Postprint: Research Advances in Biocultural Diversity

Authors: Mao Shuxin, Shen Yuan, Deng Hongbing

Date: 2018-01-09T00:00:00+00:00

Abstract

Biocultural diversity encompasses biodiversity, cultural diversity, and the complex linkages between them, constituting the foundation for maintaining the health of both natural systems and human societies. Given its rich connotations, multidisciplinary nature, and broad research scope, identifying appropriate research objects and corresponding scales is particularly crucial in its study. Biodiversity and cultural diversity are intimately interconnected through various natural and social factors, manifesting as spatial congruence, shared evolutionary processes, and common threats. Co-conservation of biodiversity and cultural diversity represents an effective pathway for mitigating biodiversity loss and preserving traditional cultures. This review systematically examines relevant research across three primary dimensions: the relationship between biodiversity and cultural diversity, traditional ecological knowledge, and cultural landscapes, while delineating major development trends. Chinese scholars have made distinctive and valuable contributions to certain domains of biocultural diversity research; however, while sustaining the development of our nation's advantageous and characteristic fields, it is imperative to align with international hotspots and trends, and intensify research efforts in mechanistic and systematic analysis, environmental impacts of biocultural diversity, and conservation and management strategies.

Full Text

Progress in Biocultural Diversity Research

Mao Shuxin[1], Shen Yuan[2], Deng Hongbing[1]

[1]State Key Laboratory of Urban and Regional Ecology, Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences, Beijing 100085, China
[2]University of Chinese Academy of Sciences, Beijing 100049, China

Abstract

Biocultural diversity includes biodiversity, cultural diversity, and the complex connections between them. It involves numerous disciplines and encompasses extensive research content. Clarifying the research object and corresponding scale is particularly important in biocultural diversity research, as it forms the foundation for maintaining the health of both nature and human society. Biodiversity and cultural diversity are closely linked through various natural and social factors, manifested as spatial overlap, co-evolutionary processes, and common threats. Joint protection of biodiversity and cultural diversity is an effective approach to slowing biodiversity loss and protecting traditional cultures. This paper reviews relevant research from three main aspects: the relationship between biodiversity and cultural diversity, traditional ecological knowledge, and cultural landscapes. Chinese scholars have conducted distinctive and valuable work in some areas of biocultural diversity research, but while maintaining these advantageous and characteristic fields, it is also necessary to keep pace with international hotspots and trends, strengthening research in mechanism and systematic analysis, environmental influences on biocultural diversity, and the conservation and management of biocultural diversity.

Keywords: biocultural diversity; ethnoecology; cultural landscape; traditional ecological knowledge

---

1. Main Research Content of Biocultural Diversity

Although biocultural diversity has not been used as a complete concept in research and management for a long time, it involves natural and social sciences, resulting in a broad research scope. Traditional ethnoecology and ethnobotany research, which focuses on the connections between biodiversity and cultural diversity, can also be incorporated into biocultural diversity studies. This paper primarily discusses three major aspects: the relationship between biodiversity and cultural diversity, traditional ecological knowledge, and cultural landscapes. Due to the interdisciplinary nature of biocultural diversity research, methods from these fields are often applied, including field surveys and interviews from ethnoecology and ethnobotany [13-15], which are indispensable in traditional knowledge research. Landscape pattern analysis and disturbance intensity analysis can be applied to biocultural diversity research at the landscape scale [16-17], while literature investigation and analysis are also suitable methods [18].

1.1 Relationship Between Biodiversity and Cultural Diversity The natural environment is intimately connected with the origin and development of culture, providing the setting for cultural processes and belief systems [1]. Biodiversity and cultural diversity are tightly linked through four bridges: indigenous beliefs and worldviews, livelihoods and practices, language and knowledge systems, and norms and institutions [1]. Their relationship is manifested

through spatial overlap, co-evolutionary processes, and common threats.

Spatial Overlap. The relationship between biodiversity and cultural diversity is first reflected in their geographic coincidence. Many biodiversity hotspots are also cultural diversity core areas [21]. Early observers of this geographic connection were field researchers. In 1992, Chapin mapped forest cover and indigenous homelands in Central America [22]. Stevens applied this method globally to map geographic relationships and identify diversity hotspots [23]. Nabhan and Terralingua found that countries with high biodiversity also ranked in the top for language richness [9, 24-25]. Moore et al. [25] quantitatively analyzed the distribution of languages and vertebrates in sub-Saharan Africa, finding that environmental factors, particularly rainfall and maximum elevation, had joint effects on both diversities. Sutherland [26] found high language abundance often accompanied high bird and mammal abundance. These two diversity indicators are closely related to country area and highest altitude. In large-scale studies, birds and mammals (including species diversity, ecosystem diversity, and landscape diversity) are commonly used to measure biodiversity, while language is used to measure cultural diversity. Although these indicators cannot fully represent both diversities and some case studies show differences between language diversity and cultural diversity [23], their data are relatively easy to obtain and have advantages in quantitative research. Combining quantitative indicators of biodiversity and cultural diversity can characterize overall diversity. Loh and Harmon [6] used the arithmetic mean of biodiversity and cultural diversity as a biocultural diversity index, considering birds and plants in biodiversity and religion, language, and ethnicity in cultural diversity to evaluate overall diversity worldwide.

Co-evolutionary Processes. Biodiversity and cultural diversity share the same driving factors in their emergence. Different combinations of geographic and climatic conditions cultivate rich biodiversity while also causing geographic isolation of human populations, thereby promoting cultural diversification [3]. Biocultural diversity results from human-environment interactions. Different cultures formed as humans adapted to different natural conditions, which in turn affected local biological resources. Biodiversity is the foundation of cultural diversity. The types, distribution, and quantities of biological resources available to different populations vary, forming different environmental adaptation strategies and resource utilization methods that constitute the basic premise and natural background for human culture [27]. Culture also influences or shapes biodiversity. When humans selected and cultivated food and economic crops on a large scale, originally diverse landscapes gradually evolved into single-crop farmland, changing species diversity and landscape configuration. Some species were widely planted, affecting original landscape patterns. Sacred natural sites have important cultural significance and often harbor rich biodiversity, preserved through human intention. While biodiversity is the material foundation and environmental condition for cultural diversity, cultural diversity also profoundly influences biodiversity. There exists a relationship of interdependence, mutual promotion, and co-evolution between them.

Common Threats. Economic globalization, agricultural industrialization, and urbanization simultaneously affect biodiversity and cultural diversity. Resource extraction driven by economic incentives reduces biological resources and destroys the biological foundation of traditional cultures. Agricultural industrialization means shifting from diverse management to single-species cultivation, reducing within-field and between-field species diversity and decreasing species habitats. Traditional diets, crops, and the ecological knowledge, skills, and practices refined in this process also disappear. Urbanization and direct urban expansion cause habitat, species, and green space loss. Population migration separates local residents from their original cultural contexts, leading to traditional culture loss. Some studies compare extinction rates between the two diversities. Loh and Harmon [31] assessed language diversity extinction risk and compared it with global bird and mammal extinction risk. Sutherland [26] found that languages face even greater threats than birds or mammals. Although the direct threats differ—habitat destruction and overexploitation of biological resources are primary causes of biodiversity loss, especially in Asia [31], while assimilation by mainstream culture, colonization, and global trade are main causes of cultural diversity loss—these factors are interconnected, causing both diversities to face common threats. Biodiversity and cultural diversity continuously adjust and adapt through long-term interactions to form dynamic equilibrium. When either changes, the balance is disrupted and both diversities suffer damage. Any biodiversity conservation practice should be accompanied by understanding and protecting cultural diversity [1].

2. Traditional Ecological Knowledge

Traditional ecological knowledge (TEK) is the accumulated natural knowledge of local people, characterized by dynamism and adaptability [32-33]. It is the product of co-evolution between local culture and ecosystems, representing the intersection of biodiversity and cultural diversity. TEK includes folk ecological wisdom whose value and contribution to modern communities are no less than modern scientific and technological knowledge [39]. Its protection is considered an effective approach to joint biocultural diversity conservation. TEK can also serve as an indicator of regional biocultural diversity, particularly indigenous ethnobotanical knowledge. Berkes [38] defines TEK as a complex of knowledge, belief, and practice, including observations of local species and environmental phenomena, resource utilization practices, and beliefs related to human adaptation to ecosystem processes. It comprises four components: knowledge of ecosystem components and their functions, indigenous resource management systems and organizations, and worldviews guiding local ecological cognition and behavior.

Researchers often focus on TEK and biodiversity conservation, traditional medicinal knowledge, TEK and environmental behavior, and TEK protection and utilization. Ethnoecology and ethnobotany provide effective theoretical and methodological support. Ethnoecology studies the complex relationships be-

tween people and their environment in past and present [40], while ethnobotany examines direct interactions between people and plants [41]. Plant knowledge itself is an important component of TEK and can represent TEK [32]. Community-based biological resource management is a key TEK element, exemplified by the rotational agriculture of Hani and Yi peoples, the swidden agriculture of Miao and Lisu peoples, and grassland agriculture in Tibetan communities [42]. These management methods based on long-term production practice ensure future natural resource security for communities with targeting and effectiveness unmatched by macro-level policy management. In resource management systems, customs and even compensation mechanisms can regulate community behavior [44-46]. Beliefs arise from human responsibility toward nature and conservation ethics [47]. Many traditional belief systems contain attitudes of respect, gratitude, and shame regarding waste [48], which guide behavior and form the basis of local conservation actions. Creation stories in communities reflect ancestors' reverence for nature and subtly regulate behavior. While different groups understand human-nature relationships differently—most traditional communities view humans as interdependent components of nature while modern communities tend to see humans as nature' s rulers—the actual situation generally lies somewhere between these extremes [5, 49].

TEK plays an important role in biodiversity conservation, especially where national policies are ineffective [50-53]. Although not all traditional practices are worth emulating, traditional knowledge systems should supplement modern knowledge systems in biocultural diversity conservation [54-56]. Traditional communities are also participants in the global economy, and TEK loss within communities is severe. It is unfair to require them to continue using traditional, low-impact survival strategies. Protecting and exploring TEK and applying it to community development and regional sustainable development deserve widespread attention.

3. Cultural Landscapes

Cultural landscapes are patterns of human activity superimposed on natural landscapes and represent the product of biodiversity-culture interactions [57]. They reflect natural and cultural changes and embody indigenous TEK. Terraced fields, as important agricultural cultural landscapes, are carriers of farming civilization and have close connections with biodiversity and cultural diversity. Some historically significant landscapes have important research value for ecosystem services and human well-being. However, global urbanization and the new technology revolution have caused landscape features to change temporally and spatially. Abandonment of cultivation leads to terraced landscape degradation [58].

Rural areas are important venues for biocultural diversity interactions. Long-term agroforestry activities introduce multiple species and management mechanisms to meet specific economic, social, and environmental needs, eventually forming rich patches and high heterogeneity—common characteristics of rural

landscapes. Rural landscapes are the result of traditional practices found worldwide. Baiamonte et al. [16] analyzed the relationship between landscape naturalness, rare and endangered species, and found significant interactions between structure and biodiversity, making them good examples for understanding biocultural diversity outcomes [12]. Marull et al. [17] analyzed Mallorca' s cultural landscapes since the 1850s, verifying the intermediate disturbance hypothesis and finding that either enhancing or eliminating human disturbance can reduce species and landscape diversity. The former may destroy the dynamic balance established through long-term practice, while reverting agricultural practices to "natural" states may be counterproductive.

Although current research focuses on rural areas, exploring urban biocultural diversity is also meaningful in the context of widespread urbanization. Urban landscape-level biocultural diversity research concentrates on two scales of urban green space: networks and point green spaces. Vierikko et al. [61] constructed a research framework for urban biocultural diversity, suggesting it should include relationships between biodiversity and cultural diversity in urban green spaces, cultural mechanisms affecting both diversities, and diversity promotion methods. Elands et al. [62] studied 20 European cities and found biocultural diversity is generally missing from urban planning.

Ethnic communities, with ethnic minorities as the main residents, are special community types whose unique ethnicity, culture, and regionality have become research foci [63]. Ethnic community research is closer to sociology, focusing on primitive societies, rural ethnic communities, urban ethnic communities, and their development, protection, and perceptions [63].

4. Domestic Research Progress

China faces tremendous pressure from rapid economic growth, biodiversity loss, and traditional culture erosion. Integrating traditional knowledge and values into conservation policies is essential for joint biocultural diversity protection [64]. Since 1949, Chinese biocultural diversity research has been fruitful, focusing on ecological anthropology, ethnobotany, and ethnoecology, with substantial work on cultural landscapes like sacred natural sites [27, 66-67]. Research on the relationship between the two diversities is rich, with distinctive and influential studies on TEK, particularly minority biodiversity conservation practices [68-71]. Xu et al. [64] discussed impacts of recent development on traditional knowledge and practices, emphasizing the important role of traditional knowledge, especially among southwestern minorities, in forest conservation. Xue and Guo introduced TEK concepts in international conventions and classified TEK related to biological resource conservation and sustainable use [72]. Cheng et al. proposed a three-dimensional ethnoecological analysis model for TEK [40], while Yin introduced and evaluated eco-museums and ethnic cultural villages in China [73]. Cultural landscape research focuses on sacred natural sites or typical agricultural landscapes [70, 74-75], with terraced landscape research representing foundational biocultural diversity studies [58, 76].

Although Chinese scholars have conducted effective work, biocultural diversity research has not been systematically integrated. Content-wise, it concentrates on TEK, especially minority biodiversity conservation practices, and landscape research focuses on specific ethnic cultural landscape formation, ecological functions, and management practices. Methodologically, while quantitative methods are well-applied in ethnobotany [77], quantitative methods and spatial analysis are still lacking in biocultural diversity research.

5. Future Development Directions

Reviewing major research content and progress in biocultural diversity, trends include: moving from qualitative to quantitative approaches, with developing indicators at different scales facilitating quantitative research; diverse research scales, where comprehensive multi-scale analysis helps explore mechanisms; and increasingly rich methodologies, from traditional field surveys and interviews to introducing more relevant disciplinary techniques and methods. Modern mapping technology has greatly developed traditional mapping and promoted landscape and regional-scale analysis, while modern biotechnology and pharmaceutical technology also play significant roles in ethnobotany applications. Based on these three points, biocultural diversity research has gradually evolved from initial documentation and descriptive work to exploring mechanisms and complex system resilience. Ecological development greatly influences and promotes biocultural diversity research, with current studies increasingly focusing on global change, ecosystem services, and sustainable development.

China has unique advantages in biocultural diversity research with abundant species resources, topographic environments, and minority cultures. Although Chinese scholars have made distinctive contributions in some fields, particularly following the ethnic identification movement [78] which provided materials and foundations for cultural diversity research, future research remains a formidable task. While maintaining advantageous and characteristic fields, China must keep pace with international hotspots and trends, strengthening research in mechanism and systematic analysis, environmental influences on biocultural diversity, and biocultural diversity conservation and management. Attention should also be paid to integrating global change, ecosystem services, and other hotspots, emphasizing disciplinary integration and cooperation between different research teams. China should fully utilize its rich biological, geographic, and cultural diversity to conduct systematic research at larger and multiple scales, broaden understanding of biocultural diversity meanings, develop suitable indicators for China' s biocultural diversity characterization, expand multi-scale analysis, and produce more influential results through greater consensus and deeper research, promoting win-win outcomes for regional development and biocultural diversity conservation.

6. Conclusion

Biocultural diversity includes both biological and cultural diversity. Biocultural diversity is an important concept representing the inseparable connections between biodiversity and cultural diversity that face common threats. It has gradually gained researcher and manager attention, forming the biocultural perspective and biocultural approach. China has unique advantages in biocultural diversity research with abundant species resources, topographic environments, and minority cultures. Although Chinese scholars have conducted distinctive work in some areas, future research remains a formidable task. While maintaining advantageous and characteristic fields, China must keep pace with international hotspots and trends, strengthening research in mechanism and systematic analysis, environmental influences on biocultural diversity, and biocultural diversity conservation and management. We hope domestic biocultural diversity research will form greater consensus, conduct deeper studies, and provide scientific and technological support for regional development and biocultural diversity conservation.

References

[1] Pretty J, Adams B, Berkes F, de Athayde S F, Dudley N, Hunn E, Maffi L, Milton K, Rappoport D, Robbins P, Sterling E, Stolton S, Tsing A, Vintinnerk E, Pilgrim S. The intersections of biological diversity and cultural diversity: towards integration. Conservation & Society, 2009, 7(2): 100-112.
[2] Butchart S H M, Walpole M, Collen B, van Strien A, Scharlemann J P W, Almond R E A, Baillie J E M, Bomhard B, Brown C, Bruno J, Carpenter K E, Carr G M, Chanson J, Chenery A M, Csirke J, Davidson N C, Dentener F, Foster M, Galli A, Galloway J N, Genovesi P, Gregory R D, Hockings M, Kapos V, Lamarque J F, Leverington F, Loh J, McGeoch M A, McRae L, Minasyan A, Morcillo M H, Oldfield T E E, Pauly D, Quader S, Revenga C, Sauer J R, Skolnik B, Spear D, Stanwell-Smith D, Stuart S N, Symes A, Tierney M, Tyrrell T D, Vie J C, Watson R. Global biodiversity: indicators of recent declines. Science, 2010, 328(5982): 1164-1168.
[3] Maffi L. On Biocultural Diversity: Linking Language, Knowledge, and the Environment. Washington, DC: Smithsonian Institution Press, 2001.
[4] Gavin M C, McCarter J, Mead A, Berkes F, Stepp J R, Peterson D, Tang R F. Defining biocultural approaches to conservation. Trends in Ecology & Evolution, 2015, 30(3): 140-145.
[5] Posey D A. Cultural and Spiritual Values of Biodiversity. London: ITDG Publishing, 1999.
[6] Loh J, Harmon D. A global index of biocultural diversity. Ecological Indicators, 2005, 5(3): 231-241.
[7] Conservation Biology. Zhejiang Science and Technology Press, 1997.
[8] Gunderson L H, Holling C S. Panarchy: Understanding Transformations in Human and Natural Systems. Washington, DC: Island Press, 2001.
[9] Maffi L. Language: a resource for nature. Nature and Resources: The

UNESCO Journal on the Environment and Natural Resources Research, 1998, 34(4): 12-21.
[10] Harmon D. In Light of Our Differences: How Diversity in Nature and Culture Makes Us Human. Washington, DC: Smithsonian Institution Scholarly Press, 2002.
[11] Maffi L, Woodley E. Biocultural Diversity Conservation: A Global Sourcebook. London: Routledge, 2012.
[12] Agnoletti M, Rotherham I D. Landscape and biocultural diversity. Biodiversity and Conservation, 2015, 24(13): 3155-3165.
[13] Ladio A, Lozada M, Weigandt M. Comparison of traditional wild plant knowledge between aboriginal communities inhabiting arid and forest environments in Patagonia, Argentina. Journal of Arid Environments, 2007, 69(4): 695-715.
[14] Phillips O, Gentry A H. The useful plants of Tambopata, Peru: I. Statistical hypotheses tests with a new quantitative technique. Economic Botany, 1993, 47(1): 15-32.
[15] Thomas E. The impact of traditional lifestyle, provenance and contact history on plant use knowledge and management: a cross-cultural comparison of two small-scale societies from the Bolivian Amazon. Human Ecology, 2012, 40(3): 355-368.
[16] Baiamonte G, Domina G, Raimondo F M, Bazan G. Agricultural landscapes and biodiversity conservation: a case study in Sicily (Italy). Biodiversity and Conservation, 2015, 24(13): 3201-3216.
[17] Marull J, Tello E, Fullana N, Murray I, Jover G, Font C, Coll F, Domene E, Leoni V, Decolli T. Long-term bio-cultural heritage: exploring the intermediate disturbance hypothesis in agro-ecological landscapes (Mallorca, c. 1850-2012). Biodiversity and Conservation, 2015, 24(13): 3217-3251.
[18] Hidayati S, Franco F M, Bussmann R W. Ready for phase 5-current status of ethnobiology in Southeast Asia. Journal of Ethnobiology and Ethnomedicine, 2015, 11: 17.
[19] Nietschmann B Q. The Interdependence of Biological and Cultural Diversity, Occasional Paper 21. Olympia, WA, USA: Center for World Indigenous Studies, 1992.
[20] Nabhan G P, Buchmann S L. Services provided by pollinators // Daily G C, ed. Nature' s Services: Societal Dependence on Natural Ecosystems. Washington, DC: Island Press, 1997: 133-150.
[21] Stevens S. Conservation Through Cultural Survival: Indigenous Peoples and Protected Areas. Washington DC: Island Press, 1997.
[22] Chapin M. The coexistence of indigenous peoples and environments in Central America. Research and Exploration, 1992, 8(2): Map supplement.
[23] Oviedo G, Maffi L, Larsen P B. Indigenous and Traditional Peoples of the World and Ecoregion Conservation: An Integrated Approach to Conserving the World' s Biological and Cultural Diversity. Gland, Switzerland: WWF International and Terralingua, 2000.
[24] Manne L L. Nothing has yet lasted forever: current and threatened levels of biological and cultural diversity. Evolutionary Ecology Research, 2003, 5(4):

517-527.
[25] Moore J L, Manne L, Brooks T, Burgess N D, Davies R, Rahbek C, Williams P, Balmford A. The distribution of cultural and biological diversity in Africa. Proceedings of the Royal Society B: Biological Sciences, 2002, 269(1501): 1645-1653.
[26] Sutherland W J. Parallel extinction risk and global distribution of languages and species. Nature, 2003, 423(6937): 276-279.
[27] On the relationship between cultural diversity and biodiversity // Proceedings of the Sixth National Conference on Biodiversity Conservation and Sustainable Use. Chinese Academy of Sciences Biodiversity Committee, 2004.
[28] Milton K. Nature is already sacred. Environmental Values, 1999, 8(4): 437-449.
[29] IUCN. Conserving Cultural and Biological Diversity: The Role of Sacred Natural Sites and Cultural Landscapes. Paris, France: IUCN, 2006.
[30] Turner N J, Berkes F. Coming to understanding: developing conservation through incremental learning in the Pacific Northwest. Human Ecology, 2006, 34(4): 495-513.
[31] Loh J, Harmon D. Biocultural Diversity: Threatened Species, Endangered Languages. Zeist, Netherlands: WWF Netherlands, 2014.
[32] Pilgrim S E, Cullen L C, Smith D J, Pretty J. Ecological knowledge is lost in wealthier communities and countries. Environmental Science & Technology, 2008, 42(4): 1004-1009.
[33] Berkes F, Colding J, Folke C. Rediscovery of traditional ecological knowledge as adaptive management. Ecological Applications, 2000, 10(5): 1251-1262.
[34] Gadgil M, Berkes F, Folke C. Indigenous knowledge for biodiversity conservation. Ambio, 1993, 22(2/3): 151-156.
[35] Colding J. Analysis of hunting options by the use of general food taboos. Ecological Modelling, 1998, 110(1): 5-17.
[36] Johannes R E. The case for data-less marine resource management: examples from tropical nearshore finfisheries. Trends in Ecology & Evolution, 1998, 13(6): 243-246.
[37] Alcorn J B, Toledo V M. Resilient resource management in Mexico' s forest ecosystems: the contribution of property rights // Berkes F, Folke C, eds. Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience. Cambridge: Cambridge University Press, 1998: 216-249.
[38] Berkes F. Sacred Ecology: Traditional Ecological Knowledge and Resource Management. Philadelphia, London: Routledge, 1999.
[39] Review of traditional knowledge research among China' s ethnic minorities in recent decades. Guizhou Normal University Journal (Social Science Edition), 2010, (1): 47-55.
[40] Analytical framework for traditional ecological knowledge from ethnoecology. Chinese Journal of Applied Ecology, 2014, 34(16): 4785-4793.
[41] Ethnobotany and plant resource development. Yunnan Botanical Research, 1988, (S1): 135-144.
[42] On ethnic traditional culture and biodiversity conservation // Proceedings

of the 16th Annual Conference of China Association for Science and Technology: Symposium on Ethnic Culture Protection and Ecological Civilization Construction, 2014.
[43] Coupled inheritance relationship between biodiversity and Miao traditional culture in Leigong Mountain area. Journal of Original Ecological National Culture, 2014, 6(1): 71-76.
[44] Pagioda S, Arcenas A, Platais G. Can payments for environmental services help reduce poverty? An exploration of the issues and the evidence to date from Latin America. World Development, 2005, 33(2): 237-253.
[45] Pagioda S, Platais G. Payments for Environmental Services. Washington, DC: World Bank, 2002.
[46] Zbinden S, Lee D R. Paying for environmental services: an analysis of participation in Costa Rica' s PSA program. World Development, 2005, 33(2): 255-272.
[47] Anderson E N. Ecologies of the Heart: Emotion, Belief, and the Environment. Oxford: Oxford University Press, 1996.
[48] Turner N J, Atleo E R. Pacific North American first peoples and the environment // Coward H, ed. Environment and Development Values in the Pacific. Albany, NY: Center for Studies in Religion and Society, State University of New York, 1998.
[49] Berkes F. Sacred Ecology. 4th ed. New York: Routledge, 2017.
[50] Ethnic regions' traditional culture and biodiversity conservation. China Environmental Science Press, 2009.
[51] Posey D A. Indigenous ecological knowledge and development of the Amazon // Moran E F, ed. The Dilemma of Amazonian Development. Boulder, Colorado: Westview Press, 1983.
[52] Posey D A. Indigenous management of tropical forest ecosystems: the case of the Kayapó Indians of the Brazilian Amazon. Agroforestry Systems, 1985, 3(2): 139-158.
[53] Veitayaki J. Traditional marine resource management practices used in the Pacific Islands: an agenda for change. Ocean & Coastal Management, 1997, 37(1): 123-136.
[54] Diamond J, Renfrew C. Guns, germs, and steel: the fates of human societies. Nature, 1997, 386(6623): 339-340.
[55] Krech Ill S. The Ecological Indian: Myth and History. New York: WW Norton & Co, 1999.
[56] Redman C L. Human Impact on Ancient Environments. Arizona: University of Arizona Press, 1999.
[57] Redford K H. The ecologically noble savage. Cultural Survival Quarterly, 1991, 15(1): 46-48.
[58] Wei W, Chen D, Wang L X, Daryanto S, Chen L D, Yu Y, Lu Y L, Sun G, Feng T J. Global synthesis of the classifications, distributions, benefits and issues of terracing. Earth-Science Reviews, 2016, 159: 388-403.
[59] Agnoletti M, Santoro A. Cultural values and sustainable forest management: the case of Europe. Journal of Forest Research, 2015, 20(5): 438-444.
[60] Amici V, Landi S, Frascaroli F, Rocchini D, Santi E, Chiarucci A. Anthro-

pogenic drivers of plant diversity: perspective on land use change in a dynamic cultural landscape. Biodiversity and Conservation, 2015, 24(13): 3185-3199.
[61] Vierikko K, Elands B H M, Szaraz L, Niemelä J. Biocultural Diversity concept and assessment in the urban context; Published Project Report on BCD Concept and Exploratory Survey of BCD in 20 European Cities. Wageningen: Wageningen University, 2015.
[62] Elands B H M, Wiersum K F, Buijs A E, Vierikko K. Policy interpretations and manifestation of biocultural diversity in urbanized Europe: conservation of lived biodiversity. Biodiversity and Conservation, 2015, 24(13): 3347-3366.
[63] Review of domestic and international ethnic community research. Progress in Geography, 2013, 32(10): 1520-1534.
[64] Xu J, Ma E, Tashi D, Fu Y, Lu Z, Melick D. Integrating sacred knowledge for conservation: cultures and landscapes in southwest China. Ecology and Society, 2005, 10(2): 7.
[65] Ethnic ecology research in mainland China (1950-2010). Journal of Yunnan University (Social Sciences Edition), 2012, 38(2): 55-59.
[66] Biodiversity and cultural diversity. Biodiversity, 2008, 60(4): 33-36.
[67] Biodiversity conservation and cultural diversity conservation are two sides of one coin: a case study of Dai ecological culture in Xishuangbanna. Biodiversity, 2015, 23(1): 126-130.
[68] Ethnobotanical study on wild edible plant resources in Jinping periodic markets. Yunnan Botanical Research, 2008, 30(5): 603-610.
[69] Ecological significance of Yunnan Chuxiong Yi people' s [practice] and biodiversity conservation. Yunnan Botanical Research, 2000, 11(4): 489-492.
[70] Preliminary ethnobotanical study in Gaoligong Mountain area. Yunnan Botanical Research, 1992, 11(2): 41-43.
[71] On the concept and protection of traditional knowledge. Biodiversity, 2009, 17(2): 135-142.
[72] Eco-museums and ethnic cultural villages. Journal of South-Central Minzu University (Humanities and Social Sciences Edition), 2009, 29(5): 28-34.
[73] Sacred natural sites and biodiversity conservation. Journal of Forestry Investigation and Planning, 2006, 58(6): 29-31.
[74] Analysis of forest vegetation types in Mengla County Dai [area]. Journal of Central Minzu University (Natural Sciences Edition), 2010, 35(3): 76-83.
[75] Study on Yunnan Hani terraced ecosystem. Journal of Central Minzu University (Natural Sciences Edition), 2008, 17(S1): 146-152.
[76] Ethnobotany. Shanghai Science and Technology Press, 2007.
[77] Fei Xiaotong' s new collection of ethnic research works. Central Minzu University Press, 2006.
[78] The ethnic identification movement [provided] materials and foundations for cultural diversity research.

Note: Figure translations are in progress. See original paper for figures.