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Spatial Distribution, Influencing Factors and Sustainable Development of Fishery Cultural Resources in the Yangtze River Basin

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Abstract: Agricultural cultural heritage is crucial in advancing comprehensive rural revitalization. The Yangtze River Basin is rich in biodiversity and abundant in fishery cultural resources. The cultural resources not only reflect the ecological wisdom of harmonious coexistence and the human–land relationship between humans and nature but also provide critical cultural support for rural revitalization and watershed sustainable development. This study investigates the spatial distribution, influencing factors, and historical evolution of fishery cultural resources in the Yangtze River Basin. The highest proportions of significant resources are found in fishery engineering and landscapes, culinary flavors, fishery customs, dances, fishery gear, and poetry. By analyzing 14 categories of fishery cultural resources and 157 national and provincial intangible cultural heritage items, this study reveals a significant geographical clustering of these resources in the mid-lower reaches, particularly around the middle reaches of the Yangtze River and Poyang Lake Basin, Wuhan and Dongting Lake, and the lower reaches of the Taihu Lake Basin. This study underscores the role of natural geographical conditions, aquatic biodiversity, socio-economic factors, and historical–cultural backgrounds in the distribution and evolution of fishery cultural resources, with these factors interacting dynamically. By advocating for a comprehensive approach to coordinating fishery culture preservation with rural revitalization, this study outlines a multidimensional strategy for the preservation and sustainable development of fishery cultural resources.

Keywords: Yangtze River Basin; fishery cultural resources; spatial distribution; rural revitalization; sustainable development; human–land relationship

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1. Introduction

The concept of "Agricultural Heritage" is central to the "Globally Important Agricultural Heritage Systems (GIAHS)" initiative of the Food and Agriculture Organization (FAO) of the United Nations. Agricultural heritage integrates elements of tangible, intangible, and cultural heritage, making it a multifaceted form of heritage. The interaction between human activities, biodiversity, natural geography, and ecological environments fosters the evolution and spread of culture from its origins, thereby forming distinct cultural regions. Extensive research has been conducted by numerous scholars on various aspects of agricultural heritage, including agrobiodiversity, knowledge systems, and international recognition as well as on dynamic preservation and adaptive management practices [1,2]. These scholarly efforts have established a robust theoretical foundation and continuously evolving academic framework for future studies. In recent years, agricultural heritage has

increasingly become a focal point in the study of rural revitalization. Current research, both domestically and internationally, primarily focuses on two areas: the intrinsic value and preservation of agricultural heritage and the relationship between agricultural heritage and rural revitalization [3,4]. Scholars have highlighted the significant role of agricultural heritage in rural revitalization, providing theoretical pathways for its protection and sustainable development.

1.1. Agricultural Heritage and Fishery Cultural Resources

Fishery culture, a branch of agricultural culture in China, includes both tangible and intangible assets created through human engagement with aquatic environments and fisheries [5,6]. Fishery culture demonstrates the profound connection between human culture and ecosystems. These assets possess transferability and hereditary characteristics. China's extensive history of fishery development has produced a rich array of material and non-material fishery cultural artifacts. Consequently, fishery culture has played a pivotal role in shaping human intellect and behavior over extensive periods, epitomizing the interaction between nature and humanity, survival and practice, as well as innovation and creation. Fishery culture embodies a reverence for nature and a deep respect for its processes, capturing essential ecological wisdom and cultural values.

The academic community has conducted substantial research on worldwide marine fishing culture and community governance, achieving noteworthy results. These studies predominantly delve into the historical evolution and fundamental characteristics of marine fishing culture, various cultural expressions, and the exploratory practices aimed at preserving and transmitting this heritage [6,7]. A notable emphasis is placed on protecting biological and cultural diversity, positing that the decline in traditional fishing culture is caused by complex socio-economic transformations [8]. In practice, the holistic approach to biocultural diversity often remains underutilized in managing ecosystems and cultural heritage [9–11]. Furthermore, extensive research has been conducted on local marine ecological knowledge, traditional fishing knowledge [12–16], and the exploitation of cultural resources within marine communities [17,18]. These studies also consider issues related to cultural resource management and community governance and examine the maintenance and development of fishery culture through the lens of marine fishery development [19,20]. Conversely, research on freshwater fishery culture, focusing on regions like the Yellow River Basin, Songhua River Basin, Poyang Lake, Dongting Lake, Taihu Lake, and Hongze Lake, has analyzed the types and traits of fishery cultural resources [21–23], their implications for related industries, and the strategies for safeguarding and inheriting cultural heritage [24–27]. Nevertheless, studies in freshwater fishery culture are often scattered and lack systematism, primarily due to the absence of comprehensive surveys and research on the spatial distribution of freshwater fishery cultural resources in different communities [28]. Consequently, some scholars advocate for a more thorough exploration of these resources and the establishment of protected areas, aiming to foster a more holistic, systematic, and dynamic approach to conserving fishery culture resources [29].

The management and governance literature has widely debated how to achieve sustainability in fisheries and communities [30]. Research has suggested that there is a need for increased attention to socio-cultural life and its importance in the management of fisheries [31]. How biodiversity resources are utilized and managed reflects the socio-cultural values associated with fish and fisheries [32,33]. Aquatic species have different meanings in different contexts and groups [34,35]. The cultural values associated with fish and fisheries affect the utilization and management of fish resources [33,36]. However, these values often remain implicit in watershed communities and governance [37]. Therefore, this may require restructuring governance and a new path for multi-cultural fishery management [38,39].

Since 2012, China has officially recognized seven batches and 188 items of important agricultural cultural heritage, including 8 fishery culture items such as the Rice–Fish Culture System of Qingtian of Zhejiang, affirming their status as critical components of China's agricultural heritage. However, despite their recognized importance, fishery cultural

heritage items remain underrepresented on national and provincial intangible cultural heritage lists and thus receive insufficient attention.

1.2. Agricultural Heritage and Rural Revitalization in the Context of Sustainable Development

Rural revitalization has become a major global issue, as it is a key to addressing rural change toward a sustainable future. In recent years, the problems of dual urban–rural structures have become prominent. Driven by the strategic planning of rural revitalization, different development modes have emerged in China. However, more research is needed on their actual performance and wider impact on rural revitalization. Governance is a global concern, with international research increasingly focusing on the governance of socio-ecological systems. Significant strides have been made in urban governance, and studies on rural governance are gaining momentum [40,41]. Since both urban and rural areas are constituted by natural and social elements, their governance requires a holistic approach that integrates ecological and social dimensions [42]. Journals such as *Science* have consistently highlighted governance issues across various domains, including rural, ecosystem, marine fisheries, and freshwater resources [43,44]. Research in these areas offers insightful implications for the governance of both urban and rural settings.

Guided by the principles of sustainable development, the safeguarding and transmission of historical and cultural heritage stand out as pivotal factors in rural revitalization and are essential for fostering sustainable development in rural communities [45]. These studies have analyzed the influences of natural, socio-economic, and historical–cultural factors on the spatial distribution of villages and contribute to a deeper understanding of rural dynamics [46]. Furthermore, some scholars have conducted geographically specific studies on agricultural cultural heritage and landscapes, exploring protective measures and utilization strategies for agricultural historical and cultural heritage across various regions and proposing tailored strategies for their preservation [47,48]. Collaborative governance, involving a multitude of stakeholders, is critical in cultural preservation, biodiversity conservation, and rural development. Rural governance is essential in this context, stressing the authenticity of cultural resources and their integration into local community life and broader socio-economic development. However, there remains a paucity of in-depth analyses on how the protection of fishery cultural heritage and utilization of biodiversity can be synergistically advanced with rural revitalization and governance under sustainable development principles.

The fishery culture serves as a crucial conduit for chronicling the history of human ancestors in the Yangtze River Basin. Currently, the ten-year fishing moratorium on the Yangtze represents the most effective strategy to conserve the river's aquatic biological diversity. However, it is crucial to ensure that the enforcement of these conservation policies does not inadvertently damage the fishery culture. Following the implementation of the ten-year fishing ban policy in the Yangtze River, approximately 231,000 fishermen from key areas of the Yangtze River Basin ceased their fishing activities, leading to the dismantling or abandonment of many traditional fishing villages. This transition poses challenges to preserving the traditional characteristics of these villages, with some Yangtze River fishery cultural resources (YRFCR) facing the risk of disappearance [49]. Therefore, there is an urgent need to transform the development and governance of these fishing villages. In this context, fishery culture can significantly contribute. Furthermore, the cessation of the natural fishing industry chain has rendered traditional fishing villages in the Yangtze River Basin ineffective as carriers of fishery culture. Under the framework of the Yangtze's ten-year fishing ban, it is imperative to systematically document the current status of fishery cultural resources, delve into the ideological essence of fishery culture, and explore innovative pathways for their creative transformation and development. This study focuses on fishery cultural resources and related intangible cultural heritage items across the Yangtze River Basin. It examines the spatial distribution characteristics and historical evolution of these resources, employing methods such as descriptive spatial analysis and kernel density analysis. Influencing factors considered include aquatic biodiversity, natural

geographical features of the basin, economic and social factors, socio-cultural elements, and aspects related to fishery production and lifestyle. This study contributes to an empirical discussion of relationality analysis between cultural heritage and rural development through the specific case of fishery culture in the Yangtze River Basin, providing theoretical and practical pathways for leveraging fishery culture to promote rural revitalization.

2. Materials and Methods

2.1. Study Area

As shown in Figure 1, the Yangtze River Basin encompasses a vast area traversed by the Yangtze River's main stream and its numerous tributaries. This region includes eleven provinces, autonomous regions, and municipalities: Qinghai, Tibet, Sichuan, Yunnan, Chongqing, Hubei, Hunan, Jiangxi, Anhui, Jiangsu, and Shanghai, with the tributaries extending into parts of an additional eight provinces and autonomous regions. The Yangtze River Economic Belt, a significant part of this basin, contributes over 46% of China's GDP. The basin boasts a wealth of biodiversity resources, including a diverse ichthyofauna with more than 400 fish species. In response to ecological pressures, a ten-year fishing moratorium was initiated in 2021. Key large lakes within the basin include Poyang Lake, Dongting Lake, Taihu Lake, and Chaohu Lake, which are critical to the region's environmental and economic framework.

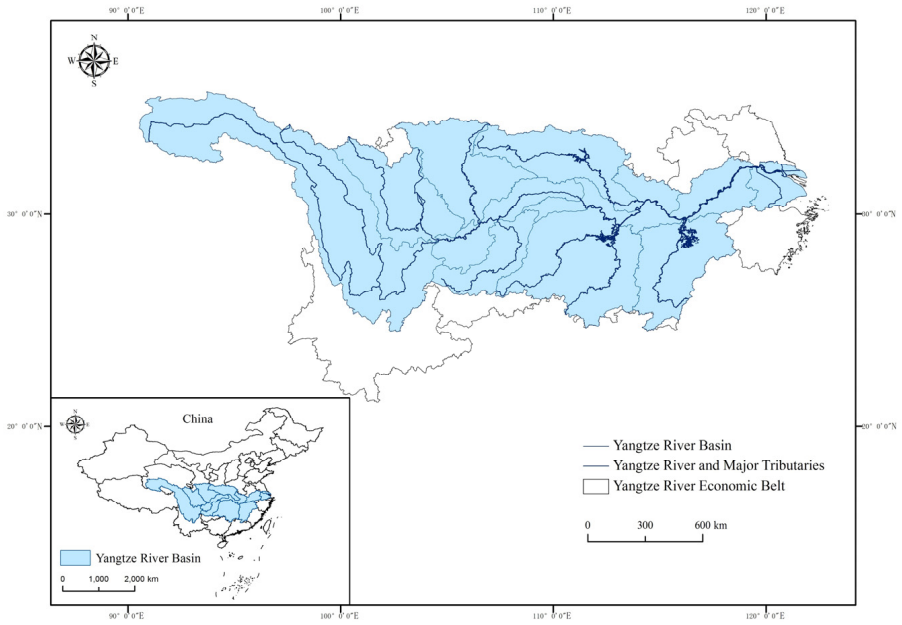

Figure 1. The location of the Yangtze River Basin.

2.2. Research Subjects and Data Sources

The primary focus of this study is the fishery cultural resources and related intangible cultural heritage of the Yangtze River. Between 2021 and 2022, the Ministry of Agriculture and Rural Affairs spearheaded an extensive survey of these resources. During this period, we contributed to designing the implementation strategy for the survey, which aimed to identify and categorize 14 distinct types of fishery cultural resources. The survey was conducted at the county level, where various fishery cultural resource registration forms and project lists were collected and compiled to construct a preliminary database of the Yangtze River's fishery cultural resources. The data primarily encompass records from the Yangtze River Basin survey, enhanced by field research conducted across Yunnan, Guizhou, Sichuan, Chongqing, Jiangxi, Anhui, Jiangsu, Zhejiang, and Shanghai. This study also integrates data on fishery cultural resources from parts of the Huaihe River Basin in Jiangsu Province within the context of the ten-year fishing ban. Moreover, 157 items of intangible cultural heritage related to fisheries, including expanded entries, were identified and

compiled from the Chinese Intangible Cultural Heritage website (https://www.ihchina.cn) and national and provincial listings published by provinces along the Yangtze River. Given that some heritage items span multiple adjacent regions, this study segments the same heritage items based on their geographical locations to facilitate a more precise analysis. The spatial vector data are obtained from the Ministry of Natural Resources Standard Map Service System and the National Basic Geographic Information System, among other platforms. Information on fishermen and fishing vessels decommissioned from service is sourced from the relevant administrative departments.

2.3. Research Methods

This study analyzed two datasets: records of 5276 Yangtze River fishery cultural resources and 157 national and provincial intangible cultural heritage items related to fisheries. For these resource records, we established an evaluation criteria system. The examination of fishery cultural resource records was performed at both the municipal and county levels (including cities and districts) using the geographical coordinates of the locations to represent the intangible cultural heritage items. This study employed geographic spatial analysis to quantify the distribution of fishing cultural resources in the Yangtze River Basin. ArcGIS 10.0 and traditional statistical methods were employed to analyze the distribution characteristics and factors influencing these resources. This study utilized descriptive spatial analysis and hotspot exploration, among other spatial statistical techniques, to evaluate the spatial attributes of the Yangtze River fishery cultural resources from various perspectives, such as the overall distribution, regional characteristics, and the surrounding resource environments. Point-based kernel density estimation was applied to assess the spatial clustering characteristics of these resources.

2.3.1. Evaluation of Significant YRFCR

This study developed a significant evaluation system using a scoring method to assess the value of YRFCR and determine their significant categories (Table 1). The resources are classified into three levels, from highest to lowest, as follows:

Table 1. The scoring standards used to evaluate the importance of categories of Yangtze River fishery cultural resources.

Evaluation Category	Evaluation Factor (Points)	Evaluation Criterion	Scoring Range
Value of Resource Elements (85)	Historical Value (30)	The item(s) exhibit exceptionally high historical value, with a long history and excellent appearance	30–22
		The item(s) exhibit high historical value, with a relatively long history and good appearance	21–13
		The item(s) exhibit average historical value, with a moderate history and average appearance	12–6
		The item(s) exhibit low historical value, with a recent history and poor appearance	5–1
	Cultural and Artistic Value (25)	The item(s) possess cultural significance of global importance and strong depth of connotation	25–20
		The item(s) possess historical significance of national importance and considerable depth of connotation	19–13
		The item(s) possess historical significance of provincial importance with moderate depth of connotation	12–6
		The item(s) have regional cultural significance with relatively low depth of connotation	5–1

Table 1. *Cont.*

Evaluation Category	Evaluation Factor (Points)	Evaluation Criterion	Scoring Range
Value of Resource Elements (85)	Rarity and Uniqueness (15)	The item(s) include numerous rare species, or extremely unique landscapes, or such phenomena that are rare in other regions	15–13
		The item(s) include several rare species, or unique landscapes, or such phenomena that are seldom seen in other regions	12–9
		The item(s) include a few rare species, or notable landscapes, or such phenomena that are rarely seen in other regions	8–4
		The item(s) include individual rare species, or relatively notable landscapes, or such phenomena that are relatively common in other regions	3–1
	Scientific Value (10)	The item(s) hold high academic significance, preservation value, or level of public awareness	10–8
		The item(s) hold considerable academic significance, preservation value, or level of public awareness	7–5
		The item(s) hold moderate academic significance, preservation value, or level of public awareness	4–3
		The item(s) hold low academic significance, preservation value, or level of public awareness	2–1
	Stability (5)	The item(s) exhibit high resistance to impact, inclusiveness, minimal change, and high stability	5–4
		The item(s) exhibit considerable resistance to impact, inclusiveness, minimal change, and considerable stability	3
		The item(s) exhibit moderate resistance to impact, inclusiveness, average change, and moderate stability	2
		The item(s) exhibit low resistance to impact, inclusiveness, considerable change, and low stability	1
Resource Influence (15)	Reputation and Influence (15)	Known globally or recognized as a world-renowned brand	15–13
		Known nationally or recognized as a national brand	12–9
		Known provincially or recognized as a provincial brand	8–4
		Known locally or recognized as a local brand	3–1

Significant resources: score range of ≥80 points. Moderately significant resources: score range of 60–79 points. General resources: score range of 30–59 points.

2.3.2. Descriptive Spatial Analysis

This approach transforms the fishery cultural resources distributed across various counties (including cities and districts) into "points" on a geographical map. Utilizing the ArcGIS 10.0 Average nearest neighbor analysis tool, this study evaluates the spatial distribution of these points to determine if they are random, uniform, or clustered. This assessment is accomplished by calculating the nearest neighbor index (NNI) using the following formula:

$$R = \frac{\overline{r_i}}{r_E} \tag{1}$$

$$r_E = {}^{1}\!/_{2\sqrt{{}^{n}\!/_{A}}} \tag{2}$$

where R represents the nearest neighbor index; $\overline{r_i}$ denotes the average actual nearest neighbor distance, measured in kilometers (km); r_E is the theoretical nearest neighbor distance, also in kilometers (km); n signifies the number of fishery cultural resources; and A is the area of the region. By observing the R value, the distribution of Yangtze River

fishery cultural resources and intangible cultural heritage projects in a geographical space can be determined ($R = 1$ for random; $R > 1$ for uniform; $R < 1$ for clustered). By analyzing the R value, we can discern the distribution pattern of the Yangtze River fishery cultural resources and related intangible cultural heritage projects within a geographical space.

2.3.3. Kernel Density Analysis

Kernel density analysis is a key tool used for examining the density and clustering of resource elements within geographical spaces. Drawing on the methodologies of Huang [50] and Han [51], this study employs the kernel density analysis tool found in the Spatial Analyst module of ArcGIS 10.0 for visual analytics. Point-based kernel density analysis offers a clear and intuitive visualization of the spatial distribution and clustering of Yangtze River fishery cultural resources. It effectively highlights regions of high activity (hotspots) and their characteristics and pinpoints areas of significant spatial clustering. The calculation formula is as follows:

$$f_n(x) = \frac{1}{nh}\sum_{i=1}^{n} k\left(\frac{x - x_i}{h}\right) \tag{3}$$

where $f(x)$ represents the kernel density value f at the spatial location x; $k\left(\frac{x-x_i}{h}\right)$ is the kernel function; n is the number of fishery cultural resources within the specified analysis range, expressed in items; h is the bandwidth measured in kilometers (km), where $h > 0$; and $(x - X_i)$ denotes the absolute distance in kilometers (km) from the estimation point x to the event X_i. Through multiple iterations, this formula allows for generating a detailed kernel density distribution pattern of Yangtze River fishery cultural resources, highlighting areas of significant concentration and distribution trends.

2.3.4. Correlation Analysis

Correlation analysis is employed to ascertain the relationships between the quantity and distribution of fishery cultural resources and various natural, social, economic, and cultural factors. The analysis investigates whether correlations exist between the number and spread of fishery cultural resources across different prefecture-level cities and variables such as the number of fishermen and fishing boats decommissioned. The correlation coefficient r, with values ranging within $[-1, 1]$, quantifies the strength of these relationships. A higher absolute value indicates a stronger correlation, with a value of 0 indicating no correlation and a value of 1 indicating a linear relationship. The calculation formula is as follows:

$$\mathrm{r} = \frac{\sum_{i=1}^{n}\left(X_i - \overline{X}\right)\left(Y_i - \overline{Y}\right)}{\sqrt{\sum_{i=1}^{n}\left(X_i - \overline{X}\right)^2}\sqrt{\sum_{i=1}^{n}\left(Y_i - \overline{Y}\right)^2}} \tag{4}$$

3. Results

3.1. Categories of YRFCR

The analysis result reveals that Yangtze River fishery cultural resources can be classified into various types based on regional characteristics, production methods, value, and function. These resources are broadly categorized into tangible and intangible cultural assets, encompassing a diverse range of historical and contemporary static and dynamic elements extensively distributed throughout the Yangtze River Basin's fisheries production areas. Fishery culture showcases a rich tapestry of expressions permeating production, daily life, education, tourism, and industry. Tangible Fishery Cultural Resources are perceptible and explicitly represented, forming the physical aspect of the fishery culture. Intangible Fishery Cultural Resources are spiritual, artistic, institutionalized, and intangible, contributing to the cultural depth of the region (Table 2). In terms of cultural history, Yangtze River fishery cultural resources are distinguished between traditional and modern fishery cultural elements (Table 2).

Table 2. The classification of types of Yangtze River fishery cultural resources.

Types		Representative Items
Manifestation Form	Tangible Fishery Culture	Aquatic species, fishery boat, fishery gear, fishery village architecture, fishery engineering and landscapes, daily necessity
	Intangible Fishery Culture	Production practices, lifestyle, customs, poetry (including fishery songs), dances (including lantern dances), fishery paintings, culinary flavors, and fishery regulations
Cultural History	Traditional Fishery Culture	Fish fossils, archaeological sites, fishing prohibition steles, and traditional intangible cultural heritage categories of folklore
	Modern Fishery Culture	Fishery production materials displayed and housed in museums, exhibition centers and cultural education bases, fishery-related crawfish food festivals, leisure fishing-related fishery culture, and derived fishery paintings and poetry

After reviewing data from the Chinese Intangible Cultural Heritage Network and the catalogs of national and provincial representative intangible cultural heritage projects issued by the provinces and cities along the Yangtze River, a total of 157 fishery-related projects were recognized in the national and provincial intangible cultural heritage listings throughout the Yangtze River Basin. These projects span 12 provinces and municipalities, 61 prefecture-level cities, and 123 counties (cities and districts). Jiangsu Province holds the distinction of having the most entries, followed by Jiangxi and Hubei Provinces. The predominant categories include fishery dances (including lantern dances), with poetry (including fishery songs) and culinary traditions (culinary flavors) also significantly represented (Table 3). Currently, there are no entries in the provincial intangible cultural heritage registries that directly relate to aquatic species, the architecture of fishing villages, daily necessities, fishery paintings, and fishery regulations.

Table 3. The number and distribution of fishery-related national and provincial intangible cultural heritage items in the Yangtze River Basin.

Province (Municipality)	Fishery Boat	Fishery Gear	Fishery Engineering and Landscapes	Fishery History	Fishery Production and Living Styles	Fishery Customs	Poetry (Fishery Songs)	Fishery Dances (Lantern Dances)	Culinary Flavors	Total	Proportion (%)
Shanghai	-	-	-	-	-	-	2	1	1	4	2.55
Jiangsu	4	2	-	-	-	1	7	6	7	27	17.20
Anhui	-	-	1	-	-	-	1	6	3	11	7.01
Jiangxi	1	-	1	1	-	7	2	10	-	22	14.01
Hubei	2	-	-	-	3	-	4	8	4	21	13.38
Hunan	2	1	-	-	-	-	4	7	2	16	10.19
Chongqing	-	-	-	-	-	-	5	1	8	14	8.92
Sichuan	-	-	-	-	-	-	12	1	2	15	9.55
Guizhou	-	-	1	-	-	1	-	-	4	6	3.82
Yunnan	-	-	-	-	-	-	-	-	1	1	0.64
Zhejiang	3	-	4	-	2	5	-	3	-	17	10.83
Shanxi	-	-	-	-	-	-	-	3	-	3	1.91
Total	12	3	7	1	5	14	37	46	32	157	-
Proportion (%)	7.64	1.91	4.46	0.64	3.18	8.92	23.57	29.30	20.38	-	-

The fishery culture mentioned in this table specifically pertains to inland freshwater fishing culture. Intangible cultural heritage projects listed are also recognized as part of the FAO's Globally Important Agricultural Heritage Systems and China's Important Agricultural Cultural Heritage projects.

3.2. Spatial Distribution of YRFCR

3.2.1. Measurement of Spatial Clustering Areas

By abstracting the locations of these resources within counties (cities, districts) into "points" on a geographical space, utilizing the average nearest neighbor analysis tool in ArcGIS 10.0, we quantified the dispersion and clustering of these points across the region. The results from the analysis revealed that the average nearest neighbor distance ($\overline{r_i}$) for the Yangtze River's fishing cultural resources is 39.7 km, compared to a theoretical

average nearest neighbor distance (r_E) of 40.9 km. The nearest neighbor index (R) computed was 0.97, less than 1, with a Z-score of −1.05, which passed the significance test. These statistics indicate a clustered distribution pattern of fishing cultural resources across the entire Yangtze River Basin (Table 4). Regarding the distribution density, the high-density clusters of fishing cultural resources are primarily located in the mid-Yangtze River around Poyang Lake, the lower reaches of the Yangtze River, and the Taihu Lake Basin. Regions with moderately high densities include the upper Yangtze area around Chongqing and the mid-Yangtze regions near Wuhan and Dongting Lake. Conversely, areas like Yunnan, Shaanxi, and Henan feature only sparse distributions (Figure 2). Notably, in the upper reaches of the Yangtze, including Chongqing, Sichuan, and Guizhou, the distribution of fishing cultural resources is relatively uniform, showing no significant clustering or random distribution patterns.

Table 4. Nearest neighbor index for the distribution of Yangtze River fishery cultural resources.

Geographic Region	Total Counties (Cities, Districts) Sites	$\overline{r_i}$ (km) Mean Distance	*rE* (km) Theoretical Distance	Nearest Neighbor Index (*R*)	*Z*-Value	*p*-Value	Type of Spatial Distribution
Yangtze River Basin	357	39.73	40.91	0.97	−1.05	0.03	Clustered
Upper Yangtze River	116	42.98	40.08	1.07	1.49	0.10	Uniform

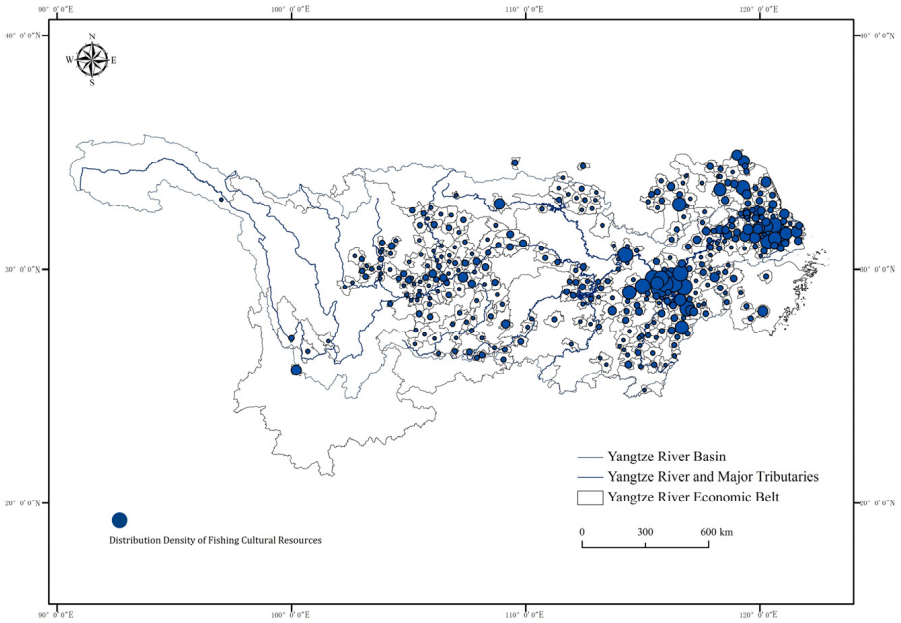

Figure 2. The spatial distribution of Yangtze River fishing cultural resources.

3.2.2. Kernel Density Distribution

In response to the observed clustering in the spatial distribution of fishery cultural resources in the Yangtze River Basin, we conducted a detailed analysis using kernel density estimation to precisely identify the centers of aggregation and their characteristics. This methodological approach allowed for a nuanced visualization of spatial patterns within the basin. The analysis, depicted in Figures 2 and 3, indicates two primary high-density clusters of fishery cultural resources. The first cluster is predominantly located around the mid-Yangtze River mainstream and Poyang Lake, while the second is centered on the lower Yangtze River mainstream and Taihu Lake. Additionally, two areas of secondary density were identified: one in the mid-Yangtze region near Wuhan and Dongting Lake and another encompassing the upper Yangtze areas of Chongqing and Sichuan (Figure 3). These

regions not only are pivotal for freshwater fishery production in the Yangtze River Basin but also represent zones of significant aquatic biodiversity and economic development. This comprehensive spatial analysis highlights the critical areas for potential conservation efforts and resource management strategies in the Yangtze River Basin.

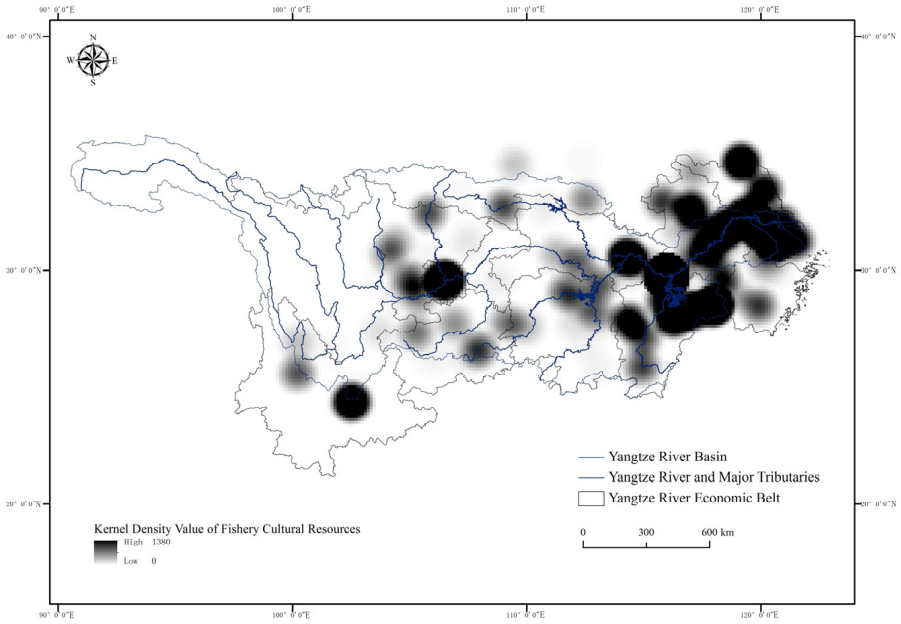

Figure 3. A kernel density map of the spatial distribution of fishery cultural resources in the Yangtze River Basin.

Correspondingly, the spatial distribution of fishery-related national and provincial intangible cultural heritage items reflects similar patterns. Spatial analysis reveals four high-density areas across the upper, middle, and lower reaches of the Yangtze River. These include the region encompassing Jiangsu and Zhejiang Province along with the Taihu Lake Basin, the Poyang Lake Basin in Jiangxi, the central area that spans the Hubei segment of the Yangtze main channel and extends to the Hunan and Dongting Lake Basin, and the Chongqing–Sichuan area (Figure 4). This distribution highlights the deep cultural significance of fishery practices across the Yangtze River Basin and pinpoints regions where cultural preservation and promotional efforts could be particularly effective.

3.2.3. Distribution of Significant YRFCR

The evaluation results of the significant categories of fishery cultural resources indicate that the highest proportions of significant resources (a score of $\geq$80) and moderately significant resources (a score of 60–79) are found in the following categories: fishery engineering and landscapes, culinary flavors, fishery customs, dances (lantern dances), fishery gear, and poetry (fishery songs). The proportions of significant resources in these categories are 67.44%, 63.66%, 59.17%, 51.73%, 51.68%, and 42.43%, respectively. The distribution of these significant fishery cultural resources is illustrated in Figure 5. In accordance with the evaluation criterion in Table 1, these categories possess substantial cultural value, marked by their historical significance, cultural and artistic merit, rarity and uniqueness, and scientific value, and display a multidimensional and interdisciplinary character, particularly pronounced in the significant areas like Poyang Lake, the main stream of Hubei in the midstream, and Taihu Lake in the downstream regions.

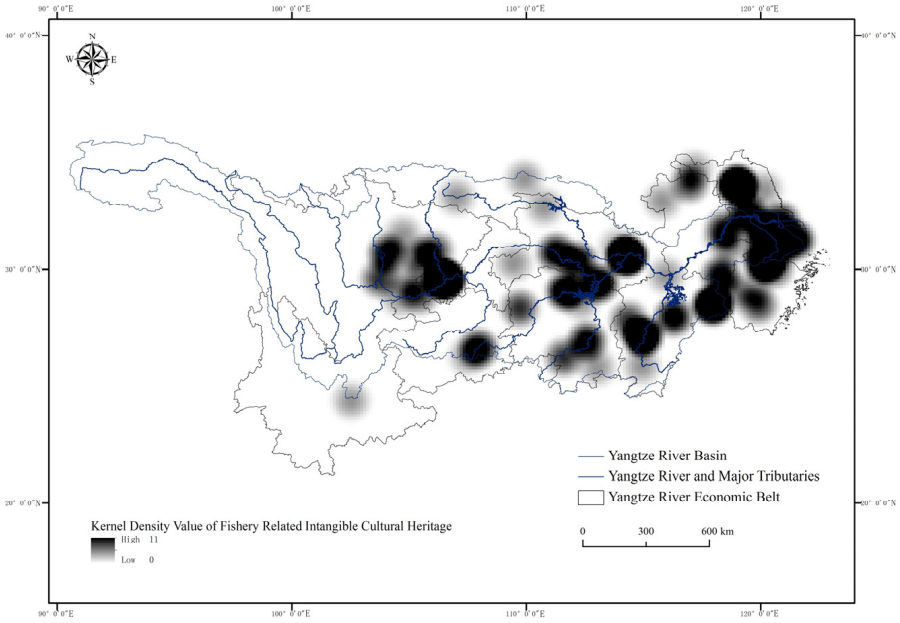

Figure 4. A kernel density map of the spatial distribution of national and provincial fishery-related intangible cultural heritage in the Yangtze River Basin.

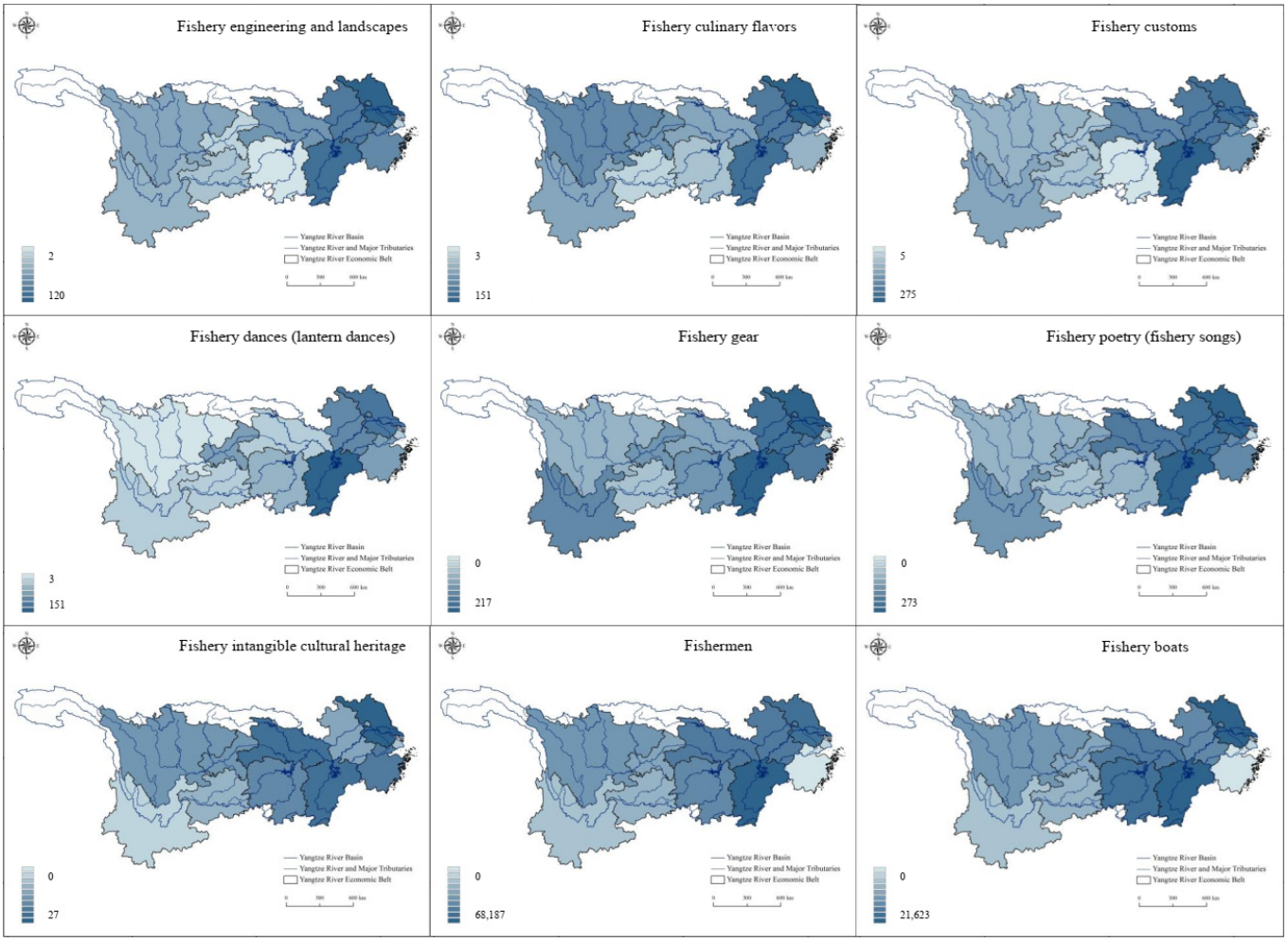

Figure 5. The distribution of significant YRFCR, the number of intangible cultural heritage, fishermen, and fishery boats that ceased fishing activities in the Yangtze River Basin.

3.3. Factors Influencing the Distribution and Sustainable Development of YRFCR

3.3.1. Natural and Geographical Factors

The distribution and evolution of fishery cultural resources in the Yangtze River Basin are profoundly influenced by its diverse natural geographical conditions and topographical features. The basin's varied terrain, climate, biodiversity, and hydrology, combined with the regional differences and the enclosed geographical spaces formed by its various tributaries, create exceptionally favorable natural conditions for the origins and development of fishery culture. These natural and geographical attributes foster a fishery culture that is regional, adaptable, complex, and multifunctional, demonstrating a profound adaptation to the water systems and the surrounding natural environment. The basin's extensive network of water bodies, including the main river, interconnected lakes, and multiple levels of tributaries, supports a widespread distribution of fishery cultural resources (Figure 6). The analysis of data from 105 prefecture-level cities reveals a significant correlation between the abundance of Yangtze River fishing culture resources and the diversity of fish species ($R = 0.83$, $p < 0.0001$) (Figure 7). Therefore, the development of the Yangtze River's fishery culture is intricately aligned with and adapted to the natural and geographical environment of its locale.

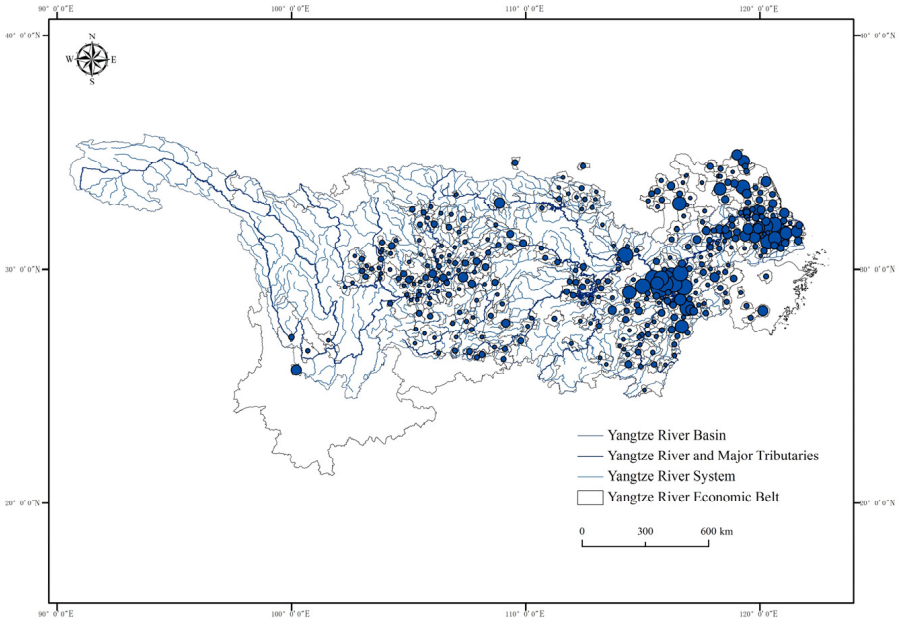

Figure 6. The spatial relationship between the distribution of fishery cultural resources and river systems in the Yangtze River Basin.

The analysis results reveal that the inherent natural characteristics of river systems are crucial factors affecting the distribution and development of these resources. This pattern demonstrates that, in regions with advanced water systems and expansive lake basins, local communities have effectively leveraged the unique aquatic biodiversity of various water bodies to develop distinct regional fishery cultures. For example, the banks of the Daning River in Wuxi of Chongqing feature karst landscapes that form underground rivers. These rivers support numerous fish species adapted to this specific ecological niche, resulting in a rich fishery landscape dominated by fish springs. Additionally, an analysis of intangible cultural heritage reveals that areas such as Huaian (8), Shangrao (7), Ji'an (6), Qiandongnan (5), Hangzhou (5), Changde (4), Wuhan (4), Yichang (3), Jingzhou (3), Honghu (3), and Huangshan (3) are notable for their high concentrations of national- and provincial-level fishery intangible cultural heritage (Table 3). These sites are predominantly located around the tributaries and lake systems, highlighting the strong link between natural water resources and the preservation of cultural heritage in fishing.

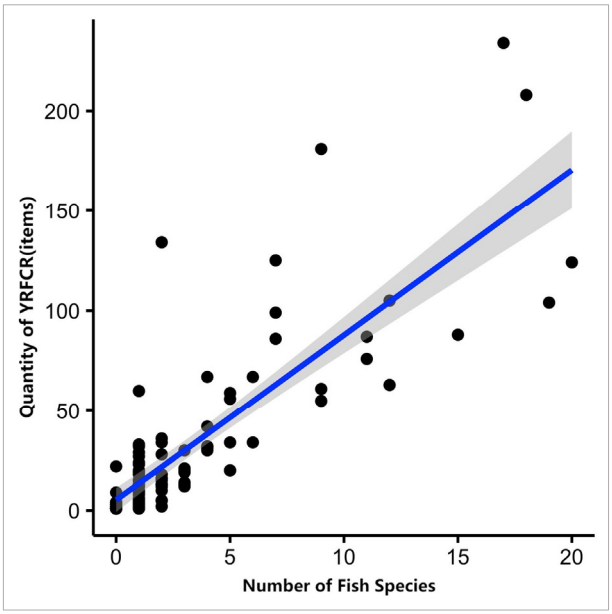

Figure 7. The correlation between the quantity of YRFCR and aquatic biodiversity in 105 prefecture-level cities.

3.3.2. Economic and Social Factors

Yangtze River fishery cultural resources are intrinsically linked to water and biological resources, necessitating that fishermen integrate various factors in their production activities. They select optimal areas for fishing and production that can support long-term, symbiotic development with the environment, ultimately aiming to maximize benefits. This strategic spatial organization results in the development of distinct fishing production technologies, fishery landscapes, fishery vessels, gear, and methods. Fishermen and their fishery boats, as the primary actors and tools of the fishery industry, serve not only as fundamental components of production but also as crucial conduits for the cultivation and preservation of fishery culture. The distribution of fishery cultural resources is widespread, encompassing 105 prefecture-level cities across the basin. A correlation analysis between the number of resources and the number of fishermen and fishery boats reveals significant positive correlations, with coefficients of 0.50 and 0.51, respectively ($p < 0.05$) (Figure 8). As a result, the bearers of fishing knowledge and cultural traditions are predominantly middle-aged and elderly fishermen. These individuals, impacted by the ten-year fishing moratorium, are either transitioning to other livelihoods or aging out of the workforce, leading to a gradual loss of significant cultural elements. Furthermore, with the decline in traditional fishing activities, cultural elements and the traditional structures of fishermen's clans are increasingly fading from memory.

3.3.3. Social and Cultural Factors

The intricate interplay of cultural, social, and economic environments profoundly impacts the distribution and evolution of fishery cultural resources along the Yangtze River. The inception of the Yangtze civilization marked the beginning of a complex coupling between natural and societal factors within the river basin, establishing broad geographical principles that are widely applicable. The foundational aspect of Yangtze fishery culture is represented by freshwater fishing. This cultural form has evolved over time, particularly due to shifts in the extent of fishing activities and transformative developments within the fishing industry, extending to include a synthesis of both fishing and aquaculture practices. The fishery culture has increasingly demonstrated characteristics of diversity, stratification, and sustainability. The result shows that, in the Yangtze River Basin, provincial intangible cultural heritage projects involving poetry (fishery songs) are predominantly situated in Sichuan and Jiangsu, hosting 12 and 7 projects, respectively (Table 2). Meanwhile, fishery

dances (including lantern dances) are mainly concentrated in the middle Yangtze River, specifically around Poyang Lake in Jiangxi, along the main and tributary streams of Hubei and the Dongting Lake in Hunan, with 10, 8, and 7 projects, respectively (Table 3).

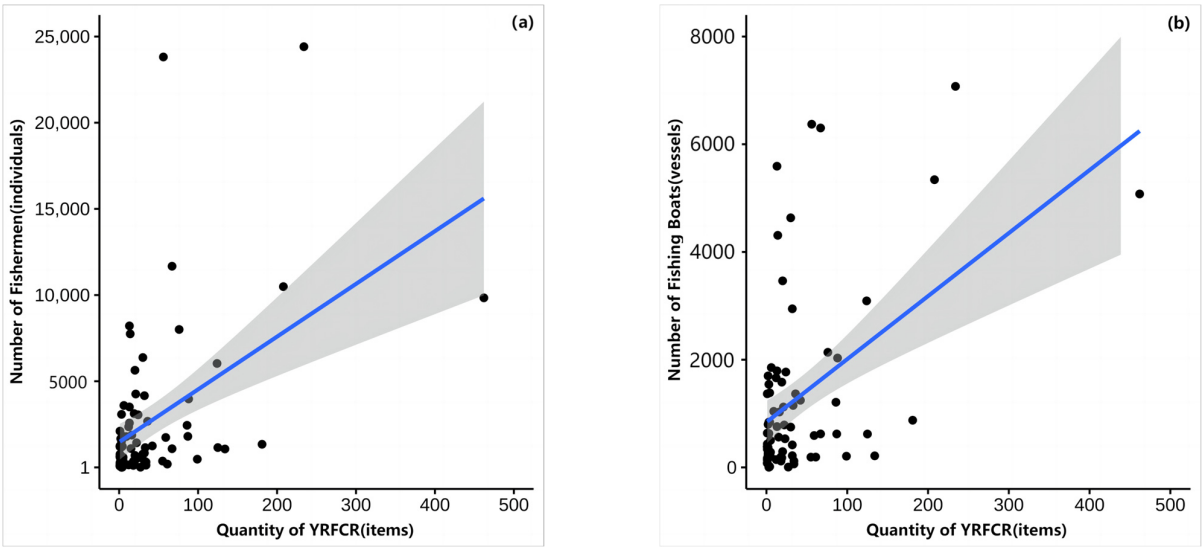

Figure 8. The correlation between the quantity of YRFCR and the number of fishermen (**a**) and fishery boats (**b**) that ceased fishing activities in 105 prefecture-level cities.

Considering the Poyang Lake Basin as an illustrative example, the fishery culture of Poyang Lake represents a pivotal element of the broader Yangtze River culture and is intricately linked to the genesis of the Gan-Po culture. The origins of fishing activities at Poyang Lake can be traced back to the Neolithic period. The traditional fishing practices at the lake include over a hundred distinct customs, which are classified into four principal categories. Moreover, the region hosts specialized fishing activities, such as lake piling and harbor opening, alongside a plethora of cultural activities related to agrarian fishing, such as fishing songs, drums, proverbs, dances, and religious customs. These varied fishing customs have been documented as early as the pre-Qin era. Typically, these practices are perpetuated through family lineages with a strong emphasis on regional continuity and transmission, predominantly maintaining a local character. Further upstream along the Yangtze River, fishery culture is seamlessly integrated with the cultures of various ethnic minorities, reflecting the unique development of fishery cultural resources in ethnic regions of Yunnan and Guizhou Provinces. Notable examples include the Tujia ethnic group's fishing drums, the Dong and Shui ethnic groups' fish totems, the Hui ethnic group's sour fish soup, the Bouyei ethnic group's integration of fish farming with rice cultivation, and the Bai ethnic group's fishing pond festivals.

4. Discussion

4.1. Characteristics and Evolution of YRFCR

The Yangtze River fishery culture holds significant historical value [52]. Landscapes such as fishing platforms, fish pool bridges, and fish-watching pavilions, widely spread throughout the Yangtze River Basin, vividly depict the rich history of the region's fishery culture. Artifacts from the upper, middle, and lower reaches of the Yangtze River, including bone-made fishhooks, pottery net sinkers, and Han dynasty fishhooks, document the varied fishing activities throughout the basin's history. During the Neolithic Age, the Hemudu culture already engaged in fishing within the Yangtze River Basin. Archaeological discoveries at the Homo erectus site in He County and the Lingjiatan site in Hanshan County in Anhui, where fish vertebra fossils were found, indicate that fishing and hunting activities began in the Jianghuai area during the Paleolithic Age. As shown in Figures 2 and 5, regions such as Bozhou, Huainan, Tongling, and Ma'anshan in Anhui; the excavation of bone

fishhooks, pottery net sinkers, and clam arrowheads; and Han dynasty fishhooks describe the fishery production activities in the Yangtze–Huaihe River Basin. In the upper reaches of the Yangtze River, over ten fishing-related archaeological sites have been discovered in Chongqing, including fish fossils, ancient fishing gear, and ancient kitchenware. Notably, the excavation in Xiushan unearthed Silurian-period "Pocket Border Town Fish" fossils, marking it as the second site globally where a significant number of complete Silurian gnathostome fossils were found.

The Yangtze River fishery culture encompasses primitive beliefs, worship practices, and taboos (Figure 5). Traditions such as the commencement of the fishing season, wedding rituals, and the custom of fishermen returning ashore are prevalent in Ma'anshan of Anhui. Similarly, in Tongcheng of Anqing, there are dietary restrictions concerning fish and general mealtime practices, along with numerous myths and folklore. These traditions offer invaluable insights for studying and preserving local customs and sentiments [53]. In Dongting Lake of Hunan, the "Songs of Dongting Fishermen" meticulously chronicle the origins, migrations, lifestyles, and folk taboos of the local fishing communities. This collection also delves into their rudimentary naturalistic and moral philosophies, as well as the full spectrum of human emotions, making it a crucial and unique representation of the region's ethnic and folkloric musical heritage. Furthermore, in some regions, historical relics such as fishery prohibition steles, fishing ban pavilions, and fish release rivers are maintained. Noteworthy examples include several Qing dynasty stone carvings in Hejiang County and the Chishui River Basin, which forbid using poison for fishing. These artifacts not only record ancient sustainable fishing practices but also highlight the historical reverence for aquatic biodiversity. Moreover, the blending of rich folk festivals with local cultural tourism initiatives significantly contributes to the development of the fishing tourism industry. This synergy plays a pivotal role in the continuation and enrichment of cultural heritage, underscoring its substantial value in fostering cultural continuity and prosperity.

The aquatic species associated with the Yangtze River's fishery culture are exceptionally diverse, reflecting a rich tapestry of aquatic biodiversity (Figure 7). These species can be broadly divided into rare and economically significant categories. Predominantly, the economic species have garnered recognition and have been certified as National Geographic Indication Products. This certification has fostered the development of distinctive brand identities through innovative cultivation methods such as integrated rice–fish farming and flowing water aquaculture. The Wuxi Yang fish from Chongqing has not only been registered for geographic indication protection but has also been listed in the national directory of special regional agricultural products. In Anhui, several local species, such as the Shiwan fish and bamboo leaf fish from Xiuning County, are celebrated for their unique local characteristics, highlighting the region's biodiversity and cultural heritage.

In the Yangtze River Basin, fishery production methods include traditional fishing tools that reflect historical practices, as well as various types of aquaculture systems and integrated farming models. In certain areas, unique fishery cultural tourism initiatives have been established as demonstration projects. These include the development of traditional fishing techniques in local cultural and tourism enterprises, such as cormorant fishing in Poyang Lake, the Jiuxing fishing method in Anhui, and the Eshan Fishing Festival in Yunnan. These initiatives have successfully fostered distinctive local fishery cultural industries. Traditional fishery production methods often carry a strong local folk cultural flavor. Examples include river fishing methods in Fuling, scoop fishing in Wushan, hookless fishing in Wuxi, and cormorant fishing in Zhong County, Chongqing. Additionally, in Wuxi County, Chongqing, the stilted houses of the fishing village serve a dual purpose: fish are farmed below the houses while inhabitants live above. This arrangement not only exemplifies unique fishery village architecture but also represents a specialized method of fishery production, embodying the integration of cultural heritage within functional community design.

The iterative advancement in the crafting of fishery implements and vessels is coupled with the distinct geographic clustering of fishing villages and culinary flavors. The specificity and diversity of fishing implements are closely tied to the localized fishery practices. Efforts to enhance fishery production efficiency have driven continual improvements in the manufacturing techniques of fishery implements and boats. This evolution has produced a wide array of fishing tools, such as various types of nets, rods, harpoons, traps, and cages. Particularly noteworthy is the craftsmanship evident in wooden twin-hulled osprey boats, residential boats, cormorant fishing boats, and net-casting boats found in Poyang Lake and Anhui. These vessels display an exquisite level of skill and design ingenuity. The fishery flavors from the upper, middle, and lower reaches of the Yangtze River capture the distinct regional culinary cultures. Notable cultural artifacts include the Han dynasty cliff tomb relief "Banquet Drinking Scene" in Yibin, which displays a sturgeon, illustrating the ancient fishing and dining culture from over 2000 years ago. Moreover, the sour soup fish technique from Kaili in Guizhou, recognized as a national-level intangible cultural heritage, embodies the distinctive culinary traditions of the Qiandongnan region in the upper Yangtze River.

In conclusion, the distribution, evolution, and development of Yangtze River fishery cultural resources are intricately linked with the characteristics of its river and lake systems, biodiversity, production methods, and the encompassing cultural and social environments (Figure 9). These cultural practices also spread in tandem with the expansion of human activities. Historically, the varying ecological, economic, and social contexts of fishermen have fostered distinctive regional and temporal variations in fishery cultural heritage, each exhibiting unique regional traits and idiosyncrasies. Predominantly, the middle and lower reaches of the Yangtze River Basin are regions where fishery culture is particularly abundant, demonstrating the area's comparative advantage in fostering and perpetuating this aspect of Yangtze culture.

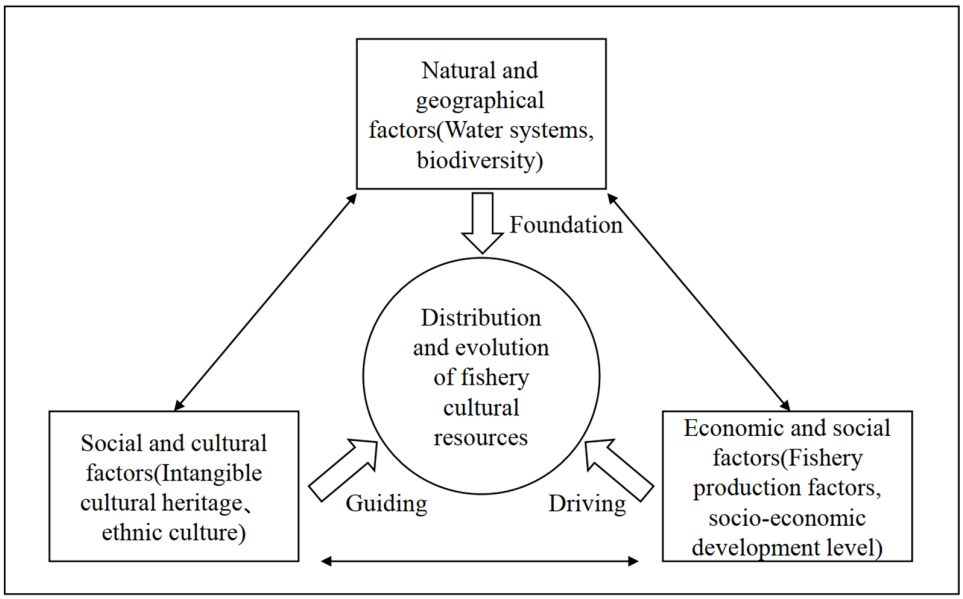

Figure 9. The distribution, evolution, and development mechanisms of the YRFCR.

4.2. The Role of Fishery Cultural Heritage Preservation in Rural Revitalization and Governance

Sustainable development is conceptualized as a complex, dynamic, and open system encompassing social, economic, and natural dimensions, highlighting the intrinsic relationship of development, coordination, and sustainability. The preservation and sustainability of Yangtze River fishery cultural resources contribute to rural revitalization and transformative governance.

The protection and inheritance of fishery cultural heritage contribute to the sustainability of rural lifestyles. Many traditional fishing techniques are not only part of cultural

heritage but also represent a harmonious coexistence between humans and nature. These techniques support ecological conservation and foster sustainable solutions for biodiversity [54]. A previous study found that the mountain stream fish farming system in Xiuning County, Anhui, not only meets the daily needs of villagers but also maintains the local ecological balance, thereby promoting sustainable rural development practices [53].

The preservation and transmission of fishery cultural heritage also strengthen community participation and cultural identity in rural areas. This engagement not only supports the preservation of cultural heritage but also promotes social stability and strengthens community bonds. By participating in the protection and revitalization of historical heritage, villagers not only gain a deeper appreciation and understanding of their traditional culture but also play an active role in community development [55].

Safeguarding and passing on fishery culture are vital for maintaining the cultural continuity of rural areas. The conservation of historical and cultural heritage is a cornerstone for preserving cultural continuity and is critical in enriching rural culture. This involves preserving ancient traditions and customs as well as providing modern interpretations, dynamic displays, and the dissemination of these heritages. Thus, the results of this study support previous research indicating that the conservation of biocultural diversity is unachievable without strong local support, collaborative efforts between scientific and local knowledge, and bridging the gap between natural and cultural perspectives in decision-making [56–58]. Attention is also focused on holistic and interdisciplinary frameworks that account for how cultures sustainably shape biodiversity, such as cultural landscapes, traditional agricultural systems, and culturally significant species [56]. As suggested by Tengö et al. (2014), in fostering biodiversity and ecosystem sustainability, the science policy community must embrace a diversity of knowledge systems [59].

Fishing culture and recreational fisheries can significantly boost rural economic development [60]. Certain regions boast distinct fishing villages and harbor architectures that are highly valuable for cultural tourism development. By integrating fishery culture with tourism, these areas are driving rural revitalization and providing new employment opportunities for Yangtze River fishermen transitioning to alternative careers. For instance, in Jiangsu, Shuanghuai Village features culturally inspired structures such as the Release Harbor, Wish Pavilion, and Celebration Platform. Wangluodian Island in Baimahu Village has evolved into a unique water island tourism hub, offering fishermen's homestays, specialty dining, fish island tours, and immersive fishery cultural experiences. In the context of rural revitalization, there is a dynamic synergy between socio-economic development and innovative advances in fishery culture. Leisure fishing brings traditional fishery cultural resources into contemporary fisheries development, utilizing water resources, fishing equipment, and fishery products [61]. As previous research has shown, this amalgamation of fishery culture and traditional lifestyle with tourism not only bolsters the interconnectivity among the recreational fishery industry's sectors, services, and organizational frameworks but also enhances the participatory and experiential dimensions of leisure fishing [62].

4.3. Strategies for the Preservation and Sustainable Development of YRFCR

Historically, the Yangtze River fishery culture exemplifies the sustainable development principle of harmonious coexistence between humans and nature, showcasing the advanced exploitation and utilization of aquatic biological resources through adept fishing techniques, reflecting the wisdom of the river basin's early inhabitants. Nonetheless, amid the ten-year fishing ban on the Yangtze River, the human–land relationship in the fishing villages has undergone significant transformation. The influence of modern civilization on traditional fishery culture is significant and should not be underestimated. This study recommends the following strategies for advancing the preservation of the Yangtze River fishery culture:

The comprehensive investigation, collection, and organization of YRFCR. An interdisciplinary approach is crucial for the thorough exploration, innovative interpretation, and research of the Yangtze River fishery culture to seamlessly integrate conservation and development initiatives. It is imperative to foster collaboration across diverse fields such

as geography, ecology, environmental science, sociology, economics, and history. This interdisciplinary engagement facilitates deep investigations into various fishery cultural resources. Through such a comprehensive approach, the complexity and significance of the Yangtze River fishery culture can be fully appreciated and understood. Establishing an interdisciplinary research platform would allow for a systematic cataloging of the types, scales, distributions, and conservation statuses of fishery cultural resources, preserving historical narratives and collecting both historical and contemporary static and dynamic aspects of fishery culture from local communities. This framework aims to enhance the depth and breadth of fishery cultural research.

Improve the legal and policy frameworks and optimize the preservation methods. The primary focuses for fishery culture resource preservation are advancing cultural heritage registration and promoting the living transmission of culture. For the resources with significant cultural and historical value, efforts should be intensified to secure recognition as intangible cultural heritage and agricultural cultural heritage at all levels. Since fishery cultural heritage accounts for only 4.3% of the national- and provincial-level intangible cultural heritage listings in China, it is crucial to prioritize advocating for heritage nominations and promoting active cultural transmission in the preservation efforts for fishery cultural resources. Guided by the principle of "protecting through development and developing through protection", this strategy involves fully exploring the value of fishery cultural heritage, implementing protective measures for cultural practitioners, establishing digital archives for Yangtze River fishery cultural bearers, and pursuing effective digital conservation strategies.

Promote the integration of fishing culture preservation and transmission with specialized industry development while expanding creative industries. We should aim to strengthen scientific planning and focus on innovation and creativity to form geographic clusters, thereby promoting the sustainable development of the fishery culture industry. Strategic planning and management are imperative to optimize the preservation, transmission, and utilization of these invaluable heritage resources, thereby facilitating the sustainable development of both cultural and natural environments. This involves safeguarding the uniqueness and authenticity of cultural heritage while integrating it into community and economic growth. Effective measures include establishing conservation standards and policies; setting up protected areas for cultural heritage, as well as museums and cultural centers; and undertaking educational and promotional activities to boost public engagement and appreciation of heritage. Strengthening the link between innovative fishery industry development and related agricultural cultural heritage is vital to creating industries with unique characteristics at heritage sites. Strategic initiatives include developing the fishery culture industry, creating unique Yangtze River fishery cultural products and derivatives, and advancing the philosophy of fishery culture conservation. By innovatively upgrading and integrating across multiple industries, a comprehensive framework can be established, consisting of a heritage chain, application chain, and innovation chain for fishery culture.

Coordinate the preservation of fishery culture resources with rural revitalization efforts and enhance public participation in rural communities. Leveraging natural, geographic, economic, social, and cultural characteristics and advantages, rural revitalization efforts should collaboratively advance the protection and development of fishery culture. In the context of the ten-year fishing ban on the Yangtze River, the revitalization of fishing villages should steadfastly promote the inheritance, enhancement, and protective utilization of fishery culture. On the one hand, consistent with the overall requirements of rural revitalization, an essential aspect of fishing village revitalization is cultural rejuvenation, necessitating the reshaping and consolidation of the soul of village transformation and development under the fishing ban, thereby promoting civilized village life. On the other hand, the scientifically sound protection and utilization of fishery culture can stimulate the revitalization of fishing villages, particularly in creating livable, workable, and aesthetically pleasing fishing communities. Developing synergies between industrial and cultural

revitalization in fishing villages—such as creating tourist hotspots, museums, science education bases, and leisure fisheries—through unified governance can lead to the formation of scalable industrial chains and strengthen the sustainable, protective development of fishery cultural resources. Community involvement is an important pathway to achieving cultural identification and represents an indispensable mechanism within the macro-system of sustainable cultural industry development. In this macro-system, community participation in planning and implementing cultural industry initiatives is fundamental to the sustainable development of regional cultural industries.

5. Conclusions and Implications

5.1. Main Findings

This study employed descriptive spatial analysis, kernel density analysis, and correlation analysis to investigate the types, expression forms, and regional distribution differences of Yangtze River fishery cultural resources. Furthermore, it examined the influence of natural–social–cultural factors—such as the watershed's natural geographic characteristics, socio-cultural aspects, fisheries production, and lifestyle—on the formation, distribution, and sustainable development of fishery culture.

(1) The Yangtze River boasts a diverse array of fishery cultural resources, encompassing 14 categories of both tangible and intangible cultural assets. Jiangsu Province has the highest number of nationally and provincially recognized intangible cultural heritage items related to fisheries, followed by Jiangxi and Hubei Provinces. The most frequently recognized categories include fishery dances (including lantern dances), followed by poetry (including fishery songs) and culinary traditions (culinary flavors). The most significant resources are found in fishery engineering and landscapes, culinary flavors, fishery customs, dances, fishery gear, and poetry.

(2) Yangtze River fishery cultural resources are characterized by notable local clustering, with two primary high-density areas and two secondary high-density regions identified. Fishery-related nationally and provincially recognized intangible cultural heritage projects in the Yangtze River Basin are distributed across four high-density zones spanning the upper, middle, and lower reaches of the river.

(3) The formation, development, and evolution of Yangtze River fishery culture are shaped by a complex interplay of factors, including the biological and natural geographical characteristics of river basins and lake systems, socio-economic development levels, fishery production factors, social environment, and historical and cultural heritage. In rural revitalization, these factors interact dynamically with each other. The distribution and evolution of Yangtze River fishery cultural resources tend to be concentrated in regions that not only are economically advanced but also boast superior natural ecological conditions, vibrant fishery production activities, and a wealth of cultural resources.

5.2. Governance and Policy Implications

Humans and nature are intimately related. Between them, the contact and flow of resources are characterized by a tangled web of interchange. The linkages value the true legacy of coexistence between biodiversity and human heritage, and the innovations for fish and fisheries were created and held by the aboriginal people over successive generations.

The preservation and governance of Yangtze River fishery cultural resources encounter numerous challenges, necessitating the adoption of a robust interdisciplinary perspective to seamlessly integrate protection and development. Enhanced scientific planning, strategic coordination, and the optimization of the Yangtze River fishery cultural and industrial resources are essential. In the contemporary era, synchronizing the preservation and inheritance of natural and cultural heritage with rural revitalization has become a vital choice for sustainable development. The three major influencing factors of fishery cultural resources indicate that the distribution and historical development of the resources are closely related to ecological, economic, social, and cultural factors. These factors play a crucial role in rural revitalization. Revitalizing fishery cultural heritage not only drives the

stable growth of the agricultural and rural economy but also underpins the sustainable advancement of comprehensive rural revitalization.

A multifaceted strategy for the conservation and transmission of the Yangtze River fishery cultural heritage is formed through a comprehensive survey of fishery cultural assets, the adoption of technology-enhanced protective measures, innovative interpretations of historical narratives, the continual enhancement of legal frameworks, and the active participation of private capital and social organizations [63]. Enhancing the application scenarios and fostering integration and innovation within the fishery culture and tourism industry are essential pathways for conserving the Yangtze River's fishery cultural resources. Moreover, boosting the proactive engagement of fishing village communities is crucial to fostering the sustainable development of these cultural resources. This comprehensive examination not only emphasizes the cultural depth of the Yangtze River's fisheries but also highlights the critical need for integrated strategies that ensure aquatic biodiversity conservation and cultural heritage preservation.

This study posits that leveraging the value and function of fishery culture can synergistically advance rural revitalization, achieving a win-win situation for both the preservation of fishery cultural resources and sustainable rural development. Additionally, this can promote the management and governance of fishing villages and watershed ecosystems in the context of the ten-year fishing ban.

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Data Availability Statement: The data presented in this study are available upon request from the corresponding author. The data are not publicly available due to privacy reasons.

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