in nature.

The research results can provide a basis for the design of HIBL courses. Data resources in a larger area can support a larger range and more in-depth HIBL courses. For example, these data can support the design of HIBL courses within the scope of Guangxi's global tourism, and can provide knowledge-level data for the design of large-scale plant HIBL courses across cities. The course content that can be designed includes ecological science, plant species identification, and the symbiosis between trees and endemic plants (such as chicory, ferns, etc.). In future research, the data can also be refined, such as refining the landscape functions of trees into landscape functions in different seasons. The data can also support the construction of HIBL courses across time scales, such as the HIBL courses of autumn plant color landscapes. Here is an example of HIBL course Framework under this research: (1) To understand the different types of plants and their characteristics in this research, for example, ornament plant in Guilin city. (2) To learn about the different landscape function of these plants, for example, in spring time, Guilin is surrounded by blooming flowers, such as cherry blossoms, Bauhinia ‘gongfen’ blossoms, and Hibiscus honghuaensis flowers, creating a picturesque landscape. In summer, the mountains and rivers are lush and green, and the trees are filled with vibrant leaves. In autumn, the leaves start to change color, creating a stunning display of red, osmanthus bloomed and the city was fragrant. In winter, the trees such as *Fagus* spp. also in green color. (3) To explore the different habitats of plants and the importance of preserving them. (4) To gain knowledge of the different uses of plants and their importance in our lives. Activities: (1) Field trips to different plant habitats and botanical gardens. (2) Lectures and discussions on the different types of plants, their characteristics and uses. (3) Hands-on activities such as planting, propagating, and harvesting plants. (4) Group projects to research and present on a chosen plant species. (5) Outdoor activities such as nature walks, bird watching, and camping. (6) Laboratory experiments to learn about the different parts of plants and their functions. Evaluation: (1) Quizzes and tests to assess comprehension of the material. (2) Group projects and presentations to assess teamwork skills and knowledge. (3) Participation in activities to assess engagement and enthusiasm.

In the future, HIBL in Guangxi will continue to develop, with more diverse and interesting itineraries, better services and more convenient travel. It will become an important part of people's leisure life, and bring more fun and knowledge to people. This study provides a set of methods for collating woody plant data, and the obtained data can be used for the construction of HIBL courses. This study collected the data supported by plant HIBL in Guangxi by summarizing woody plant data, and provided ideas for the collection and construction of HIBL course data in other disciplines.

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