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The role of Chinese folk ritual music in biodiversity conservation: an ethnobiological perspective from the Lingnan region

Yibo Liu^{1*} and Yingjie Song²

Abstract

Background Traditional ecological knowledge embedded in cultural practices is vital for biodiversity conservation but is increasingly under threat from modernization and globalization. This study investigates the role of Chinese folk ritual music in promoting biodiversity conservation, with a focus on Cantonese Opera and agricultural rituals in the Lingnan region of southern China.

Methods We employed literature review, qualitative fieldwork, and ethnographic analysis, including interviews with local musicians and community members, to investigate how Cantonese Opera and agricultural rituals contribute to ecological sustainability by integrating cultural narratives with environmental stewardship.

Results The findings reveal three main ways in which Chinese folk ritual music supports biodiversity conservation: (1) fostering ecological understanding through symbolic representations, such as the carp and water buffalo; (2) promoting sustainable practices, including traditional farming techniques and the conservation of wetland ecosystems; and (3) enhancing community cohesion and the transmission of ecological values across generations. Notably, 70% of interviewees highlighted the role of symbolic animals in raising awareness of ecological sustainability.

Conclusions The study underscores the potential of integrating traditional ecological knowledge with modern conservation strategies. Cultural traditions, such as Cantonese Opera and agricultural rituals, not only preserve biodiversity but also provide a framework for sustainable resource management. These findings highlight the importance of protecting and revitalizing cultural practices to ensure both cultural and ecological resilience in the face of global challenges.

Keywords Chinese folk ritual music, Traditional ecological knowledge, Cultural sustainability, Agrobiodiversity, Lingnan region

Introduction

In recent years, the link between cultural diversity and biodiversity conservation has received increasing attention from the international community. Organizations, such as the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the International Union for Conservation of Nature (IUCN), have highlighted the interdependence between cultural diversity and biodiversity. They argue that the protection of cultural diversity is critical for achieving biodiversity conservation goals [1–3]. However, the role of specific cultural

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practices, such as folk songs and rituals, in conservation has not been systematically reviewed. For example, studies from Brazil and the Himalayas illustrate how indigenous and pastoral communities embed ecological knowledge in cultural traditions, effectively preserving biodiversity through controlled burning, agroforestry, and sacred groves [4, 5]. Yet, these practices are seldom operationalized in global conservation frameworks.

Cultural diversity, defined as the variety of cultural expressions, languages, practices, and traditions within human societies, supports biodiversity conservation by embedding ecological knowledge in rituals, songs, and practices [6]. These cultural expressions often emphasize sustainable interactions with the environment, fostering conservation values through generational transmission. For example, traditional agricultural rituals in Lingnan incorporate symbolic elements that highlight biodiversity, such as the celebration of specific crops and the use of animals like water buffalo in planting ceremonies, which reinforce sustainable agricultural practices [7–10], which is manifested in the form of cultural influence on species diversity, cultural influence on genetic diversity, cultural influence on ecosystem diversity, and culture influences landscape diversity. Chinese scholars have used concepts, such as ethnobotany and ethnoecology, to examine the interplay between cultural values and biological resources. The term 'natural-cultural heritage protection' refers to the integrated conservation of both natural ecosystems and the cultural traditions that sustain them. Studies have focused on biodiversity management through traditional agricultural techniques, sacred landscapes, and cultural festivals, collectively termed 'natural-cultural heritage.' This concept refers to the integration of natural ecosystems and culturally significant practices, emphasizing the need to protect both tangible and intangible cultural expressions alongside their associated biodiversity [11, 12]. However, with the rapid development of social economy and science and technology, which leads to the gradual change of people's cultural values, some traditional knowledge and technology have been gradually abandoned, the inheritance mechanism of culture and knowledge is disintegrated, and there are even some misunderstandings about traditional culture. Chinese traditional culture is facing a rapid loss, and the role of traditional culture in biodiversity needs to be further emphasized and more protection provided.

Research has shown that traditional cultural practices play a crucial role in maintaining ecosystem stability and conserving biodiversity [13, 14]. In addition to the well-documented cases of the Kayapo People in the Amazon and Himalayan pastoralists, examples from China illustrate similar connections. For instance, Zhuang Dragon Boat Songs incorporate themes of sustainable fishing

practices and river conservation [15], while Yi ethnic rituals emphasize forest protection through community stewardship of sacred groves [16]. These examples demonstrate that cultural practices not only preserve species diversity but also support ecosystem resilience by promoting sustainable resource use. Research has shown that these indigenous practices not only preserve a wide range of plant and animal species but also enhance the resilience of ecosystems to environmental changes [17]. Another example is found in the Himalayas, where traditional pastoral communities utilize rotational grazing and sacred groves to sustain both biodiversity and ecosystem health. The sacred groves, in particular, are areas of forest preserved for religious purposes, often harboring rare and endemic species [18]. These practices demonstrate how cultural traditions and biodiversity conservation are intertwined, supporting the argument that cultural diversity can play a significant role in the preservation of biological diversity.

While research in this area has significantly expanded, gaps remain in the operationalization, assessment, and scaling of cultural practices for biodiversity conservation. Studies, such as those by Berkes on sacred ecology and by the IPBES on traditional ecological knowledge, highlight the potential of cultural practices to contribute to conservation [19, 20]. However, challenges persist in translating these practices into actionable strategies within modern conservation frameworks. This study seeks to address these gaps by exploring how Chinese folk ritual music, as a case study, can provide a model for integrating cultural practices into biodiversity conservation strategies. This is compounded by the fact that the trend toward cultural homogenization brought about by globalization poses a challenge to the preservation of traditional cultures, which not only affects cultural diversity, but also indirectly affects biodiversity conservation. Furthermore, international agreements and frameworks, such as the Convention on Biological Diversity (CBD) and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), explicitly recognize the interdependence of cultural diversity and biodiversity, as highlighted in the Local Biodiversity Outlooks 2 (2020). These reports emphasize that traditional knowledge, cultural practices, and community-driven strategies are critical for achieving global biodiversity targets, such as those outlined in the Aichi Biodiversity Targets and the Kunming-Montreal Global Biodiversity Framework. However, these recognitions, the operationalization, and scaling up of cultural strategies within biodiversity conservation programs remain significant challenges. Therefore, exploring and deepening the links between cultural diversity and biodiversity conservation, especially studying how traditional cultural forms, such

as folk ritual music, contribute to biodiversity conservation, has become a new research direction.

Chinese folk ritual music refers to traditional musical expressions performed during rituals, festivals, and ceremonies, deeply rooted in cultural and spiritual practices [21]. While the primary purpose of these traditions is artistic and ceremonial, they frequently reflect ecological values through their narratives, symbolism, and themes. The ecological relevance of these traditions arises not from their original artistic intent but from the environmental values embedded within their cultural context. Additionally, agricultural rituals in Lingnan not only highlight biodiversity through symbolic representations of crops and animals but have also been observed to promote practical conservation outcomes, such as maintaining wetland ecosystems and ensuring sustainable farming. Thus, Chinese folk ritual music represents both a cultural expression and a medium for transmitting ecological awareness. While primarily artistic and ceremonial, these traditions often reflect ecological themes by incorporating narratives, symbols, and practices that emphasize harmony with nature and sustainable resource use. For example, Cantonese Opera integrates stories of water deities to underscore the importance of wetland conservation, while agricultural songs in Lingnan highlight biodiversity through references to crops and symbolic animals like the water buffalo and migratory birds [22]. This dual role as both an artistic expression and a repository of traditional ecological knowledge makes Chinese folk ritual music a significant cultural asset in biodiversity conservation. However, with the rapid development of modern society, these traditional music forms and the ecological protection consciousness embedded in them are facing the risk of being forgotten and disappearing. In this study, 'Chinese folk ritual music' refers to traditional music forms associated with specific linguistic cultures that have ecological and cultural significance. These forms of music are often tied to ceremonial and communal activities that embody respect for nature. This research specifically focuses on Cantonese Opera and agricultural rituals in the Lingnan region, which are closely linked to local ecosystems and cultural practices.

Above all, we aim to deeply explore the intrinsic connection between Chinese folk ritual music and biodiversity conservation, and tries to provide new ideas and methods for biodiversity conservation from a cultural perspective. By analyzing in detail the natural elements and symbolism in Chinese folk ritual music and the impact of these musical activities on biodiversity conservation, this study can not only provide theoretical support for the conservation and inheritance of traditional culture, but also provide new perspectives and practical cases for biodiversity conservation.

Methodology

Research areas

The selection of research areas was predicated on ecosystems in China that are both ecologically representative and rich in linguistic cultural backgrounds. The case study areas chosen include Cantonese Opera and Ancestral Worship and Agricultural Rituals in Lingnan. These regions are not only biodiversity hotspots but also frequent venues for musical activities, providing a unique platform for cross-disciplinary research into the intersections between natural environments and cultural landscapes. This integration allows for a comprehensive analysis of how local cultural practices, particularly musical traditions, may influence and be influenced by ecological conservation efforts.

Case study

We conducted fieldwork from 2020 to 2023 to investigate the relationship between Chinese folk ritual music (Chinese folk ritual music is defined as traditional musical expressions performed in the context of rituals, festivals, or community gatherings) and biodiversity conservation, focusing on two key case studies in the Lingnan region: Cantonese Opera and agricultural rituals. As part of this study, we employed semi-structured interviews with 30 participants, including local musicians, ecologists, and community members who are actively involved in these practices.

To provide a comprehensive understanding, the background of the interviewees was documented. Participants ranged in age from 25 to 70, with a mean age of 48 years. The group included 18 male and 12 female participants, representing a variety of professions, such as traditional musicians ($n=15$), farmers involved in ritual practices ($n=8$), and local scholars or ecologists ($n=7$). Interviewees were selected through purposive sampling, targeting individuals recognized within their communities for their expertise or active involvement in ritual practices. Selection criteria included their familiarity with the cultural and ecological significance of the rituals, as well as their willingness to participate in extended discussions.

Each interview lasted approximately 90 min and covered topics such as the historical development of the rituals, their connection to the natural environment, and the ways in which biodiversity conservation concepts are embedded and transmitted through musical traditions. Quantitative insights were also gathered during the qualitative interviews. For example, 70% of the participants emphasized the symbolic importance of animals, such as fish and birds, in ritual music, with this understanding being particularly prevalent among older participants (aged 50 and above). Younger participants (aged 25–40) were more likely to discuss the practical implications of

conservation efforts, such as sustainable fishing or farming techniques, suggesting a generational difference in focus. Gender differences were also noted: female participants more frequently highlighted the spiritual and cultural aspects of the rituals, while male participants often addressed the rituals' logistical and community-wide implications.

The study adhered to rigorous ethical standards to ensure the protection of participants' rights and data integrity. Prior to the interviews, participants were provided with detailed information about the study's objectives, the types of questions they would be asked, and how the collected data would be utilized. Written informed consent was obtained from all participants, confirming their voluntary participation and agreement to have their responses used for research purposes [23]. Participants were also informed of their right to withdraw from the study at any time without penalty.

Interviews were audio-recorded with explicit consent to ensure the accuracy of the data and to facilitate transcription and analysis. All recordings and transcriptions were securely stored on password-protected devices accessible only to the research team. To maintain confidentiality, identifying information was anonymized, and pseudonyms were assigned in all research outputs. This study was reviewed and approved by the Ethical Review Board of Guangzhou College of Technology and Business, ensuring compliance with ethical standards for research involving human subjects.

Literature review

In order to comprehensively review and analyze the folk ritual music related to biodiversity across various provinces and regions of China, we systematically collected literature pertaining to specific folk rituals and festivals across various regions in China, particularly those incorporating elements of biodiversity in their musical activities during the ceremonies. The literature was primarily sourced through an extensive exploration of both domestic and international academic databases, including CNKI (China National Knowledge Infrastructure), VIP Database, Google Scholar, and Web of Science.

Results

Overview of Chinese folk ritual music and biodiversity conservation

Based on literature analysis, we outlined a comprehensive list of regions across China, detailing their linguistic or cultural groups, forms of ritual music, biodiversity elements, and conservation roles associated with these musical traditions (Table 1). It paints a vivid picture of how diverse cultural practices, especially ritual music and festivals, play an integral role in promoting

environmental awareness and conservation efforts across various ecological systems—from mountain and forest ecosystems to aquatic biodiversity, and from urban green spaces to vast grasslands.

Natural elements in Chinese folk rituals music

Many of the described folk rituals are specific to particular natural elements—mountains, rivers, forests, or coastal areas—as well as the animals inhabiting these environments. For example, the carp often appears in Cantonese ritual songs as a symbol of prosperity and ecological harmony in wetland ecosystems. Similarly, egrets, frequently mentioned in Lingnan agricultural songs, symbolize the coexistence of humans and birds in rice paddies. In addition, Zhuang People's Dragon Boat Songs highlight the role of aquatic animals such as fish and turtles in maintaining riverine biodiversity. The turtle is often revered as a guardian of water ecosystems and a symbol of longevity, reflecting its cultural and ecological significance. Chinese folk ritual music reflects specific natural elements across diverse ecosystems: **Mountain Ecosystems:** Celebrated in Huizhou Guqin Music and Songs of the Goddess of Wushan, symbolizing reverence for mountains and their ecological significance. **Woodlands and Wildlife:** Highlighted in Anhui folk ceremonies, emphasizing the connection between cultural rituals and forest biodiversity. **Aquatic Biodiversity:** Zhuang People's Dragon Boat Songs focus on the ecological roles of fish and turtles in river ecosystems. **River and Wetland Ecosystems:** Cantonese Opera in Guangdong integrates narratives of wetland protection, symbolized by animals like the carp. **Grasslands and Farmland:** Dongxiang People's Pastoral Songs in Gansu advocate for sustainable grazing and agrobiodiversity. This synthesis underscores the integral role of natural elements in folk rituals, fostering biodiversity awareness through cultural narratives (Table 1).

The symbolic significance embedded within folk ritual music reflects the profound harmony between humans and nature, reverence for ecosystems, and an awareness of conserving natural resources (Table 1). Key themes include:

Reverence for Mountains and Plateaus: Folk music often portrays mountains and plateaus as both physical and spiritual symbols. Animals like the golden carp and water buffalo are central to these representations, symbolizing harmony and productivity. For instance, Huizhou Guqin Music from Huangshan in Anhui extols the Yellow Mountains, blending aesthetic appreciation with ecological conservation. **Custodianship of Rare Species:** Many rituals emphasize the protection of rare flora and fauna. Gong and Drum music of the Jingpo People in Yunnan highlights wildlife conservation,

Table 1 Chinese folk ritual music related to biodiversity conservation

Region	Ethnic/culture	Form of ritual music	Biodiversity element	Conservation role	References
Anhui	Huangshan region culture	Huizhou Guqin Music	Mountain ecosystems and rare plant species	Advocate for the protection of the Huangshan region's ecosystem and its unique biodiversity	[24]
	Anhui folk beliefs	Blessing and sacrificial music ceremony	Woodland and Wildlife Conservation	Express reverence for natural gods through music and dance, and promote respect and protection of forests and wildlife reserves	[25]
Beijing	Han in Beijing	Traditional music and folk performances at Spring Festival Temple Fairs	Urban green spaces and historical parks	Spring Festival Temple Fairs, through traditional music and folk performances, attract citizens and tourists, enhancing their awareness of biodiversity conservation in urban green spaces and historical parks, promoting eco-friendly festival celebrations	[26]
Chongqing	Wushan culture	Songs of the Goddess of Wushan	Yangtze River and Wushan area ecosystems	The Songs of the Goddess of Wushan, traditional folk music, tell stories of the Goddess and her connection to nature, advocating for the protection of the Yangtze River basin and its surrounding ecosystems	[27]
Fujian	Hokkien People	Dragon dance music	Agrobiodiversity	Inherit traditional agricultural knowledge, and promote the protection of mountain ecosystems and agricultural biodiversity	[28]
	Aboriginal People from western Fujian	Tulou ancestor worship music	Farmland biodiversity	Promote the understanding and conservation of traditional agricultural biodiversity, including sustainable practices in land management and crop growing	[29]
	Minnan culture	Sea ritual music	Marine life	Raise community awareness of marine ecosystems and their biodiversity through rituals and songs	[30]
Guangxi	Zhuang People	Dragon Boat Songs	Aquatic biodiversity	Promotes water environment protection and awareness of aquatic ecosystems	[31]
	Yao People	Sacrificial singing and dancing	Mountain natural resources	Emphasize respect and protection of natural resources through sacrificial activities	[32]
	Maonan People	Maonan People's sacrificial music	Natural resources	Ceremonies reflect respect for forests and natural resources	[33]
	Buyi People	Buyi People's wind and rain bridge song	Ecosystem near rivers and bridges	Singing activities highlight water conservation and the importance of bridges as ecological corridors	[34]

Table 1 (continued)

Region	Ethnic/culture	Form of ritual music	Biodiversity element	Conservation role	References
Guangdong	Hakka People	Hakka Mountain Songs	Agricultural ecosystems, land	Mountain Songs reflect the Hakka People's wisdom and practices in agricultural ecology and land conservation	[35]
	Huizhou	Ancestor worship songs in Hakka ancestral halls	Traditional medicine and plant protection	Through singing in ancestor worship rituals, knowledge and awareness of the protection of medicinal plants are passed down	[36]
	Cantonese Opera	Water Town Operas	River and wetland ecosystems	Operas telling stories of water towns highlight the importance of respecting water resources and wetland ecosystems, raising environmental awareness	[37]
	Shantou	Poseidon Festival Sea Song	Marine biodiversity	Emphasizes the importance of marine life and raises local residents' awareness of protecting the ocean	[38]
	Chaozhou	Prayer music for the event of racing gods	Wildlife	Worshipping wild animals and plants during blessing activities reflects respect for nature protection	[39]
Gansu	Dongxiang People	Pastoral Songs	Grassland and farmland ecosystems	Pastoral Songs contain practices and wisdom for grassland conservation and sustainable agriculture	[40]
	Qiang People	Qiang Flute Music	Mountain ecosystems, water resources	Reflects reverence for mountains and water, advocating for the protection of natural resources	[41]
	Silk road trading culture	Caravan Marches	Natural landscapes and biodiversity along the trade routes	Ancient caravans' dependence on natural environments along the routes, promoting the protection of the historical silk road and its natural heritage	[42]
	Hexi corridor culture	Folk Legend Songs	Oasis ecosystems in the Hexi Corridor	Legend Songs, narrating stories of coexistence with nature, strengthen the awareness of protecting oasis ecosystems	[40]

Table 1 (continued)

Region	Ethnic/culture	Form of ritual music	Biodiversity element	Conservation role	References
Guizhou	Miao People	Lusheng Dance	Mountainous ecosystems, plant	Emphasizes harmony with nature through music and dance, promoting environmental protection	[43]
	Dong People	Dage/Dong Opera	Forest, River	Promote awareness of forest and water resource protection and inherit the concept of harmonious coexistence with nature	[44]
		Dong Diaojiaolou and Drum Tower Song and Dance	Village and surrounding forest environment	Promote community consensus on forest protection through drum tower gatherings, singing, and dancing	[45]
	Gelao People	Song of life	Mountain ecosystem	Celebrate the harmony between man and nature and convey the importance of biodiversity conservation	[46]
	Shui People	Dragon Boat Song	Aquatic ecosystem	Increase awareness of water ecosystem protection through celebration activities	[47]
	Mulao People	Traditional sacrificial music	Mountains and rivers	Enhance awareness of the protection of the natural environment and water resources through sacrificial rituals	[48]
Hubei	Tujia People	Mountain Songs	Mountainous forest ecosystems	Mountain Songs with nature worship and sustainable use of forest resources enhance ecological conservation awareness	[49]
	Wuhan	Lotus Festival music event	Urban wetlands and their biodiversity	Lotus Festival celebrates Wuhan's wetland culture through music and dance, encouraging public participation in urban wetland protection	[50]
Human	Tujia People	Stilted House Songs	Mountainous forest ecosystems	By praising natural landscapes and land, emphasizes the protection of forests and mountainous ecosystems	[51]
	Han People	Flower Drum Opera	Farmland biodiversity	People's awareness of the protection of farmland ecosystems and their biodiversity is enhanced	[52]
Heilongjiang	Hezhe People	Fishing Songs	River ecosystems, aquatic life	Transmits traditions of coexistence with aquatic life, promoting river ecosystem conservation	[53]

Table 1 (continued)

Region	Ethnic/culture	Form of ritual music	Biodiversity element	Conservation role	References
Hainan	Li People	Traditional Sea Worship Rituals	Marine biodiversity	Expresses respect for the ocean and marine life, enhancing marine conservation awareness	[54]
		Bamboo pole dance	Tropical rainforest ecosystems	Dance and music reflect dependency on and the protection of tropical rainforests, transmitting ecological wisdom	[55]
	Danzhou	Danzhou beats gongs and drums to worship the sea ceremony	Marine biodiversity	The sea offering ceremony expresses respect for the ocean through music and dance, and raises awareness of ocean protection	[56]
	Qionghai	Rain Prayer Songs Thunder Worship Ceremony	Water conservation and rational utilization	The thunder and rain praying ceremony reflects respect for natural water resources and promotes water resource protection	[57]
	Sanya	New Year's Song and Dance	Fisheries and Marine Ecology	Fishermen's New Year's Song and Dance promotes sustainable fishery practices by inheriting fishery culture	[58]
Henan	Songshan Taoist culture	Songshan Taoist music	Forests and wildlife in the Songshan area	Promote respect for the natural landscape and ecosystem of Songshan Mountain and raise awareness of forest and wildlife protection	[59]
	Henan rural culture	Henan Yangge	Farmland Biodiversity and Traditional Crops	Promoting the maintenance of traditional crop growing methods will help protect farmland biodiversity	[60]
Hebei	Culture surrounding Chengde Summer Resort	Royal garden music	Mountain forest ecosystem and garden plants	Enhance public appreciation of natural beauty and biodiversity and promote the protection of the natural environment	[61]
	Hebei folk beliefs	Water God Festival song	Natural landscape of sacred mountains and rivers	Advocate for the protection of the natural environment and biodiversity	[62]

Table 1 (continued)

Region	Ethnic/culture	Form of ritual music	Biodiversity element	Conservation role	References
Inner Mongolia	Mongolian People	Morin Khuur (Horsehead Fiddle) Music	Grassland ecosystems, horse culture	Reflects respect for grasslands and horses, transmitting grassland conservation culture	[63]
	Evenki People	Hunting Songs	Grassland and forest ecosystems	Demonstrates the hunting community's respect for nature, advocating for the protection of wildlife and ecosystems	[64]
	Daur ethnic culture	Daur Traditional Lake Worship Songs	Wetland ecosystems and aquatic biodiversity	Praise wetlands and their biodiversity, encouraging local community participation in wetland conservation efforts	[65]
	Grassland ritual culture	Grassland Oboo Worship ritual music	Grassland and cultural landscape biodiversity	Enhancing the protection awareness of grassland ecosystems and their cultural heritage, thus fostering biodiversity conservation	[66]
Jiangsu	Water Town Residents	Boatmen's Chants	River and lake ecosystems	Reflects the dependence on aquatic environments and related biodiversity, advocating for aquatic ecosystem protection	[67]
	Suzhou Pingtan	Water Town Narratives	River and lake ecosystems	Pingtan stories related to water towns recount lives intertwined with water, reminding of aquatic ecosystem conservation	[68]
Jilin	Korean Ethnic Group	Ariang	Mountains and farmlands	Reflects the Korean Ethnic Group's dependence on and respect for the land, advocating for harmonious coexistence with nature	[69]
	Indigenous cultures	Indigenous Traditional Hunting Songs	Mountainous areas and their wildlife	Through Hunting Songs, indigenous communities pass down respect for nature and wildlife, encouraging the protection of wildlife habitats and the preservation of traditional knowledge	[70]
Jiangxi	Hakka People	Mountain Songs	Agricultural ecosystems, land and water resources	Mountain Songs contain agricultural cultural wisdom and ecological knowledge, promoting land and water conservation	[71]
	Nanchang	Harvest Festival ritual music	Farmland biodiversity	Through the ceremony of thanking the gods for blessing the harvest, the protection of farmland ecology and crop diversity is emphasized	[72]

Table 1 (continued)

Region	Ethnic/culture	Form of ritual music	Biodiversity element	Conservation role	References
Liaoning	Manchu People	Manchu Traditional Ancestral Worship and Sacrificial Music	Forest and wetland ecosystems	Propagating the conservation of forests and wetlands, thus promoting ecosystem health and biodiversity	[73]
	Liao River Basin Communities	Traditional Fishing Songs of Liao River Fishermen	Liao River and its surrounding aquatic ecosystems	Emphasizing the significance of aquatic ecosystems, thus promoting the conservation of river ecosystems and aquatic biodiversity	[74]
Ningxia	Hui People	Recitation of Quranic Music	Desert and oasis ecosystems	The community's awareness of protecting Ningxia's desert and oasis ecosystems is enhanced, conveying messages of coexistence with nature as per religious teachings	[75]
	Yellow River culture	Yellow River Boatmen's Song	Aquatic biodiversity of the Yellow River basin	Promotes attention to the conservation of biodiversity in the Yellow River, advocating for the river's cleanliness and ecological balance	[76]
Qinghai	Tuva People	Throat singing	Highland meadow ecosystems	Mimics natural sounds like wind and bird calls, showcasing respect and conservation awareness for natural environments	[77]
	Salar People	Salar prayer ritual music	Biodiversity and cultural heritage in Salar inhabited areas	Contributing to the conservation of biodiversity and cultural heritage	[78]
Sichuan	Tibetan People	Praise Songs and Prayer Songs	Plateau ecosystems, wild animals	Emphasizes protection of the natural environment and wildlife on the plateau	[79]
	Mosuo People	Mountain turning ceremony music	Lugu Lake and surrounding ecosystems	Emphasize the protection of Lugu Lake waters and its ecological diversity	[80]
	Yi People	Folk songs	Mountain ecosystems, plants and animals	Songs transmit respect and awareness for vegetation and animal conservation	[81]
	Qiang People	Qiang New Year Festival	Mountainous ecosystems, wild flora and fauna	The music and dances during the Qiang New Year Festival showcase reverence for nature, advocating ecological protection	[82]
Shaanxi	Qinling culture	Qinling Mountain Songs	Qinling mountainous forest ecosystems	Celebrating the natural beauty and biodiversity of the Qinling Mountains, enhance public awareness of the need to protect mountain forests	[83]
	Louguantai culture	Louguantai Poems	Natural environment and biodiversity around historical architecture	Praising historical buildings and their surrounding natural environment advocate for the conservation of cultural sites and their ecological surroundings	[84]

Table 1 (continued)

Region	Ethnic/culture	Form of ritual music	Biodiversity element	Conservation role	References
Shanxi	Taihang Mountains	Taihang Mountain Worship Songs	Mountainous forest ecosystems	Ancient worship songs express reverence for the natural landscapes of the Taihang Mountains, encouraging the conservation of mountainous forests	[85]
Shandong	Taishan culture	Taishan Temple Fair Music	Mountain forest ecosystem	Express admiration for the natural landscape of Mount Tai and encourage participation in mountain forest protection	[86]
	Qufu Confucian culture	Music for worshipping Confucius in Confucius Temple	Cultural landscape and native plants	Carry forward Confucianism, advocate environmental protection, and promote the protection of cultural and natural heritage	[87]
Shanghai	Diverse Ethnic Groups in Shanghai	Spring Festival Sea Worship Ceremony Music	Urban rivers and marine ecosystems	The Spring Festival Sea Worship Ceremony, through music and ritual activities, emphasizes the significance of marine and river ecosystems, raising public awareness for aquatic ecological conservation	[88]
Taiwan	Indigenous cultures	Ancestral Spirit Worship Dance and Songs	Taiwan's forest and river ecosystems	Emphasizing the importance of conserving forest and river ecosystems and promoting community participation in ecological conservation	[89]
	Hoklo (Hokkien) culture	Hoklo God Welcoming Music	Taiwan's cultural landscapes and their habitats	Strengthens the reverence for land, advocating for the protection of cultural landscapes and their associated habitats	[90]
	Atayal culture	Atayal Traditional Hunting Songs	Montane ecosystems	Atayal Hunting Songs not only pass down hunting skills but also express respect for mountainous natural environments and biodiversity, advocating for the protection of montane ecosystems and the preservation of traditional knowledge	[91]

Table 1 (continued)

Region	Ethnic/culture	Form of ritual music	Biodiversity element	Conservation role	References
Tibet	Tibetan People	Circumambulation Songs	Highland lakes and rivers	Emphasizes the protection and respect for the natural environment of the plateau	[92]
	Religious Monasteries	Gelug School Scriptural Recitation	Natural environment surrounding mountain monasteries	encouraging the protection of the natural surroundings and wildlife habitats around monasteries	[93]
	Cross-cultural Exchange	Losar Festival Intercultural Choirs	Diverse natural ecosystems and cultural heritage sites	Foster understanding and respect for the protection of Tibet's diverse natural ecosystems and cultural heritage sites	[94]
Xinjiang	Kazakh People	Dombra Music and Traditional Songs	Grassland and desert ecosystems	Songs and music emphasize harmony with nature, advocating for the protection of grasslands and deserts	[95]
	Uyghur People	Mass Dance Music	Desert oasis ecosystems	Dance and folk songs celebrate life brought by water resources, emphasizing the protection of desert oases	[96]
	Kyrgyz culture	Kupuz	Montane meadow ecosystems	Reflects the Kyrgyz respect for nature, encouraging the protection of montane meadow ecosystems	[97]

Table 1 (continued)

Region	Ethnic/culture	Form of ritual music	Biodiversity element	Conservation role	References
Yunan	Dai People	Water Splashing Festival Songs and Dances	Aquatic ecosystems	Celebrates and emphasizes the importance of water resources, advocating for the conservation of aquatic ecosystems	[98]
	Hani People	Hani folk songs	Terraced agricultural ecosystems	Songs reflect reverence for the terraces and water, advocating for the protection of land and water resources	[99]
	Bai People	March Street Festival	Lakes and river ecosystems	Celebratory water rituals enhance awareness of water resources and the protection of aquatic biodiversity	[100]
	Naxi People	Dongba ritual music	Mountain ecosystem	Protect mountains and water sources and maintain ecological balance	[101]
	Bulang People	Drum Dances/Tea Festival Song and Dance	Forest ecosystem/tea plantation ecosystem	Strengthen awareness of forest protection through ritual activities/emphasize the harmonious coexistence of traditional agriculture and biodiversity	[102]
	Lisu People	New Year's Eve Song and Dance	Ecological Agriculture and Traditional Festivals	Enhance awareness of ecological agriculture and traditional culture protection	[103]
	Dulong People	Dulongjiang Song and Dance	Rivers and Biodiversity	Strengthen awareness of river ecosystem protection	[104]
	Achang People	Dragon Boat Song	River ecosystem	Promote water resources protection and sustainable use	[105]
Zhejiang	Tea culture	Tea Songs	Agricultural ecosystems, especially tea plantations	Tea Songs reflect the close relationship between tea culture and ecological agriculture, promoting protection of the agricultural environment	[106]

symbolizing coexistence with the natural world's animal inhabitants. **Agricultural Biodiversity:** Musical traditions frequently celebrate the biodiversity of agricultural ecosystems. Tulou ancestor worship music in western Fujian reflects respect for traditional crop diversity through ancestral veneration. **Sustainable Use of Natural Resources:** Songs like the Miao People's Lusheng Dance and the drum tower singing in Guizhou advocate for protecting mountain ecosystems and maintaining traditional agricultural lands, promoting sustainable environmental interactions. **Resilience Against Natural Disasters:** Some performances, such as Hakka Mountain Songs from Guangdong, serve as prayers for disaster resilience, reflecting the Hakka community's wisdom in land conservation and ecological adaptation. **Reverence for Ancestors and Traditions:** Rituals dedicated to ancestral respect, such as Minnan sea rituals, incorporate songs that promote marine ecosystem awareness, reflecting the ocean's importance as a life source. **Celebration of Life Cycles and Rhythms:** Songs like the Tujia People's Stilted House Songs in Hunan emphasize the cyclical nature of agriculture and the protection of forests and mountainous landscapes. **Community Cohesion and Shared Responsibility:** Collective participation in music and dance fosters unity and environmental responsibility. In Lingnan, migratory birds and aquatic animals feature prominently in ritual songs, inspiring awareness of wetland and forest conservation, as seen in Dong People's Opera and singing in Guangxi. **Environmental Education and Awareness:** Performances like the Fish Lantern Festival Music in Jiangxi convey ecological knowledge. By celebrating wetland and aquatic life, these rituals enhance public understanding of ecosystem conservation.

These folk ritual musics transcend their cultural significance, acting as carriers of ecological and environmental awareness. Through these musical expressions, communities demonstrate their reverence for nature, commitment to biodiversity, and dedication to sustainability. This cultural heritage serves as a crucial bridge, connecting traditional wisdom with modern environmental conservation practices.

Cultural diversity and environmental conservation

Cultural diversity plays a significant role in biodiversity conservation, as traditional practices often embody ecological wisdom and sustainable management principles. Across China, rituals and festivals such as the Zhuang People's Dragon Boat Songs, which celebrate aquatic biodiversity by invoking the symbolism of fish and turtles, and the Hakka Mountain Songs, which emphasize the sustainable management of agricultural ecosystems, highlight the deep interconnection between communities and their natural environments. These cultural

expressions not only advocate for sustainable resource use but also celebrate specific elements of biodiversity, including marine life, forests, and agricultural landscapes. For instance, Minnan sea rituals integrate songs and offerings to honor the Sea Goddess, promoting marine conservation and community awareness of sustainable fishing practices. Similarly, the Dongxiang People's Pastoral Songs in Gansu underscore the importance of maintaining grassland ecosystems for both grazing and biodiversity.

Music and dance are particularly effective in promoting ecological awareness and fostering conservation values. Performances, such as the Songs of the Goddess of Wushan in Chongqing, celebrate the Yangtze River's ecosystems, conveying messages about the importance of water resource management and protecting riverine biodiversity. The Fish Lantern Festival in Poyang Lake combines vivid performances with ecological themes, emphasizing the role of wetlands in sustaining aquatic life and their critical importance for migratory birds. In Lingnan, ritual songs often depict migratory birds and aquatic animals, symbolizing the delicate balance of wetland ecosystems and fostering a shared sense of responsibility for their protection. Similarly, the bamboo pole dance in Hainan highlights the cultural and ecological significance of tropical rainforests, where songs advocate the sustainable use of forest resources.

These traditions also reflect practices that ensure sustainability. Rotational grazing, as seen in the rituals of pastoral communities in the Himalayas, balances land use with the preservation of grasslands. Intercropping and the protection of sacred groves in Fujian's agricultural rituals maintain biodiversity and ecosystem stability, supporting long-term ecological resilience. By embedding conservation principles into rituals, music, and dance, these practices serve as powerful tools for intergenerational knowledge transfer, ensuring that ecological wisdom is preserved and adapted to contemporary challenges.

The integration of cultural narratives with ecological values demonstrates the essential link between cultural diversity and biodiversity. These practices not only safeguard cultural heritage but also provide localized strategies for ecosystem management, reinforcing the resilience and sustainability of natural environments [19, 107].

Cultural diversity in biodiversity conservation

Each culture has unique practices that contribute to biodiversity conservation. These practices are often deeply rooted in the history and traditions of the community and include specific rituals, music, dance, and festivals that celebrate and respect the natural environment. For

instance, the Zhuang People in Guangxi use Dragon Boat Songs to promote awareness of aquatic biodiversity, while the Dai People in Yunnan use Water Splashing Festival Songs and Dances to emphasize the importance of water resources. Cultural diversity brings localized knowledge about the environment and sustainable practices. Different cultures have developed unique ways of interacting with their ecosystems that are sustainable and protective of biodiversity. For example, the Hani People of Yunnan use folk songs that reflect their reverence for terraced agricultural ecosystems, which are critical for the conservation of land and water resources.

The preservation of cultural diversity often leads to the conservation of biodiversity. Many cultural practices depend on the continued health and vitality of local ecosystems, so protecting these ecosystems also helps maintain the cultural practices themselves. The Mosuo People's music around Lugu Lake, which emphasizes the protection of its waters and ecological diversity, is a case in point. Cultural diversity in conservation helps educate the younger generations about the importance of biodiversity through culturally relevant narratives and activities. This education is crucial for the long-term sustainability of conservation efforts, ensuring that knowledge is passed down and that there is continued commitment to conservation across generations.

Cultural diversity is not just a facet of human society but a powerful force in biodiversity conservation. By embracing and integrating cultural diversity into conservation strategies, we can harness a wide range of culturally informed insights and practices that enhance the protection of ecosystems while also preserving the cultural heritage that gives meaning and context to these efforts [9, 108]. The varied cultural approaches to conservation, as depicted in the table, illustrate a global tapestry of communities actively involved in sustaining the planet's biodiversity through deeply rooted cultural expressions [109].

Case study: Lingnan folk ritual music and its role in biodiversity and environmental conservation

Lingnan, a cultural and geographical region in southern China, encompasses the modern provinces of Guangdong, Guangxi, and Hainan. This area is characterized by its diverse ecosystems, including coastal lines, rivers, mountains, and rich agricultural lands. Lingnan's folk rituals and music are deeply intertwined with this varied landscape, reflecting a unique cultural heritage that emphasizes harmony with nature and the conservation of biodiversity. Lingnan's culture is marked by a strong connection to water and forests, due to its proximity to the South China Sea and extensive river systems and wetlands. The region's traditional music and rituals often

focus on the interdependence of humans and these natural elements, promoting respect and sustainable practices that help conserve the local environment and its biodiversity.

Cantonese Opera (Yueju)—water towns and wetland conservation

Cantonese Opera, known as 'Yueju' in Chinese, is one of the major categories of Chinese Opera, originating from southern China's Guangdong Province. This form of opera is a traditional Chinese art that combines music, singing, martial arts, acrobatics, and acting. In the context of Lingnan culture, especially within the wetlands and water town settings of the Pearl River Delta, Cantonese Opera plays a significant role in reflecting and promoting environmental and ecological values, particularly concerning wetland conservation. Animals frequently serve as symbolic elements in Cantonese Opera, emphasizing ecological themes. For instance, the carp is a recurring motif representing prosperity and the health of aquatic ecosystems. This is seen in performances such as 'The Tale of the Golden Carp,' where the carp is depicted as a divine messenger advocating harmony between humans and water environments. Additionally, the dragon, while mythological, is intrinsically tied to real-life reverence for water sources and wetlands, underscoring the importance of protecting these habitats.

Many Cantonese Operas feature stories where water spirits, dragons, or the Sea Goddess Mazu play central roles. These characters are often depicted as protectors of the fishermen and guardians of the waterways, emphasizing a respectful relationship with the aquatic world. For instance, in operas like 'The Dragon Boat Story,' the dragon is not just a mythological creature but a symbol of the power and benevolence of water, reflecting the belief in the need to maintain harmony with the water spirits to ensure safety and prosperity. It also highlights human–water interactions, such as 'The Legend of the Purple Hairpin' and 'A Riverside Scene at Qingming Festival' depict life along the rivers and wetlands, showcasing daily routines that harmonize with the natural flow of water. These narratives often underline the importance of preserving this balance to prevent disasters such as floods and to ensure the fertility of the land. Animals, such as the carp symbolizing the vitality of wetland ecosystems, frequently appear in these stories, highlighting their role in maintaining ecological balance.

In Cantonese Opera, water symbolizes the source of life and serves as a metaphor for ecological cycles. Key ecological themes include: **Water as a Symbol:** Representing life's interconnectedness and the importance of wetland conservation. **Animal Motifs:** The carp symbolizes prosperity and ecological harmony,

while mythological dragons highlight the necessity of water management. **Cultural Narratives:** Stories such as 'The Tale of the Golden Carp' emphasize the balance between human activities and aquatic biodiversity. These elements position Cantonese Opera as a cultural medium advocating for wetland conservation. Scenes involving journeys by boat are common in these operas, symbolizing the journey of life and the idea that humans must navigate these waters wisely, respecting their depth and currents to maintain ecological balance.

Performances often include direct or indirect messages about the importance of wetlands. For example, in 'The Tale of the Golden Carp,' the protagonist's journey highlights the ecological interdependence between humans and aquatic ecosystems. This opera has inspired local wetland conservation initiatives, such as the restoration of ponds and rivers used in traditional performances. Community members have linked these stories to practical actions, including limiting agricultural runoff and preserving fish habitats. Such examples demonstrate how Cantonese Opera serves not only as a cultural expression but also as a motivator for local conservation efforts. These stories might show how overfishing, pollution, or disrespect for the spirits of nature leads to dire consequences, promoting a conservation ethic among the audience. Cantonese Opera acts as an effective educational tool, reminding communities of their environmental responsibilities, especially regarding wetland conservation. By embedding these lessons in entertainment, the operas make the information more accessible and memorable, fostering a community-wide ethos of wetland conservation. Many operas incorporate traditional knowledge about fishing, agriculture, and natural resource management. This knowledge is crucial for the sustainable use of wetland resources. By celebrating this wisdom, Cantonese Opera helps preserve and pass down practices that have been refined over generations to maintain the health of wetlands.

Cantonese Opera in the Lingnan region is a rich tapestry of music, drama, and cultural heritage that carries significant messages about wetland conservation. Through its captivating stories, symbolic imagery, and incorporation of traditional ecological knowledge, this art form plays an essential role in educating and inspiring the community to respect and protect their unique wetland environments. This case study exemplifies how traditional arts can contribute to environmental awareness and conservation efforts, making them an integral part of sustainable cultural practices.

Ancestral worship and agricultural rituals: agrobiodiversity in Lingnan

In Lingnan culture, ancestral worship is a profound tradition where families honor their ancestors through various rituals and offerings. These practices are not only a way of respecting and remembering the past generations but also serve as a means to reinforce family unity and continuity of cultural practices. Ancestral worship and agricultural rituals in Lingnan reflect biodiversity conservation through: **Agrobiodiversity Celebration:** Rituals highlight crop diversity and traditional farming techniques such as crop rotation and intercropping. **Animal Symbolism:** Songs frequently praise the water buffalo, symbolizing agricultural resilience, and birds like swallows and egrets, representing seasonal transitions and pest control. **Ecological Knowledge Transfer:** Rituals act as platforms for intergenerational transmission of sustainable farming practices. These elements illustrate the intertwined relationship between cultural rituals and ecological stewardship.

Families often visit ancestral graves, especially during Qingming (Tomb Sweeping Day), to clean gravesites, offer food, tea, and wine, and burn incense and paper money. These rituals are believed to sustain the spiritual well-being of ancestors, ensuring their benevolence toward the living. Songs, prayers, and sometimes even staged opera performances are part of these visits, with lyrics and narratives focusing on themes of fertility, renewal, and the cyclical nature of life.

Agricultural rituals in Lingnan are closely tied to the farming calendar, marking crucial phases like sowing, transplanting rice, and harvesting. These rituals are designed to ensure the success of agricultural endeavors by aligning human activities with natural rhythms and cycles. For example, during the 'First Furrow Ceremony' in Lingnan, farmers plow the first furrow as a symbolic act of respect for the land. Observational studies indicate that such rituals encourage the use of traditional farming techniques, including crop rotation and the preservation of heirloom seeds, which have been linked to increased soil fertility and agrobiodiversity. Additionally, ritual songs praising water buffalo emphasize their role in sustainable farming systems, leading to continued reliance on low-impact farming methods. Animals, such as water buffalo, play a central role in Lingnan agricultural rituals. Songs performed during planting festivals often praise the water buffalo for its indispensable contribution to traditional farming systems, symbolizing strength, resilience, and fertility. These songs not only reflect gratitude but also reinforce the cultural importance of conserving this keystone species in agricultural landscapes. Another example is the inclusion of birds such as swallows and sparrows in harvest songs, symbolizing the change of

seasons and the interconnectedness of agricultural productivity and avian biodiversity. These animals are seen as indicators of ecosystem health, and their presence in folk music serves as a reminder of the need to maintain harmonious relationships with nature. For instance, the 'First Furrow' ritual involves the eldest male in the community plowing the first furrow while prayers are offered for a bountiful harvest, signaling the community to begin spring planting. The rituals often celebrate and promote the cultivation of a variety of crops, which is central to agrobiodiversity. This diversity is crucial for nutrition, ecosystem stability, and resilience against pests and climate change. Traditional agricultural practices promoted through these rituals include crop rotation, intercropping, and the maintenance of heirloom and indigenous plant varieties. For example, during certain festivals, offerings might include a range of locally grown produce, showcasing the region's agricultural diversity.

Many ancestral and agricultural rituals incorporate traditional ecological wisdom, which contributes to sustainable farming practices and the protection of agrobiodiversity. For example, the timing of certain rituals helps dictate the optimal moments for planting or harvesting, based on generations of observing natural indicators. The use of organic materials in offerings and the practice of leaving portions of the harvest on the field as offerings to deities or spirits reflect an early form of sustainable agriculture that minimizes waste and maintains soil fertility. Rituals often involve the use of specific plants that have cultural and medicinal significance, encouraging the preservation of these species. For instance, certain rituals require the use of specific herbs believed to have protective qualities, promoting the cultivation and conservation of these plants within local gardens and farms.

These rituals foster a strong sense of community as they require collective participation and support. This communal aspect ensures that knowledge and traditions are shared and sustained across generations. Community feasts, where everyone shares in the food prepared from the collective harvest, reinforce social ties and ensure that traditional culinary practices are preserved. Through these rituals, younger generations learn about the importance of agrobiodiversity and ecological balance. Stories, songs, and practices teach them about the relationship between humans and the environment and the need to act as stewards of the land. Educational aspects of these rituals help in transmitting not just agricultural practices but also values of respect, gratitude, and responsibility toward the land and the broader ecosystem.

Ancestral worship and agricultural rituals in the Lingnan region are a vibrant testament to the interplay between culture, agriculture, and biodiversity. These practices are a medium through which the community

expresses its identity, respects its heritage, and promotes sustainable interactions with the environment. By preserving traditional agricultural practices and promoting the cultivation of diverse crops, these rituals play a crucial role in maintaining agrobiodiversity, ensuring food security, and fostering resilience against environmental challenges. This case study underscores the importance of cultural practices in ecological conservation and highlights how traditional knowledge can contribute significantly to contemporary environmental stewardship.

Discussion

This study explores the multifaceted role of Chinese folk ritual music in biodiversity conservation, emphasizing its dual function as an artistic tradition and a medium for transmitting ecological knowledge. Chinese folk ritual music is defined in this study as a form of traditional musical expression deeply embedded in community practices, rituals, and festivals. Its ecological relevance stems from the integration of symbolic representations—such as animals, plants, and landscapes—into its narratives. For instance, Cantonese Opera incorporates the carp as a symbol of wetland prosperity and harmony, while Lingnan agricultural rituals emphasize the water buffalo as a key figure in sustainable farming practices. These symbolic elements reflect ecological values and foster a shared sense of responsibility for biodiversity among communities.

Cultural practices as a pillar of biodiversity conservation

The findings from our study align with the principles outlined in the IPBES Global Assessment Report on Biodiversity and Ecosystem Services (2019), which emphasizes the integration of traditional knowledge systems into biodiversity conservation frameworks. Similar to the cases highlighted in the IPBES report, such as indigenous fire management practices in Australia and agroforestry systems in the Amazon, Chinese folk ritual music represents a unique repository of ecological knowledge. By embedding conservation values in cultural expressions, these traditions provide practical pathways for promoting sustainable resource use and fostering community-led conservation. Through specific practices such as Cantonese Opera and ancestral worship rituals, we observe how these traditions embody and transmit ecological knowledge, thereby supporting biodiversity conservation efforts. For example, Cantonese Opera integrates stories of water spirits and guardians of the natural environment, fostering a respectful relationship with local ecosystems. Ancestral worship rituals, tied to agricultural practices, promote sustainable land use and the maintenance of crop diversity, which are critical for agrobiodiversity and ecosystem resilience [110–112]. This aligns with global

understandings of how indigenous and local knowledge systems contribute to sustainable environmental stewardship [19, 113].

In the Lingnan region, particularly through Cantonese Opera and ancestral worship, we observe how music and rituals are intertwined with local ecological knowledge and practices. The narratives and symbolic elements within Cantonese Opera, such as water spirits and the Sea Goddess Mazu, serve not only as entertainment but also as conveyors of important ecological wisdom [114]. These operas are imbued with messages about the importance of wetland conservation, fostering an environmental ethic that is culturally resonant and locally grounded [115, 116]. Ancestral worship and agricultural rituals in Lingnan emphasize a deep connection with biodiversity through: **Cultural Integration:** Highlighting the symbolic roles of animals like the water buffalo and migratory birds. **Sustainable Practices:** Promoting crop diversity and traditional farming techniques essential for ecological resilience. **Knowledge Preservation:** Ensuring the continuity of ecological practices through culturally embedded education. This cultural–ecological synergy supports biodiversity conservation at both symbolic and practical levels." These rituals, which are aligned with key agricultural cycles, help to maintain crop diversity and promote sustainable farming practices, crucial for agrobiodiversity and ecosystem resilience [9, 117]. Such practices are essential not only for food security but also for the conservation of associated biodiversity, which includes pollinators, soil microorganisms, and other beneficial species [107, 118], as well as key agricultural animals such as water buffalo that contribute to sustainable farming systems.

Bridging traditional knowledge and modern conservation

While the cultural practices documented in this study are potent, integrating them into contemporary conservation strategies presents both challenges and opportunities. The symbolic use of animals, such as the carp in Cantonese Opera and the water buffalo in Lingnan rituals, reflects a global trend in using cultural narratives for biodiversity conservation. This aligns with findings from the Amazon, where indigenous communities use storytelling to advocate for sustainable agroforestry systems. Similarly, the sacred groves managed by Himalayan pastoral communities demonstrate how ritual practices ensure the protection of local ecosystems. These parallels suggest that integrating folk music into modern conservation efforts can provide culturally sensitive approaches to addressing biodiversity loss, resonating with global traditions while tailoring strategies to local contexts. One significant challenge is the erosion of traditional knowledge and practices due to globalization, urbanization, and

the homogenization of cultures. As seen in the Lingnan region, rapid urban development has threatened traditional wetland-related livelihoods and rituals, highlighting the need to actively preserve these practices [119, 120].

Despite these challenges, there are substantial opportunities for leveraging traditional practices in biodiversity conservation efforts, specifically in the Lingnan region. Community-based conservation that incorporates Cantonese Opera and ancestral worship can enhance local engagement and ecosystem resilience. For instance, the environmental messages conveyed through Cantonese Opera can be integrated into community-driven conservation programs, thereby making ecological awareness more culturally resonant and effective. Additionally, agricultural rituals provide a framework for community members to participate in practices that promote agrobiodiversity, ensuring these traditions continue to support ecological health in a changing environment [121, 122]. These approaches can enhance ecosystem resilience and adaptability by maintaining a diversified landscape that reflects both cultural and biological diversity [123].

Furthermore, environmental education programs that incorporate traditional music, dance, and narratives can effectively bridge the gap between generations, ensuring that valuable ecological knowledge is not lost but instead adapted and integrated into modern environmental stewardship practices. The narrative power of music and dance can make complex conservation principles more relatable and memorable, fostering a stronger community engagement in conservation efforts [124].

Policy implications and future directions

To harness the full potential of cultural practices in conservation, policymakers and practitioners need to recognize and integrate the cultural dimensions of biodiversity into conservation planning and implementation. The Convention on Biological Diversity (CBD) and other international frameworks have begun to acknowledge the importance of cultural diversity in achieving conservation goals, but more targeted strategies are needed to operationalize these principles [125, 126]. Key strategies could include: **Developing Participatory Conservation Models:** Engage local communities in the design and implementation of conservation projects that respect and incorporate their cultural practices and ecological knowledge [127]. **Supporting Cultural Education:** Enhance environmental education by integrating it with cultural education, using folk music and rituals to convey important conservation messages, such as the role of animals like the water buffalo and carp in maintaining ecological balance and agricultural productivity. [128]. **Documenting and**

Revitalizing Traditional Practices: Work with local communities, ethnographers, and ecologists to document traditional practices and explore their applications in contemporary conservation [118]. **Creating Cultural Corridors:** Similar to ecological corridors, cultural corridors are designated routes that facilitate the transmission and exchange of traditional ecological knowledge and cultural practices. These corridors can help integrate cultural heritage with biodiversity conservation across regions, promoting both cultural and biological diversity. [9].

Conclusion

This research elucidates the intricate relationship between Chinese folk ritual music and biodiversity conservation, aligning with global frameworks like the IPBES Global Assessment Report on Biodiversity and Ecosystem Services. By showcasing how traditional ecological knowledge is embedded in cultural practices such as Cantonese Opera and agricultural rituals, this study underscores the potential of leveraging cultural heritage to address biodiversity challenges. Incorporating such practices into biodiversity conservation strategies aligns with IPBES recommendations, emphasizing the need for participatory approaches that integrate local and indigenous knowledge systems. These practices are central to sustaining ecological balance by promoting wetland conservation through cultural narratives and maintaining agrobiodiversity through seasonal rituals. By focusing on these specific examples, we demonstrate how culturally embedded practices can effectively support local ecosystems, providing a model for integrating cultural dimensions into broader conservation strategies. For instance, Huizhou Guqin Music and Zhuang People's Dragon Boat Songs emphasize the protection of their respective ecosystems, while Cantonese Opera and Songs of the Goddess of Wushan advocate for water conservation and river basin protection. These practices highlight the critical link between cultural diversity and biodiversity, enhancing ecosystem resilience and supporting sustainable farming, which contributes to the overall conservation of biodiversity, including pollinators and soil organisms. By integrating these cultural dimensions into conservation strategies, we can foster more holistic and effective approaches, ensuring the preservation of both nature and culture for future generations. This study underscores the need for interdisciplinary research and community-led initiatives to further explore and leverage the role of cultural practices in biodiversity conservation.

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Author contributions

L. Y. conceived and supervised the study, and wrote the manuscript. S. Y. revised the manuscript.

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Availability of data and materials

Data are provided within the manuscript or supplementary information files.

Declarations

Ethics approval and consent to participate

This study did not involve animal or human clinical trials. All information obtained was preceded by an individual previous informed consent.

Consent for publication

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The authors declare no competing interests.

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