Advances in Humanities Research Vol.12 Issue 2 EWA Publishing
Available Online: 28 May 2025 DOI: 10.54254/2753-7080/2025.23456

Research on the benefits of Cultural Keystone Species conservation on enhancing local communities' sense of place: the case of Guangzhou, China

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Abstract. This study investigates the potential for Cultural Keystone Species (CKS) historically nurtured by Guangzhou Traditional Central Axis to enhance Sense of Place in contemporary communities within its boundaries, addressing the ruptures caused by the city in the Lived and Materialized Layers of the people-place relationship. It is therefore hypothesized that reintroducing these species can enhance visitors' Sense of Place. The study focuses on three thematic CKS: Daily Life, Biodiversity Resources, and the Exchange of Goods and Knowledge. The social benefits of CKS implantation are examined in the form of structured interviews based on three Sense of Place sub-dimensions: Place Dependence, Emotional Attachment, and Place Identity. The results show that all three CKS categories significantly improve the overall Sense of Place, and different CKS types have different abilities in placemaking: culturally oriented species strengthen intangible connections through shared memories and practices, while biodiversity-focused species emphasize specific ecological functions. This study introduces a correlation analysis framework between CKS and Sense of Place, providing theoretical and practical support for the realization of ecological and cultural synergistic regeneration in the renewal of contemporary urban historical environments.

Keywords: Guangzhou Traditional Central Axis, biocultural conservation, Cultural Keystone Species, sense of place

1. Introduction

In the process of urbanization, unintentional neglect of plant species due to people's limited access to nature, and plant design in gardens has led to the marginalization of many fine native species in pursuit of short-term landscape effects. Due to the single aesthetically oriented planting selections, such as seasonal species for road landscaping, specifically the municipal landscaping in cities is dominated by short-cycle replacement of seasonal species, which to a certain extent guides and influences the public's aesthetics and perceptions. Short-cycle replacement of time-flowering species does not ensure the ecological function of the place, but also misses the role of good native species in local culture and memory. Some native species may have been abandoned because their appearance does not meet current aesthetic standards, but these species may have played an important role in local history, religion or social activities. Their absence means not only the reduction of biodiversity but also the loss of cultural memory. The enhancement of human experiences, feelings and perceptions of nature in that process will be further hampered, and is one of the key reasons for the weak Sense of Place. The above phenomenon is typical of the break between the Materialized and Lived Layers within the framework of Biocultural diversity.

In summary, the question is clear: what are the Sense-of-Place benefits of Cultural Keystone Species relative to other species? That is, can Cultural Keystone Species be utilized to bridge the gap between the Materialized and Lived layers of the Biocultural diversity framework?

2. Concept

2.1. Cultural keystone species

The concept of Cultural Keystone Species (CKS) provides a new solution to the above problems by emphasizing the cultural value and ecological importance of species. By incorporating these species into urban greening and landscape design, the sense of place in urban spaces can be enhanced and the quality of life of residents improved.

Species can have different labels depending on their contribution to the ecosystem and other species. Examples include Keystone Species, Indicator Species, and Umbrella Species [2]. Each of these taxonomic labels helps to provide an understanding of the specific functions and interactions of these species to the ecosystem. The concept of Keystone Species has a long history in ecological analysis, and it is where the concept of Cultural Keystone Species originated, first mentioned by Theodore M. Barkley and Paula DePriest in 2004 [4]. Cultural Keystone Species are those species in a cultural system that, because of their religious, economic, historical or social importance, are essential to the continuation and identity of the local culture. These species are not only important components of natural ecosystems, but also profoundly influence the formation and development of human culture.

The concept of Cultural Keystone Species (CKS) was first systematically defined by Garibaldi and Turner in 2004 as a species that shapes the cultural identity of a people in a major way as part of the multiple and entangled relationships between species and the socio-ecological systems in which they exist. As shown in Figure 1, the term CKS captures the relationship between a particular society or population and its environment through the definition of a species that plays a prominent role in the culture of that society or population. However, the vagueness and richness of definitions of CKS by different scholars have hindered its clear application.

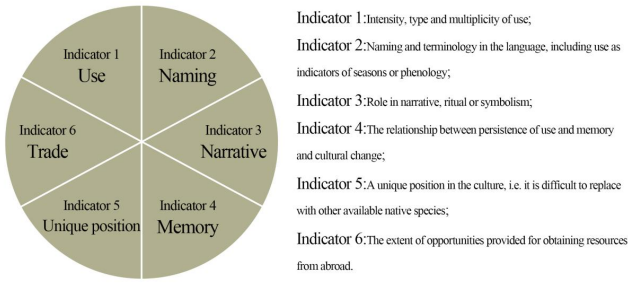

Figure 1. The 6 elements of CKS
Figure credit: Author's own drawing

2.2. Sense of Place

The definition of Sense of Place by Université du Québec à Montréal has been cited by many scholars: Sense of Place refers to the emotional connection and significance that an individual or a group of individuals have to a particular place, which includes not only the perception of the physical environment, but also involves a multitude of factors, such as emotions, memories, cultures and social interactions. Sense of Place is a complex emotional experience that reflects the deep connection between people and their environment, and is an important part of identity and social belonging.

Regarding the dimensional structure of the Sense of Place, as shown in Figure 2, the classic two-dimensional structure of the Sense of Place was first proposed by Daniel Williams and Joseph Roggenbuck in 1989 that Place Attachment consists of Place Dependence and Place Identity [5]. In 1992, Low Setha M. studied the process of Place Attachment from the perspective of environmental psychology and concluded that Sense of Place is categorized into Place Dependence, Place Attachment, and Place Identity [3]. The difference between Place Dependence, Place Attachment and Place Identity is mainly manifested in the logical relationship between the three: Place Identity, Place Attachment and Place Dependence are juxtaposed as sub-dimensions of Sense of Place. (i) Place Dependence is one of the core dimensions of the traditional Sense of Place, emphasizing an individual's dependence on the functional needs and resources of a specific place. For example, the facilities, environmental conditions, etc. of a particular place fulfill the needs of an individual, thus creating a dependency relationship. (ii) Place Attachment is another important dimension that refers to an individual's emotional bond and psychological connection to a specific place. This attachment is usually based on the individual's interactions, memories and emotional experiences with the place. (iii) Place Identity involves an individual's cognitive and emotional identification with the culture, values and social roles of a particular place. This identity reflects an individual's sense of belonging and self-definition in a socio-cultural context.

Figure 2. The 5 dimensional structures common to Sense of Place
Figure credit: Author's own drawing

The Sense of Place based on Cultural Keystone Species incorporates object assessment dimensions and assessment logic from perspectives such as Environmental Psychology and Landscape Architecture. The implantation of Cultural Keystone Species is not a direct response of people to plant species, but rather a response to the place in which it is found, triggered by the plant species. Among them, Cultural Identity, as its core link, compensates to a certain extent for the omission of the mutual detachment of people, objects and places in the evaluation system of Sense of Place, and bridges the rupture between the Material and Lived layers in the framework of biocultural diversity. Thus the use of a novel dimensional analysis is more conducive to the accurate evaluation of places shaped by species with culture as a connecting link. The novel dimension is (i) functional Dependence. Functional Dependence in the novel dimension continues the traditional focus on the functionality of place in the traditional Sense of Place, but with a greater emphasis on the individual's dependence on an object or environment in meeting his or her needs and goals. (ii) emotional Attachment. Emotional Attachment is further refined in the novel dimension to include not only emotional ties to the location, but also extends to the emotional experience of the location's memory, history, and culture. This type of attachment may place more emphasis on the individual's interaction and emotional engagement with the object. (iii) cultural Identity. Cultural Identity is given a more socio-cultural dimension in the new type of dimension, emphasizing the individual's social role and sense of cultural belonging in a given location. This identity is not limited to the individual level, but may also involve the construction of community and collective identities.

3. Research content

3.1. Cultural keystone species description

Garibaldi proposed three aspects of the interrelationship between people and specific places and their cross-cutting content in 2015 [1]. As shown in Figure 3, the intersection of culture and environment partly produces Collective Memory, Traditional Activities, Spiritual and Ritual Practices, Language and Stories, Traditional Management. The intersection of environment and socio-economy partly produces Fuel and Shelter, Food Security, Hunting and Gathering, and Biodiversity Resources. The intersection of culture and socio-economics has given rise, in part, to Travel, Exchange of goods and knowledge, and Archaeological Preservation and Tourism. In this case, we screened the cross-cutting content from a Landscape Architecture perspective and categorized it into three dimensions: Daily Life, Biodiversity Resources, and Commodity Flows and Knowledge Dissemination, which are independent of each other. Such a categorization framework will directly guide us in sorting out and applying Cultural Keystone Species.

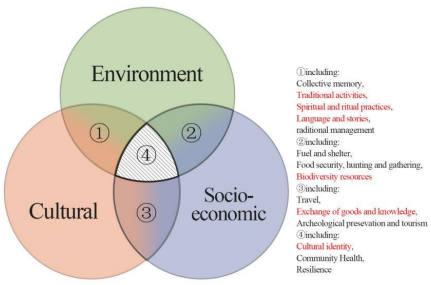

Figure 3. Taxonomic basis for cultural keystone species

3.2. Sense of Place evaluation based on conservation of Cultural Keystone Species

The Signs of Social Memory Vehicles and Socio-Cultural Symbols theme under the Materialized layer of the Biocultural Diversity framework includes two important measurement items: Biological Salient Features and Signs of Prior Use, and the theme of meaning, perception and value for users under the Lived layer includes an important measurement item, Sense of Place. Therefore, on the basis of the above framework of the basic dimensions of Sense of Place, As shown in Figure 4, six indicators under the Cultural Keystone Species are incorporated into the evaluation system, and the quantitative data of the species criticality are extracted through the scoring of the question items associated with the six indicators.

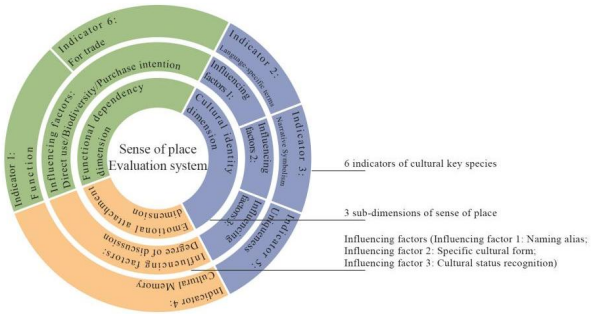

Figure 4. Sense of Place Evaluation system construction
Figure credit: Author's own drawing

3.3. Methods

3.3.1. Experimental evaluation materials

3.3.1.1. Assessment scale

Williams et al.'s Sense of Place Scale[5] is one of the most researched and applied measurement tools, which posits that Sense of Place is composed of two dimensions: Place Dependence and Place Identity. Based on this understanding, Kyle et al. designed a scale to measure the Sense of Place, which was composed of nine items with high consistency coefficients in the scales of selected previous studies, including three items for each of the three dimensions of Functional Dependence, Emotional Attachment, and Cultural Identity, and subjects responded on a five-point Likert scale.

This study also adopts the three-dimensional scale on Sense of Place. Combining the translation and validation of the scale by domestic scholars on the basis of correction according to the characteristics of the research object, 10 of the items are selected, three items in each of the three dimensions to form the current questionnaire, as shown in Table 1.

Table 1. Sense of Place measurement scale of Kyle

Serial Number	Functional Dependence	Emotional Attachment	Cultural Identity
1	You are more satisfied with the environment of X.	You're very attached to X.	X Plays an Important Role in Your Life.
2	What you do at X is more important.	X is special to you.	When you're in X, you feel like you're part of the city.
3	The activities you do at X can't be replaced by any other place.	Your favorite place to go is X.	Do you think X is one of the representative spaces of the city?

3.3.1.2. Assessment questionnaire design - Sense of Place Assessment questionnaire for conservation of cultural keystone species (pre-test, post-test)

Sense of Place Assessment Questionnaire for Conservation of Cultural Keystone Species (pre-test) consists of key items from the Sense of Place Scale to measure the level of sense of place of subjects prior to co-construction. Sense of Place Assessment Questionnaire for Conservation of Cultural Keystone Species (post-test) includes a variable number of detailed evaluation items in the scale questions of the pre-tested questionnaire to measure the extent to which the Sense of Place level of the subjects has increased after the implantation of the Cultural Keystone Species and their experiences, to facilitate the subsequent analysis of the differences in the Sense of Place level of the subjects before and after the co-construction of the questionnaire, and to explore the correlation of the thematic plants and their sub-dimensions of Sense of Place with the overall Sense of Place. The correlation between each Theme Plant and its Sense of Place sub-dimension and the overall Sense of Place was also explored. The detailed

evaluation items for the sub-dimensions are also scored on a five-point scale, with several items in the detailed evaluation of functional dependence, the detailed evaluation of Emotional Attachment, and the detailed evaluation of Cultural Identity derived from the six elements that define Cultural Keystone Species.

3.3.2. Semi-structured interviews prior to co-construction

Interviewees: Community staff, residents and businesses who were willing to participate in the co-construction. A total of 20 people, all of whom were tagged and accepted to be interviewed after the co-construction.

Questionnaire recipients: Staff of the above community, residents and businesses who wish to participate in the co-construction, and visitors. A total of 76 people, all of whom have marked and taken the post-construction questionnaire.

The format was a structured interview, with the following process: as shown in Table 2, users and administrators were interviewed in turn and a pre-tested questionnaire was distributed, where users were self-referred and recommended by the community staff to be included as residents and businessmen willing to participate in the co-construction, and the community staff were arranged by their organizations to be responsible for the whole process of coordination and participation in the co-construction. Another 35 visitors were given pre-tested questionnaires and confirmed their willingness to participate in the follow-up test. The interviews are described as Table 2:

Table 2. Pre-construction interviews

Theme	Dimension	Evaluation Item	Description of Evaluation
Sense of Place evaluation of extant plants	Functional Dependence Evaluation	Overall Evaluation	How much do you rely on the functionality of the place with extant plantings?
		Detailed Evaluation	A. Are extant plants heavily used or have multiple uses in everyday life?
			B. Do you believe that the extant plants enhance the species and habitat diversity of the place?
			C. Are extant plants common in commodity markets (for example, flower markets)?
			D. If the commodity is commonly available on the market, is the willingness to purchase it high?
	Emotional Attachment Evaluation	Overall Evaluation	What is your level of Emotional Attachment to the place where the extant plants are grown?
		Detailed Evaluation	A. Are extant plants ubiquitous and frequently discussed in everyday life in the context of changing living cultures?
			B. Are extant plants ubiquitous and frequently discussed in everyday life in the context of changing urban ecosystems?
			C. Are extant plants ubiquitous and frequently discussed in everyday life in the context of changing species exchange and knowledge dissemination?
	Cultural Identity Evaluation	Overall Evaluation	How well do you culturally identify with the place where the extant plants were planted?
		Detailed Evaluation	A. Do you know the scientific names, dialectal designations or proverbs of extant plants?
			B. Do extant plants enhance your focus on historical cultural connotations, such as historical or present-day occurrences in music, totems, or other cultural forms?
			C. Do extant plants increase your concern for avian insectivores that use plant parts as a food source for nectar?
			D. Do extant plants increase your attention to often-neglected urban habitats such as building skylines and treetops and the biological processes they harbor?
			E. Do extant plants promote your ability to actively learn and communicate with others about plants through a variety of channels such as lectures and the Internet?
			F. Do the extant plants promote your participation in the maintenance of community greenery and sharing or swapping plants with others when appropriate?
			G. Do you think it is difficult to replace extant plants with other native species?

3.3.3. Post-construction revisit and sense of place enhancement benefit quiz

Respondents: Including community staff, residents who have participated in the co-op, businesses who have participated in the co-op, residents who have not participated in the co-op, and businesses who have not participated in the co-op. A total of 38 people, all of whom were marked in the interview stage.

Questionnaire respondents: the above community staff, the above residents who have participated in the co-development, the above businesses who have participated in the co-development, the above residents who have not participated in the co-development, the above businesses who have not participated in the co-development, and the tourists who have visited the place. The total number of respondents was 76, and all of them were marked in the interview stage.

The interviews were structured as follows: as shown in Table 3, a review of the results of the community planting activities; sharing of experiences; a collection of Green Memory stories aimed at collecting residents' experiences and feelings related to plants in their daily lives; and completion of a post-tested questionnaire. The interviews are described as Table 3:

Table 3. Post-construction interviews

Theme	Dimension	Evaluation Item	Description of Evaluation
Sense of Place Evaluation of Daily Life Theme Plants	Functional Dependence Evaluation	Overall Evaluation	Do you rely more on the place with the Newly planted Daily Life Theme Plants than you did before the co-construction?
		Detailed Evaluation	A. Are the newly planted Theme Plants heavily used or have multiple uses in daily life?
	Emotional Attachment Evaluation	Overall Evaluation	Are you more emotionally attached to the place with the newly planted Daily Life Theme Plants than you were before the co-construction?
		Detailed Evaluation	A. Are the Newly planted Theme Plants ubiquitous and frequently discussed in everyday life in the context of the changing culture of life??
	Cultural Identity Evaluation	Overall Evaluation	Do you identify more culturally with a place that has the newly planted Daily Life Theme Plants than you did before the construction??
		Detailed Evaluation	A. Do you know the scientific names, dialectal designations or proverbs of newly planted Theme Plants?
			B. Does the newly planted Theme Plants raise your awareness of historical and cultural connotations, such as historical or present-day occurrences of music, iconography, or other cultural forms?
			C. Do you think it would be difficult to replace the newly planted Theme Plants with other native species considering the importance of plants in daily life?
Sense of Place Evaluation of Biodiversity Resources Theme Plants	Functional Dependence Evaluation	Overall Evaluation	Do you rely more on places that have added Biodiversity Resources Theme plants than you did before the co-construction?
		Detailed Evaluation	A. Do you think the newly planted Theme Plants has improved the species and habitat diversity of the place?
	Emotional Attachment Evaluation	Overall Evaluation	Are you more emotionally attached to a place with the newly planted Biodiversity Resources Theme Plants than you were before the co-construction?
		Detailed Evaluation	A. Are the newly planted Theme Plants ubiquitous and frequently discussed in daily life in the context of changing urban ecologies?
	Cultural Identity Evaluation	Overall Evaluation	Do you identify more culturally with a place that has newly planted Biodiversity Resources Theme Plants than you did before the co-construction?
		Detailed Evaluation	A. Does the newly planted Theme Plants increase your concern for birds or insects that use plant parts as a food source?
			B. Does the newly planted Theme Plants raise your awareness of often-neglected urban habitats such as building skylines, treetops, etc. and the biological processes they contain?
			C. Do you think it would be difficult to replace the newly planted Theme Plants with other native species considering the importance of plants in the Biodiversity Resources?
Sense of Place Evaluation of the Exchange of Goo	Functional Dependence Evaluation	Overall Evaluation	Do you rely more on the place with the newly planted Theme Plants of the Exchange of Goods and Knowledge than you did before the co-construction?
		Detailed	A.Are the newly planted Theme Plants common in commodity

Table 3. Continued

ds and Know ledge Theme Plants		Evaluation	markets (for example, flower markets)?Is your willingness to purchase it high if it is common in commodity markets?
	Emotional Attachment Evaluation	Overall Evaluation	Are you more emotionally attached to the place with the newly planted Theme Plants of the Exchange of Goods and Knowledge than you were before the co-construction?
		Detailed Evaluation	A. Are the newly planted Theme Plants ubiquitous and frequently discussed in daily life in the context of species exchanges and changes in knowledge dissemination?
		Overall Evaluation	Do you identify more culturally with the place where the newly planted Theme Plants of the Exchange of Goods and Knowledge were grown than you did before the co- construction?
	Cultural Identity Evaluation	Detailed Evaluation	A. Does the newly planted Theme Plants promote you to actively learn and communicate with others about plants through various channels such as lectures and the Internet?
			B.Does the newly planted Theme Plants promote your participation in the co- construction and maintenance of community greenery and sharing or swapping plants with others at the appropriate time?
			C. Do you think it would be difficult to replace the newly planted Theme Plants with other native species considering the importance of plants in the exchange of goods and knowledge?

4. Results

4.1. Statistical results

4.1.1. Reliability and validity analysis

In this study, Reliability Analysis was used to test the reliability of Sense of Place Assessment Questionnaire for Conservation of Cultural Keystone Species (pre-test) and Sense of Place Assessment Questionnaire for Conservation of Cultural Keystone Species (post-test). The analysis was operated in SPSS 26.0 (version 26.0, IBM, Armonk, NY, USA) software, and Reliability was tested using Cronbach's Alpha.

The statistical results are shown in Table 4 and the Cronbach's α coefficients for each dimension are as follows: the Cronbach's α coefficient for the pre-test was 0.943, for the post-test it was 0.970. The Cronbach's α values for all dimensions were greater than 0.8, indicating good Reliability.

Table 4. Reliability test

Dimension	Number of Items	Sample Size	Cronbach α
Pre-tested	14	76	0.943
Post-tested	24	76	0.970

The KMO test was conducted on the scale and the results of the test are shown in Table 5 and Table 6. The pre-tested KMO result is 0.896 and the post-tested KMO result is 0.929, which is greater than 0.8, and $p<0.001$ in Bartlett's test of sphericity, which indicates that the research data are well suited for the extraction of information and have good Validity.

Table 5. Pre-tested validity test

KMO value	Bartlett's Test of Sphericity		
	Approximate Chi-squared value	df	P value
0.896	864.289	171	0.000

Table 6. Post-tested validity test

KMO value	Bartlett's Test of Sphericity

	Approximate Chi-squared value	df	P value
0.929	1675.379	300	0.000

4.1.2. Pre-tested and post-tested overall Sense of Place descriptive statistics

The results of the pre-tested and post-tested overall Sense of Place descriptive statistics can be seen in Table 7: Prior to co-construction, the mean of the pre-tested overall Sense of Place was 2.539 with a standard deviation of 0.969, which suggests that residents have a weaker sense of belonging and emotional connection to their community, and that inter-individual differences in the perception of place are large. However, after the project, the mean of the post-tested overall Sense of Place increased to 4.129 and the standard deviation decreased to 0.763.This change indicates that with the promotion of the Plants in the Community co-construction activities, the residents' sense of identity and sense of belonging to the community environment has significantly increased, while the inter-individual differences in perceptions have been reduced, and the stability of the Sense of Place has been improved.

Table 7. Pre-tested and post-tested overall Sense of Place descriptive statistics

Name	Mean(M)	Standard Deviation(SD)
pre-test overall Sense of Place(Overall sense of place of extant plants)	2.539	0.969
post-tested overall Sense of Place	4.129	0.763
Sense of Place of Daily Life Theme Plants	4.148	0.787
Sense of Place of Biodiversity Resources Theme Plants	4.079	0.774
Sense of Place of the Exchange of Goods and Knowledge Theme Plants	4.149	0.786

4.1.3. Three-dimensional descriptive statistics of the Sense of Place of each Theme Plant

4.1.3.1. Descriptive statistics on the Sense of Place of extant plants

The results of descriptive statistics on the Sense of Place of extant plants are shown in Table 8, which shows that the Overall Evaluation of the Sense of Place of the extant plants in the community by the interviewees was low before the Plants in the Community co-construction activity was held, and all the indicators were at a low level.

Table 8. Descriptive Statistics on the Sense of Place of Extant Plants

Name	Mean(M)	Standard Deviation(SD)
Functional dependence evaluation	2.569	0.957
Emotional attachment evaluation	2.613	0.941
Cultural identity evaluation	2.551	0.916

4.1.3.2. \ Descriptive statistics on the Sense of Place of Daily Life Theme Plants

The results of the descriptive statistics of the Sense of Place of the Daily Life Theme Plants are shown in Table 9, which shows that: the interviewees generally believe that the practical value of these plants has a greater supportive role in enhancing the Sense of Place, while the low Standard Deviation indicates that the interviewees are more unanimous in recognizing the functionality of these plants.

Table 9. Descriptive statistics on the Sense of Place of Daily Life Theme Plants

Name	Mean(M)	Standard Deviation(SD)
Functional dependence evaluation	4.178	0.807
Emotional attachment evaluation	4.112	0.882
Cultural identity evaluation	4.155	0.785

4.1.3.3. Descriptive statistics on the Sense of Place of Biodiversity Resources Theme Plants

The descriptive statistics of the Sense of Place of the Biodiversity Resources Theme Plants are shown in Table 10, the interviewees generally recognized that the ecological functions of these plants have a greater supportive role in enhancing the Sense of Place.

Table 10. Descriptive statistics on the Sense of Place of Biodiversity Resources Theme Plants

Name	Mean(M)	Standard Deviation (SD)
Functional dependence evaluation	4.211	0.943
Emotional attachment evaluation	3.961	1.076
Cultural identity evaluation	4.066	0.899

4.1.3.4. Descriptive statistics on the Sense of Place of the Exchange of Goods and Knowledge Theme Plants

The results of descriptive statistics of the Exchange of Goods and Knowledge, as shown in Table 11, had a positive effect in enhancing the Sense of Place of the interviewees, especially in the dimension of Cultural Identity.

Table 11. Descriptive statistics on the Sense of Place of the Exchange Goods and Knowledge Theme Plants

Name	Mean(M)	Standard Deviation (SD)
Functional dependence evaluation	4.132	1.024
Emotional attachment evaluation	4.132	0.984
Cultural identity evaluation	4.184	0.905

4.2. Correlation analysis

4.2.1. Correlation of overall Sense of Place levels with each Theme Plant

In order to analyze the strength of the correlation that exists between the sub-dimensions of the Sense of Place and the influences they contain, and to test the consistency of the level of the Sense of Place with the levels under the system, the linear correlation calculation method, Pearson's correlation coefficient, was used.

4.2.1.1. Pre-tested and post-tested Overall Sense of Place paired-sample correlations

From Table 12, it can be concluded that correlation analyses were utilized to examine the correlations between the overall Sense of Place pre-test and each of the eight items of the Sense of Place of each theme of the post-test. Specific analysis can be seen:

The value of the correlation coefficient between the pre-tested overall Sense of Place and the post-tested overall Sense of Place is -0.773 and shows significance at the 0.01 level, thus indicating a significant negative correlation between the pre-tested overall Sense of Place and the post-tested overall Sense of Place.

Table 12. Results of the overall Sense of Place pre-test and post-tested paired-sample correlation analysis (N=76)

	Pre-tested overall Sense of Place	Post-tested overall Sense of Place
Pre-tested overall Sense of Place	1	
Post-tested overall Sense of Place	-0.773***	1

Remarks: *** indicates $p<0.001$, significant correlation

4.2.1.2. Correlation of post-tested overall Sense of Place evaluation with three Theme Plants

From Table 13, it can be concluded that the correlation analysis was used to investigate the correlation between the post-tested overall Sense of Place and the Sense of Place Evaluation of Theme Plants of Daily Life, the Sense of Place Evaluation of Theme Plants of Biodiversity Resources, and the Sense of Place Evaluation of Theme Plants of the Exchange of Goods and Knowledge, respectively. Specific analyses were conducted:

The value of the correlation coefficient between the post-tested overall Sense of Place and the Sense of Place Evaluation of the Daily Life Theme Plants was 0.924, and the value of the correlation coefficient between the post-tested overall Sense of Place and the Sense of Place Evaluation of the Biodiversity Resources Theme Plants was 0.918, and the value of the correlation coefficient between the post-tested overall Sense of Place and the Sense of Place Evaluation of the Exchange of Goods and Knowledges Theme Plants was 0.928, and all showed significance at the 0.001 level, Thus, it is shown that there is a significant positive correlation between the post-tested overall Sense of Place and the sense of place Evaluations of all three Theme Plants.

Table 13. Correlation of post-tested overall Sense of Place Evaluation with three Theme Plants(N=76)

	post-tested overall Sense of Place	Daily Life Theme Plants	Biodiversity Resources Theme Plants	Exchange of Goods and Knowledges Theme Plants
post-tested overall Sense of Place	1			
Daily Life Theme Plants	0.924***	1		
Biodiversity Resources Theme Plants	0.918***	0.766***	1	
Exchange of Goods and Knowledges Theme Plants	0.928***	0.787***	0.786***	1

Source of data: Authors' self-test, Remarks: *** indicates p<0.001, significant correlation

4.2.2. Correlations between the three dimensions of Sense of Place for each Themes Plant

4.2.2.1. Correlation between Sense of Place Evaluation and three dimensions of Sense of Place for Daily Life Theme Plants

As can be seen from Table 14 correlation analysis was utilized to investigate the correlation between the Sense of Place Evaluation of Daily Life Theme Plants and a total of three items, namely, Functional dependence evaluation, Emotional attachment evaluation and Cultural identity evaluation, respectively. The specific analysis can be seen:

The correlation coefficients between the Sense of Place Evaluation and the Functional Dependence Evaluation of Daily Life Theme Plants are 0.714, the correlation coefficients with the Emotional Attachment Evaluation are 0.622, and the correlation coefficients with the Cultural Identity Evaluation are 0.757, and all of them are significant at the level of 0.01, which indicates that there is a significant positive correlation between the level of Sense of Place of the Daily Life Theme Plants and the level of the three dimensions. positive correlation between the level of Sense of Place of the Daily Life Theme Plants and the levels of the three dimensions.

Table 14. Correlation between Sense of Place Evaluation and three dimensions of Sense of Place for Daily Life Theme Plants(N=76)

	the Sense of Place Evaluation of Daily Life Theme Plants	Functional dependence evaluation	Emotional attachment evaluation	Cultural identity evaluation
the Sense of Place Evaluation of Daily Life Theme Plants	1			
Functional dependence evaluation	0.714***	1		
Emotional attachment evaluation	0.622***	0.400***	1	
Cultural identity evaluation	0.757***	0.523***	0.554***	1

Remarks: *** indicates p<0.001, significant correlation

4.2.2.2. Correlation between Sense of Place Evaluation and three dimensions of Sense of Place for Biodiversity Resources Theme Plants

As can be seen from Table 15, correlation analysis was utilized to investigate the correlation between the Sense of Place Evaluation of the Biodiversity Resource Theme Plants and a total of three items, namely, Functional Dependence Evaluation, Emotional Attachment Evaluation, and Cultural Identity Evaluation, respectively. Specific analysis can be seen:

The correlation coefficients between the Sense of Place Evaluation and the Functional Dependence Evaluation of Biodiversity Resources Theme Plants are 0.731, and the correlation coefficients between the Emotional Attachment Evaluation are 0.693, and the correlation coefficients between the Emotional Dependence Evaluation and the Cultural Identity Evaluation are 0.657, and all of them show the significance of the 0.01 level, which indicates that there are significant positive correlations

between the levels of the Sense of Place of the Biodiversity Resources Theme Plants and the levels of the three dimensions. There is a significant positive correlation between the level of Sense of Place of Biodiversity Resources Theme Plants and the level of the three dimensions.

Table 15. Correlation between Sense of Place Evaluation and three dimensions of Sense of Place for Biodiversity Resources Theme Plants(N=76)

	the Sense of Place Evaluation of Biodiversity Resources Theme Plants	Functional dependence evaluation	Emotional attachment evaluation	Cultural identity evaluation
the Sense of Place Evaluation of Biodiversity Resources Theme Plants	1			
Functional dependence evaluation	0.731***	1		
Emotional attachment evaluation	0.693***	0.400***	1	
Cultural identity evaluation	0.657***	0.523***	0.554***	1

Remarks: *** indicates p<0.001, significant correlation

4.2.2.3. Correlation between Sense of Place Evaluation and three dimensions of Sense of Place for the Exchange of Goods and Knowledges Theme Plants

As can be seen from Table 16, correlation analysis was utilized to investigate the correlation between the Sense of Place Evaluation of the Exchange of Goods and Knowledges Theme Plants and a total of three items, namely, the Functional Dependence Evaluation, the Emotional Attachment Evaluation, and the Cultural Identity Evaluation, respectively. The specific analysis can be seen:

The correlation coefficient values between the Sense of Place Evaluation and the Functional Dependence Evaluation of the Exchange of Goods and Knowledges Theme Plants are 0.632, the correlation coefficient value between the Sense of Place Evaluation and the Emotional Attachment Evaluation is 0.691, and the correlation coefficient value between the Sense of Place Evaluation and the Cultural Identity Evaluation is 0.786 and all of them show the significance at 0.01 level, thus indicating that there is a significant positive correlation between the Sense of Place level of the Exchange of Goods and Knowledges Theme Plants and the level of the three dimensions. level of Sense of Place and the three dimensions.

Table 16. Correlation between Sense of Place Evaluation and three dimensions of Sense of Place for the exchange of goods and knowledges Theme Plants(N=76)

	the Sense of Place Evaluation of the Exchange of Goods and Knowledges Theme Plants	Functional dependence evaluation	Emotional attachment evaluation	Cultural identity evaluation
the Sense of Place Evaluation of the Exchange of Goods and Knowledges Theme Plants	1			
Functional dependence evaluation	0.632***	1		
Emotional attachment evaluation	0.691***	0.400***	1	
Cultural identity evaluation	0.786***	0.523***	0.554***	1

Remarks: *** indicates p<0.001, significant correlation

4.3. Results

In this study, the community of Old Nanhai County is used as the research sample to carry out the experimental research on the assessment of the benefits of the sense of place enhancement, and adopts the statistical analysis methods such as paired samples t-test and correlation analysis to analyze the experimental data, and the results of the experiments are as follows:

The results of the pre-tested and post-tested data of the questionnaire show that the implantation of Cultural Keystone Species in the community of Old Nanhai County can effectively enhance the level of Sense of Place of the interviewees, including residents, tourists and other groups, and has the efficacy of promoting Cultural Identity. In other words, it can be argued that the Cultural Keystone Species proposed in this paper based on text analysis and community-oriented co-construction has a statistically significant Sense of Place enhancement effect.

The results of Pearson's correlation analysis showed that there was a significant positive correlation between the interviewees' implantation and experience of the three Theme Plants constructed in this paper and the level of post-tested overall Sense of Place. In terms of the degree of correlation, the theme of Exchange of Goods and Knowledge> theme of Daily Life > theme of Biodiversity Resources. It can be seen that of the three types of Theme Plants presented in this paper, species with themes of Daily Life and the Exchange of Goods and Knowledge have had a stronger impact on Cultural Identity, attributed to their role in facilitating socio-cultural exchanges and historical narratives. Of these, the three dimensions under the three themes supported the Sense of Place to varying degrees, with Functional Dependence > Cultural Identity > Emotional Attachment among the three dimensions under the Daily Life Theme Plants. Functional Dependence > Cultural Identity > Emotional Attachment in three dimensions of Biodiversity Resource Theme Plants, and Cultural Identity > Functional Dependence = Emotional Attachment in the three dimensions of the Exchange of Goods and Knowledge Theme Plants.

Taken as a whole, all three categories of Cultural Keystone Species nurtured in Guangzhou's historic district significantly improved the Sense of Place. These findings emphasize the different capacities of types in placemaking, with species in the Daily Life category and the Goods and Knowledge Exchange category reinforcing intangible connections through shared memories and practices, while species in the Biodiversity Resources category emphasize specific ecological functions.

The old Nanhai County community is located in the high-density historic district of Guangzhou, and the public living in or visiting this area has fewer opportunities for contacting with nature, and has a shallow knowledge and understanding of plant species, while its current situation of cultural neglect should be improved along with the pressure of work and life generated by urbanization. Before the co-construction activities, the greening of public spaces in the community was only to meet the quantitative urban greening targets, providing limited ecological functions and lacking in cultural vitality, and the relationship between the public and this type of greening was broken, while the greening of the residents' balconies or roofs was more relevant to the residents' lives, for example, a resident was uniquely attracted to a plant species that was acquired by chance, and was emotionally attached to the place where he or she lived. The rest of the greening of public spaces is mostly for aesthetic and atmospheric reasons, and the purpose of this co-construction activities is to clarify this ambiguous sense of dependence and need for atmosphere, and to create more opportunities to contact with nature through the implantation of Cultural Keystone Species.

In summary, the co-construction opportunity and later life experience provided by this practice case is a guide to regain the knowledge of the historical species application, and the resulting Sense of Place benefit is significant and an innovative attempt to apply Landscape Architecture practice.

5. Discussion and conclusion

In order to provide application ideas for urban renewal and species culture conservation, and to provide reference for public participation in the form of elements and processes under the perspective of landscape Architecture. The study mainly produces the following conclusions:

(1) An evaluation system for Sense of Place Evaluation based on the criteria for identification of Cultural Keystone Species was constructed. Williams' classic sense of place scale as the basic structure, combined with domestic and foreign scholars in environmental psychology, landscape architecture perspective of the dimensional analysis adjusted to the Sense of Place scale based on Cultural Key Species, each theme contains three dimensions, each dimension contains a number of unequal detailed evaluation, that is, the Cultural Key Species indicators of the application of the transformation of the scene, and ultimately the formation of a plant and its attributes as a variable, the role of the place as an object, and the human sense of place as the goal of an empirical questionnaire. The final result is an empirical questionnaire that takes plants and their properties as variables, places as objects, and human Sense of Place as the goal.

(2) Cultural Keystone Species were implanted into different scenes of community places and experiments were conducted to derive Sense of Place enhancement benefits. The statistical results found that the three Theme Plants can enhance the Sense of Place well within 0.1 in the descriptive statistics of the post-test, among which the daily life Theme Plants and the Goods and Knowledge Exchange Theme Plants can support the Sense of Place enhancement most effectively in terms of the Cultural Identity dimension, and the rest of the dimensions are significantly different from them. Biodiversity Resources Theme Plants have the best support for Sense of Place in terms of Functional Dependence dimension, and the rest of the dimensions are significantly different from them. Looking at the dimension with the highest correlation at the level of influencing factors under that dimension, the factor of uniqueness of the Daily Life Theme Plants has the highest correlation coefficient, indicating that the irreplaceable status of the Theme Plants in the material and spiritual activities of the participants largely influences their cultural identification with the Theme Plants. The highest correlation coefficient for the Learning to Exchange Plant Knowledge factor for the Goods and Knowledge Exchange Theme Plants suggests that participants were most able to influence their cultural identification with the Theme Plant by learning to exchange plant knowledge. The increase in species and habitat diversity of the Biodiversity Resources Theme Plants on the site was moderately correlated with the participants' Functional Dependence on this type of plant, indicating that the participants were concerned about changes in species diversity and developed a dependence on diverse plants while at the same time lacked a deeper understanding of this type of plant and its life processes due to a lack of knowledge in the appropriate disciplines, resulting in statistically insignificant values, and therefore also a subsequent focus of the work on sustainable operation of the co-construction results. Therefore, it is also a priority for the subsequent sustainable operation of the results of the co-construction.

According to the above conclusion, the conservation, promotion and popularization of Cultural Keystone Species will be the focus of small-scale urban greening for a long time. This form of sustainable content is expected to cultivate keystones in the practical sense of the word, thus promoting the conservation and revitalization of bioculture, enhancing the cultural recognition of the community, and gradually expanding the scope of its influence as a catalyst. The outlook is as follows:

The evaluation system of Sense of Place can be refined on the basis of the existing evaluation by sub-thematic plants or individual plants to explore the most suitable plants for place planting. Moreover, the influencing factors under the dimension of Sense of Place can be further revised and expanded according to different scenarios in different places. In the previous section, we mentioned the limitations of the public's aesthetic demand for plants, because it is theoretically unable to become a separate dimension of the evaluation system, and the aesthetic value for the generation of the Sense of Place cannot be completely ignored, so we can consider incorporating it into one of the influencing factors under the functional dependence dimension, so that the evaluation content will add visual and other sensory sensations other than the cognitive understanding of rationality to the original basis, which may result in the motivation of the evaluation biased sensibility, affecting the reliability of the data, so it is recommended that the evaluation system be constructed for different objectives.

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