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Biocultural diversity and traditional ecological knowledge in island regions of Southwestern Korea

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Abstract

In 2009, United Nations Educational, Scientific and Cultural Organization (UNESCO) recognized the unique outstanding ecosystem biodiversity and distinct ecocultural values of the Shinan Dadohae Biosphere Reserve in the island region. The Dadohae area, which has been sustainably conserved for scores of years, boasts not only a unique ecosystem, but also has residents with a wide range of traditional ecological knowledge. In terms of understanding the soundness of the ecosystem network known as the landscape system, the recent expansion of environmental development has served to heighten the degree of consideration given not only to biodiversity, which has long been used as an indicator to assess ecosystem soundness, but also to assess cultural diversity. Man has used the surrounding landscape and living organisms as his life resources since the beginning. Moreover, whenever necessary, man has developed new species through cultivation. Biodiversity became a foundation that facilitated establishing cultural diversity such as food and housing. Such ecological knowledge has been conveyed not only to adjacent regions, but also at the international level. The recent rapid changes in the Dadohae area island ecosystem caused by the transformation of fishing grounds by such factors as climate change, excess human activities, and marine pollution, is an epoch event in environmental history that shows that the balance between man and nature has become skewed. Furthermore, this issue has moved beyond the biodiversity and landscape diversity level to become an issue that should be addressed at the cultural diversity level. To this end, the time has come to pay close attention to this issue.

Key words: biocultural diversity, biosphere reserve, ecological culture, island ecology, sustainability, traditional ecological knowledge

BIOCULTURAL DIVERSITY

While industrial development helped widen the scope of man's activities, the population increase has served to destroy habitats in which organisms long lived. The recent publication of various studies showing that the rapid decline in biodiversity could someday threaten the survival of the human race has led to discussions on the relationship between the sustainable development of biodiversity and the future of mankind. Biodiversity is an ecological indicator that is useful to predict the soundness and stability of an ecosystem (Ro and Hong 2007). Biodiversity is a quantitative assessment of the kinds and numbers of organisms that inhabit a simple space (Choe 2010). However, studies showing that organisms share various habitats has resulted in expanding the notion of biodiversity to include not only habitat diversity but also the landscape diversity associated with organisms, which require larger spaces for activities (Morimoto 2007), or what can be referred to as spatial diversity (Turner 1989,

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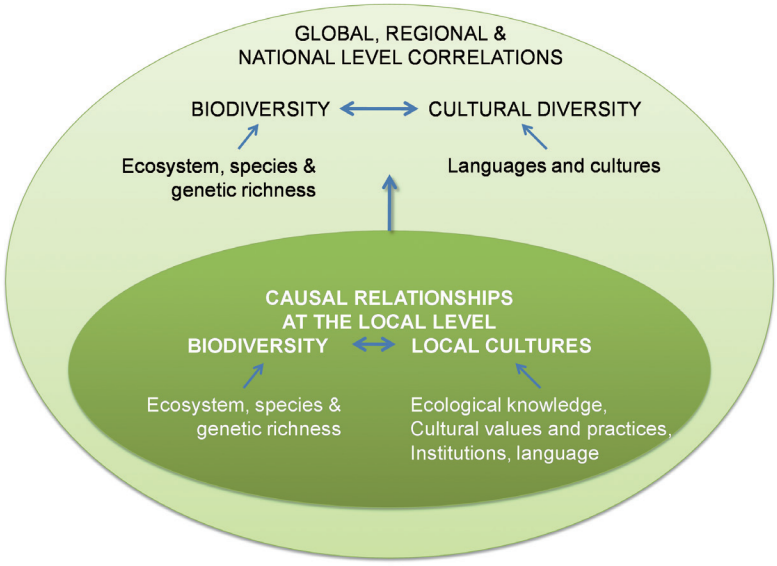

Fig. 1. Relationship between biological diversity and cultural diversity. Interaction of biocultural diversity at the local and global levels (Adopted from Maffi and Woodley 2010).

Delcourt and Delcourt 1992, Hong and Kim 2011, Wu 2011).

Culture is an ecological process created by man to adjust to natural ecosystems. History has taught us that a close relationship exists between survival of the human race and the use of natural resources (Netting 1977). It is evident that many of the tangible and intangible resources forming the backbone of man's lifestyle, such as language, etiquette, food, shelter, agricultural and fishing methods, tools for daily life, clothing, and villages, have traditionally been closely related to surrounding natural resources (Berkes et al. 2000, Huntington 2000, Folke 2004). For example, traditional Korean villages can be regarded as "biocultural gardens" created by combining the physical geographic environment, which includes naturally formed mountains, rivers, seas, islands, natural ecosystems, and organisms, as well as the methods employed by the people who settled in these areas to adjust to their environment. While these biocultural gardens were at the center of human life for centuries, industrialization, urbanization, and westernization have rapidly eroded this traditional and indigenous cultural system and further destroyed and transformed cultural prototypes.

These rapid changes have lead to spatial and temporal disconnection and the disappearance of biocultural diversity prototypes, which can be equated to the gene pool of an organism. The impetus to combine biodiversity and cultural diversity into what we can be referred to as biocultural diversity has its roots in the recent concerns surrounding the sustainability of the Earth and the future of mankind (Fig. 1). The diversity of organisms and cultures, which are increasingly being dispersed, can be compared to a time capsule that contains the wisdom needed to ensure the survival of man in a future marked by a shortage of resources such as food, energy, and water.

The unique methods employed by various organisms to adjust to their environments have been referred to as "ecoculture" (Cho 2010, Hong 2011). United Nations Educational, Scientific and Cultural Organization (UNESCO) used the term bioculture to conceptualize mankind's ability to adjust to various environments from an anthropological standpoint (Persic and Martin 2008). However, scholars have adopted a more inclusive interpretation and application of this term. Additionally, the manner in which biodiversity, cultural diversity, and traditional knowledge interact with one another within complex ecosystems has been defined as biocultural diversity (Huntington 2000, Hunn 2001, Maffi 2010).

THE RECENT TREND TOWARDS CONNECTIVITY BETWEEN SUSTAINABILITY AND BIOCULTURAL DIVERSITY

Ecologists have implored business people and politicians living in advanced countries to change their perception of climate change and reckless development.

They have introduced many examples to show how mankind is dependent on organisms and ecosystems, how culture is connected to biodiversity; and how culture has been created (Korea National Commission for UNESCO 2010, Secretariat of the Convention on Biological Diversity 2010). The United Nations designated the year 2010 as the International Year of Biodiversity and the International Year of Rapprochement of Cultures. The importance of this designation at a time in which the Earth's ecosystems are being destroyed by climate change, reckless development, the destruction of prototype ecosystems environmental pollution, and the value of biocultural diversity, which has been on the decline, cannot be overestimated. Various programs have been carried out to celebrate the International Year of Biodiversity and International Year of Rapprochement of Cultures. To this end, the Convention on Biological Diversity (CBD) was held in Montreal, Canada from June 8-10, 2010. The CBD is an international treaty established in 1993 among the United Nations Environment Program members. The Convention had three main goals: conservation of biodiversity; sustainable use of its components; and fair and equitable sharing of the benefits arising from genetic resources. The 2010 CBD revolved around the theme of "Diversity for development-development for diversity" and was particularly significant in that it was jointly organized by the business sector and UNESCO (International Conference on Biological and Cultural Diversity 2010a). Individuals employed by environmental development enterprises, energy-related international organizations, and politicians from North America participated in the session and discussed possible ways to enhance understanding of the changes in the global environment and the biodiversity crisis by business people. The need for cooperation between business people and environmental policymakers as far as diversity, the advent of a green economy, and new growth models was emphasized. However, the most interesting development from the Convention was the in-depth discussions held between UNESCO, United Nations Development Programme (UNDP) and politicians as part of panels entitled "Energy, sustainable development, and diversity" and "Biological and cultural diversity for sustainable development." As such, interest in biodiversity and cultural diversity, which constitute fundamental indicators upon which any discussion of the sustainability of the global environment and local community must be based, has been on the rise (International Conference on Biological and Cultural Diversity 2010b).

The debate over the formation of landscapes, which is a criterion to evaluate biodiversity, has focused on identifying the ecological significance of the various types, characteristics, and functions of landscapes (Turner 1989, Forman 1995). In terms of the methods used to measure the value of landscapes, much attention has been paid to indigenous knowledge such as spiritual values (Chen and Wu 2009). These values include the various indigenous resources possessed by minority groups such as the indigenous people of South America, native Indians of Canada, and adherents of *Fengshui* in Asia (Berkes et al. 2000, Stepp et al. 2002, Folke 2004, Lee 2004). In this regard, the languages and dialects of such minority groups have rapidly declined in the face of westernization (Hunn 2001, International Conference on Biological and Cultural Diversity 2010b). The indigenous knowledge associated with the use of natural resources is intricately related to the biodiversity crisis caused by reckless energy development and land use. One of the major points of contention has been the question of how this indigenous knowledge can best be preserved. The survival of mankind will be greatly dependent on biodiversity (Folke 2004). The ecocultural flexibility and sustainability stemming from the intricate links between biodiversity and cultural diversity (Brown et al. 2005), which has been used as a model for harmonized coexistence within ecosystems, is the basis for the continued existence of man.

Korea's traditional concept of land use and ecological knowledge are in many ways consistent with the tenets of "*fengshui* (Poongsu in Korean)." *Fengshui* is a term that combines *feng*, "wind," which denotes mountains, and *shui,* "water," which indicates rivers and streams. Wind forms in the mountains, and water quality is determined by the greenness of the land (Hong et al. 2007). The structure of mountains determines the strength and direction of wind as well as the river structure. Water quality, aquatic ecosystems, and biota in turn depend on valley forest characteristics. As such, the concept of "*fengshui*" is not simply applied to traditional land use but is also connected to the concept of landscape ecology, which is intricately related to land use and ecosystem management policies in the modern era. Korea has long been governed by the fundamental philosophy known as "*chi-san-chi-su*" (proper management of forest and water). Simply put, this philosophy maintains that people's lives remains happy as long as the mountains and waterways are properly controlled. This philosophy is traditionally reflected in national land-use policies (Kim and Hong 2008). However, with the advent of modernization, this traditional land-use method was rapidly altered amidst excessive industrial development and the

related runaway land development. To this end, the concept of "*fengshui*" was also altered. Korea has traditionally been called the country of "*geum-su-gang-san*," an expression that means a land with landscapes so beautiful that it almost appears as if the rivers and mountains were embroidered on silk cloth. However, one would be hard-pressed to uncover such beautiful or ecological landscape elements anywhere in Korea today. Mountains and rivers can only express their ecological efficiency and natural beauty when they are naturally connected to one another. Viewed from the standpoint of landscape ecology, rivers are dynamic systems that play the role of ecological corridors for ecological materials and organisms (Hong 2007). While landscape diversity increases as a river travels downstream, the dynamic elements decrease (The Japan Society of Erosion Control Engineering 2000, Downs et al. 2002), indicating that a river system becomes more complex as it travel through other ecosystems downstream. The man-made land uses upstream also differ from those employed downstream. Rivers are not a single system. Depending on their scale, a river may flow through many countries, cities, and administrative districts and involve divergent interests. This, in turn, results in difficulties managing rivers and land use. Nevertheless, the functions of a river as a provider of nutrition and materials and as a transportation mechanism for biological species should be main elements of any spatial planning effort designed to activate ecosystem networks (Hong and Kim 2007). The river continuum concept and eddy concept (Downs et al. 2002), both of which are regarded as core elements of any landscape ecology approach to river ecosystems, have played key roles for understanding the spatial and temporal ecological processes that occur in rivers and streams. These two concepts should also be referred to when establishing ecological plans (Hong 2007, Hong and Kim 2007). According to Richard Forman (Forman 1995), the roles of aqua space when composing an ecosystem network and, in particular, the characteristics of rivers and streams, can be determined by the degree of connectivity and circuitry of the related waterways. These two elements not only determine river structure and its functional characteristics, but are also used as indicators of life through which the ecological functions of rivers as habitats for organisms and their ecological corridors can be perceived. As such, they continue to be of great importance to mankind and its culture today.

In contrast, Japan established the *Satoyama* concept in conjunction with forest system sustainability. Since the 1990s, the *Satoyama* concept has been considered not only a mechanism for managing forests but also as the prototypical or ideal landscape system for Japanese rural areas (Hirose 2010). The advent of the International Year of Biodiversity in 2010 saw a concerted effort on the part of the Japanese government, academic circles, and citizens to promote the concept of *Satoyama* globally. Rapid industrial development in Japan since the 1960s has resulted in the widespread neglect of forests during transfer of its main energy source (or what was known as the fuel revolution in Japan) from wood to fossil fuels (Nakagoshi and Hong 2001). The long-term neglect of forests that ensued resulted in a number of indigenous organisms facing extinction threats and landscapes were damaged by reckless development, all of which resulted in the disappearance of the prototypical landscape of traditional villages (Hirose 2010). The Japanese Ministry of the Environment responded to these problems by identifying the concept of *Satoyama* as the prototype, selecting ecological monitoring sites, and conducting various studies carried out by specialists as well as civic groups. Using the Meeting of the Conference of the Parties (COP10) as an opportunity (Secretariat of the Convention on Biological Diversity 2011), the Ministry of the Environment of Japan has since promoted the concept of *Satoyama*, which it defines as an "ecological space within which nature and man coexist in a balanced manner" across the world. Additionally, to prepare for the spread of *Satoyama* across the globe, Japan has sought to upgrade the concept of *Satoyama* to the level of UNESCO's Biosphere Reserve or higher. The current concept of *Satoyama* can be regarded as a furthering of the original notion of *Satoyama* that prevailed in Japan prior to the 1960s, at which time it referred to the traditional methods of extracting charcoal and lumber from the village forests around which efforts to manage forests revolved. Today, the concept of *Satoyama,* as understood by Japanese ecologists, revolves around the ecological management of forests as a whole.

USE OF BIOCULTURAL RESOURCES AND TRADITIONAL ECOLOGICAL KNOWLEDGE IN DADOHAE

Man, who is dependent on ecosystem complexity, has adopted various adjustment strategies. Humans developed the biological resources required for survival, including food, clothing, and shelter. What started out as simple survival methods over time developed into indigenous knowledge Unlike inland areas, islands, whose landscape matrix is the sea, are characterized by solitariness and communicativeness (Hong 2010). The Dadohae

(literally meaning "sea of many islands") area in Korea serves not only as a bridgehead through which inland organisms are dispersed to maritime areas but also acts as a filter to restrain the environmental changes emanating from the sea to make their way inland (Hong 2011). Thus, Dadohae is the point of contact where biodiversity dispersed from the inland area meets that originating from the sea. Therefore, as related ecological information was accumulated, Dadohae became entrenched as the "island ecoculture" which, in turn, formed what is known as Dadohae culture (Ministry of Oceanic and Marine Products 2002). The existence of such an island ecosystem is closely related to conveying ecological knowledge by the residents who utilized biodiversity.

The increase in the urban population caused by Korea's rapid economic development has resulted in a significant transformation of Korea's inland ecosystem over the past 30 years. Fortunately, the development of islands and remote rural areas has been delayed. Topographically, Korea is surrounded by the sea on three sides. Furthermore, the wide array of large and small islands, 3,400 in total, have helped to ensure a complex biological and cultural structure in Korea. Located in southwest Korea, the Dadohae area boasts well-developed ria coasts, broadened tidal flats, and 2,000 islands. The topographical characteristics, landscape, ecological characteristics, and biodiversity value of this area have been recognized by UNESCO, who designated the area as a UNESCO Biosphere Reserve in 2009 (Lee et al. 2010). Contrary to the denizens of the inland urban areas, the islands residents on the southwest coast of Korea remain greatly dependent on the biological resources obtained from their surrounding ecosystems (Hong et al. 2010).

These include the various seagrasses, fish, and shellfish obtained from tidal flats, marine areas, and uninhabited islands; the sun-dried salt produced through the specific use of land in tidal flat areas; and processed foods such as salted and dried fish products. These are the basic industries from which income is generated in fishery areas. The indigenous biological resources used by the residents of the Dadohae Biosphere Reserve are shown in Table 1.

Plant resources have not only been used to prepare medicines but also serve as a way to generate income (Table 2). Most plant resources consist of medicinal herbs and mountain vegetables. Although the diversity of mountain vegetables is not as great as that found in the mountainous inland provinces in the northeast, some indigenous plants that only grow in evergreen broadleaved forests can be found. As Dadohae is a maritime area, it naturally features a wide diversity of fishes and seagrasses. While Europeans and other denizens of the Western world did not eat these seagrasses which they referred to as "seaweeds," they have recently started to realize the taste and efficacy of such resources, which they now refer to as "sea vegetables." Seagrasses, which have long been used in Korea, are increasingly being touted as health food or as a representative local food. However, factors such as climate change and environmental pollution have caused marked fluctuations in sea vegetable production. Meanwhile, the advent of an ageing society in island areas has resulted in a significant decrease in the number of human resources engaged in the gathering of sea vegetables. Fishing village residents possess a unique environmental adjustment method that can best be defined as fishery power (Tables 2 and 3). This kind of power, which cannot be found in agricultural areas, has helped to develop a sophisticated understanding of the prevailing spatial and temporal arrangements.

Fishing activities are dependent on this fishery power (Table 2). The concept of "*multtae*" (literally tidal time), based on the ebb and flow of tidal water and the wind, are important elements of this fishery power. Although the concept of *multtae* is referred to by different names in different regions, the first day of the month on the lunar calendar, when the tidal effect is significant and the

Table 1. Main biological resources found in Dadohae region

Type	Sorts
Medicinal herbs	*Dendropanax morbiferus* (*hwanchil namu*), *Machilus thunbergii Siebold & Zucc* (*hubak namu*), *Asparagus cochinchinensis* (*cheonmundong*), *Liriope platyphyllla* (*maengmundong*), *Pleuropterus multiflorus* (*hasuo*), *Atractylodis rhizoma* (*changchul*), *Cirsium* (*eonggeongkwi*), *Adenophora triphylla* (*jandae*), etc.
Mountain vegetables	*Fernbrake* (*gosari*), *Aster scaber* (*chwinamul*), *mugwort* (*ssuk*), *Chinese bellflower* (*doraji*), *jute* (*ma*), etc.
Animals (insects)	Black goat, centipede, frog, snake, bees, etc.
Fish	Long-legged or small octopus, skate ray, shrimp, yellow corvina, estuarine mud crab, mullet, abalone, etc.
Seaweed	*Undaria pinnatifida* (*miyeok*), *Fusiforme* sp. (*tot*), *Laminaria japonica* (*dasima*), *Gelidium amansii* (*umut gasari*), *Ecklonia cava* (*gamtae*), *Porphyra tenera* (*kim*), *Seaweed fulvescen* (*maesaengi*), etc.

Table 2. Traditional ecological knowledge pertaining to the use of the main biological resources in coastal and island regions

Type	Species/Method	Knowledge and usage
Plant resources	*Dendropanax morbiferus* (*Hwangchil namu*)	The Greek name for this plant, *Dendropanax morbiferus*, literally means a panacea or cure-all. This plant can be found on the islands of Hongdo and Heuksando in Shinan county. Components emanating from the leaves and branches have been used to cure common endemic diseases in maritime areas, including food poisoning.
	Machilus thunbergii Siebold & Zucc (*Hubak namu*)	This tree is found mostly on Gageodo Island in the provinces of Heuksan-myeon, Shinan-gun, and Jeonnam. The residents have used the bark of this tree, which alleviate asthmas symptoms and improves digestion, to generate income.
	Vitex rotundifolia (*Sunbigi namu*)	A sand dune plant. This particular tree is a common sight on the sandy areas along the southwest coast of Korea. Despite being a woody plant, it is widely regarded as a herb because its branches grow sideways from the ground. The black berries become ripe in autumn. The scent of these dried berries, which are used in pillows, cures headaches. Small twigs are sliced up and boiled before being used as a natural dye. In this regard, many natural dyes have been produced using this tree.
Maritime products	Long-legged or small octopus	Long-legged or small octopi are caught in intertidal zones or shallow areas using torchlights, spades, fishing rods, or the bare hands. Catching a small octopus with a trap is referred to as "*tongbal nakji,*" with fishing rods as "*nakji junak,*" small octopus with bare hands ("*sonnakji*"), with a torchlight as "*hwaenakji,*" and with a spade as "*garae nakji.*" "*Tongbal nakji*" refers to the practice of catching small octopus by placing traps with live bait in deepwater areas. This method has been widely used in Southern coastal areas such as Namhae in Gyeongnam province, and Yeosu, Goheung, Haenam, and Wando in Jeonnam province. "*Nakji junak*" refers to the practice of catching small octopi using fishing rods. This method has been used in places with well-developed tidal flats, such as Yeosu, Haenam, Shinan, Muan, and Hampyeong in Jeonnam province. In areas such as Muan, Shinan, and Hampyeong, rods are placed at 1-2 m intervals along a 200-300 m wide line at a depth of 1-2 m. Mud crabs are used as bait to catch small octopus. The catching of small octopi is generally carried out in accordance with the "*multtae*" (tidal time), outside of the summer and winter seasons.
	Oysters: rock-based oyster culture	This method is based on the inherent tendency of oyster larvae floating in the seas to attach themselves to stones. Oyster larvae affix themselves to stones located in tidal flats and begin the growth process. In many cases, rocks along the coastal area are broken into pieces and used to draw the larvae. Although the rock-based oyster culture method is actually an artificial culture technique, the fact that humans do not feed on the larvae or in any way artificially interfere with their growth process means that the oysters are naturally-produced.
Seagrasses	Harvesting method	Various grasses, such as *Ulvales* (*galparae*), *Fusiforme* (*tot*), lichen (*bawiot*), *Sargassum fulvellum* (*mojaban*), and "*deumbuk*" can be found in the area. As "*bawiot*" and "*galparae*" grow in July and August, the entire year's supply is harvested during this period. The seagrasses are thoroughly dried before being stored in sealed bags and can then be taken out whenever needed. The harvesting of *Ecklonia cava* ("*gamtae*") involves the cutting up of the roots with a knife, with the remainder rolled up by hand. The use of such a method helps to foster the growth of a new batch of "*gamtae*" within 3-4 weeks. The second batch of "*gamtae*" is softer than the first one. A rake called a "*danggeulgae*" can also be used to gather this seagrass.
	Sargassum fulvellum (*mojaban*)	"*Mojaban*" is usually gathered during the winter. The entire year's supply is dried in spring. While most "*mojaban*" is naturally produced, people in the Neungsando area increase their income by successfully engaging in large-scale culture of this particular seagrass. The "*mojaban*" is then sold to processing companies in Busan and Jindo.
	Undaria pinnatifida (*miyeok*) and *Laminaria japonica* (*dasima*)	People engage in the large-scale culture of "*miyeok*" and "*dasima.*" While the majority is used to feed abalone, a certain portion is produced and sold as a commodity.
	Ecklonia cava (*gamtae*)	"*Gamtae,*" which contains abundant vitamins and mineral salts such as alginate, iodine, and potassium, constitutes one of the main spring vegetables in tidal flats.
Fishery power	Tidal water and "*multtae*"	The tide is closely related to fish and shellfish behavior, so when specific maritime organisms can be harvested based on the tidal time and strength of the water, current can be determined.

Table 3. Ecological knowledge pertaining to the main biological resources found on particular islands along the southwest coast of Korea

Area	Item	Use made of ecological knowledge
Goheung-gun	Mullet, goby, Spanish mackerel and tuna	The method used to catch mullet and goby is known as "*gaemaeki*" Spanish mackerel markets can be found on Narodo Island
Mokpo	Upland cotton in Gohado	Upland cotton has been used by the spinning and weaving industry, which played a key role as a raw material for moving Korea towards a modern industrial society. Gohado emerged as the center of the large-scale upland cotton cultivation area established by the Japanese colonial government.
	Small octopus in Aphae-myeon	The traditional method of catching small octopi consists of finding holes in tidal flats where these creatures live and then catching them by digging a hole with a hoe, spade, or bare hands. "*Doksal*" (stone-wire) is a kind of stone fence used to catch fish using the difference between the ebb and flow of tidal water. This method is based on the principle that fish entering tidal land during high tide are caught by the "*doksal*" when they try to return to sea during low tide.
Boseong-gun	Ark shell clams (*kkomak*) in Beolgyoeup	Situated in front of the sea in Beolgyo, the tidal flats in Yeoja Bay, which is encircled by the Goheung and Yeosu peninsulas, are believed to possess the best conditions for "*kkomak*." This assumption is based on the fact that the tidal flats do not contact any sand, and they are not polluted. To this end, the Ministry of Land, Transport, and Maritime Affairs announced in 2005 that the tidal flats in Yeoja Bay possess the best conditions among all Korean tidal flats. The "*kkomak*" is gathered by threshing the tidal flats with 2 m long and 50 cm wide "*kkomak*" poles hung from a boat.
Shinan-gun	Skate ray (*hongeo*) in Heuksando	Skates are caught live by placing a net on the edges of the areas where schools of fish swim and directing them towards another fishing net. They are also caught with nets strewn from boats. Fishing rods are also often used to catch skate. The best season to catch skate ray is during the spawning period from winter to early spring.
	Yellow corvina and mackerel in Heuksando	Up until 40 years ago, Heuksando was home to a market selling yellow corvina, whale, and mackerel that ran from February to May. At that time, the Heuksando fish market was one of three fish markets in the West Sea area, the others were the Wido and Yeonpyeongdo fish markets.
	Whales in Heuksando	The whaling season in the West Sea traditionally ran from February to May. It was common practice for fishermen from the East Sea area to relocate to Heuksando when the whaling season ended on their side of the peninsula. The whale meat processing factory ships, carriers, and brokers, which also made their way to the area once the whaling season started, meant that a huge fishing fleet was assembled every year.
	Oak trees in Hongdo	The islands along the southwest coast have long served as a source of wood for ships. It was not uncommon for Japanese marauders to enter the Heuksando area to secure the wood they needed for their ships. During the Japanese colonial era, the oak trees in Hongdo were used to make charcoal. During this period, the production of charcoal was very common not only in Hongdo, but also in other areas along the southwest coast such as Heuksando and Jindo.
	Undaria pinnatifida (*dolmiyeok*) in Hongdo	For the residents of Hongdo, "*miyeok*" has long been a special marine product. It eventually became a community industry that revolved around the joint gathering of this marine product and the joint distribution of the income that was earned from its sale.
	Anchovies in Gageodo	Catching anchovies in Gageodo long represented the main source of income for local residents and involved almost all of the local population. The method used to catch anchovies in the Gageodo was different from that used in other locations in the Dadohae area. Officially known as "*bungichomang chatbae*," this method involves the use of lights to attract anchovies.
	Seaweeds (*tot, miyeok, umulgasari,* and *pulgasari*) in Gageodo	During the colonial era, Japan used seaweeds such as "*umulgasari*" and "*pulgasari*" that had been gathered by residents of Gageodo as raw materials for its industries and construction sector. They served as important implements through which villages ensured their survival.
	Woosil in Anjwado	*Celtis sinensis* (*paengnamu*), *Kalopanax pictus* (*eumnamu*), and pine tree (*sonamu*): The islands along the South Sea boast windbreak forests and fish-shelter forests that effectively protect inland areas from the impact of the southwesterly wind. The residents of islands in the Shinan area routinely planted trees behind their villages to protect them from the northwesterly wind. They also built shrines called "*dangjip*" in the forests where gods were enshrined. The majority of villages in Anjwado featured a windbreak forest called "*woosil*." In addition to protecting them from the northwesterly wind, the "*woosil*" were also perceived by local residents as a border which demarcated their village from the outside world. Located northwest of the village, the 300-m long *woosil* in Daecheok-ri is composed of 30 *Albizzia julivrissin* (*jagwi namu*) and *Celtis sinensis* (*paengnamu*) trees of more than 100 years of age, as well as camellia (*dongbaek namu*), *Machilus thunbergii Siebold & Zucc* (*hubak namu*), and *Sasa borealis* (*joritdae*) trees. Viewed from the standpoint of *feng shui*, this forest played the role of a remedial forest (*bibosup*).

Table 3. Continued.

Area	Item	Use made of ecological knowledge
		The "*woosil*" in Yeoheul-ri traditionally played the role of stopping the sea winds and sounds of the waves emanating from the West Sea from affecting the village. Located to the west of Yeoheul-ri, this windbreak forest running in a south-north direction is composed of *paengnamu* and *eumnamu*, which are more than 300 years old.
Jindo	Gwanmaedo	White (*baeksasong*), black (*gomsol*), red (*gangsong*), umbrella (*bansong*), and pitch pine (rigida), etc. (village forests): The area is home to *gomsol* forests boasting black pine trees that are over 300 years old. Black pine trees (*gomsol*), which are also referred to as beach pines (*haesong*), possess a strong resistance to salt. These trees, which formed the village forests possessed both windbreak and erosion control functions. From the standpoint of "*fengshui*," village forests were also called "*sugumak*," and were believed to protect villages from strong sunlight and the innate power of rocks and mountains. *Machilus thunbergii Siebold & Zucc* (*hubak namu*): The village people performed a ritual ceremony called "*dangje*" under the "*hubak namu*". The black pine forest served as a space where village ritual ceremonies such as "*dangje*" and exorcisms ("*gut*") were conducted. "*Dangje*" was a village ceremony in which local residents wished for peace within the village and an abundant harvest of marine products.

Table 4. Systems of biocultural diversity and its concern with evaluation (Hunn 2001)

Units/Measures	Biodiversity	Linguistic diversity	Cultural diversity
Taxonomic units	Families	Families	Culture areas?
Basic units:	*Species* Subspecies	*Languages* Dialects	*Cultures*? Subcultures?
Elementary particle:	Gene	Word	Idea
qua systems:	Genome: genetic information coded in DNA generates organisms and directs behavior	Grammar: generates sentences	Cultural system: symbolic information coded in language directs behavior
Ecological units	Communities of many interacting species populations: food webs; niche packing	*Prestate*: dialect mosaics; *modern*: languages of empire displace tribal languages	*Prestate*: mosaic of community-based cultural traditions; modern: global culture challenges autonomy of local traditions
Measure of diversity	Taxa/area + indices of endemism	Languages/area + indices of time depth	Cultural endemism, autonomy of local tradition

Table 5. Ecological knowledge developed in the Dadohae area and potential research themes pertaining to biocultural diversity

Ecological knowledge	Biocultural diversity
The influence of climate change on traditional ecological knowledge and biological resources	The relationship between cultural diversity and biological diversity Biodiversity as the key to survival of local communities
The cognitive system of local residents as it pertains to biodiversity and ecosystems	The management of biological resources by indigenous residents
The cognitive system of fishermen (*multtae,* direction of wind, spawning places and periods, marine product harvesting sites) and the study of the cognitive system of local residents	The periodic (seasonal) monitoring of production activities (activities from which a living is earned)
Indigenous knowledge gleaned from the method of acquiring resources (fishing resources and plant resources)	Study of the unique behavioral methods of residents gleaned from production activities and the process of acquiring resources
Indigenous knowledge gleaned from the use of resources (storage methods, folk remedies, use of natural fertilizers, etc.)	Residents' method of classifying resources based on their cognitive system
The cognitive system as it pertains to natural phenomena and the development of indigenous knowledge (development of indigenous knowledge such as the prediction of weather and good or bad harvests based on natural phenomena)	Facilitation of local industry based on the conservative development of indigenous animal and plant resources: horticulture and medicinal industry using indigenous plants, and the development of goods using indigenous biological resources

water current is fast, is known as "*ilgommul*" or "7 *mul*." This particular time period is also known as "*sari*" (high tide). The difference between the ebb and flow gradually increases, moving from *ilgommul or* 7 *mul* to "*yeolsemul*" or "13 *mul*" on the 7th day of the lunar calendar month. This particular time is known as "*achim jogeum*" (morning neap tide). After "*jogeum*" (neap tide) on the 8th day, and "*musu*" (slight neap tide) on the 9th day, "*hanmul*" or "1 *mul*" begins on the 10th day of the month, only to become "*yeoseonmul*" or "6 *mul*" on the 15th day of the month. A new cycle of *multtae* starts on the 16th day of every lunar calendar month.

CONCLUSION

The biological resources and ecological habitats that serve as ecosystems have long provided the foundation for traditional ecological knowledge (Beller et al. 1990, Berkes et al. 2000, Folke 2004). Many studies have shown that the human adjustment process rooted in biological resources and the traditional knowledge created during the adjustment process is directly connected to the biodiversity and cultural diversity that exists in a particular region (see Table 3).

Biodiversity, which can be regarded herein as natural resources, becomes the basis that determines community cultural characteristics. Regions with greater biodiversity boast greater cultural diversity in terms of food, language, architecture, and social structures (Table 4). The detailed knowledge related to the natural environment has become entrenched in the languages used by the various human groups who have lived in close contact with their respective environments for centuries.

One-fourth of all pharmaceuticals prescribed by doctors in the United States are currently made of materials extracted from plants grown in tropical rainforests (Stepp et al. 2002, Secretariat of the Convention on Biological Diversity 2010). Thus, a very strong likelihood exists that useful materials can be extracted from the sub-tropical forests and maritime organisms (maritime products and seaweeds, etc.) found in the Dadohae area of Shinan-gun, Korea. For much the same reasons, the indigenous knowledge possessed by local residents can also be perceived as a valuable resource (Table 5). As Maffi and Woodley (2010) stated, a treasure trove of scientific and medical wisdom is lost whenever a native culture disappears. Man's ability to respond to changes in the global environment, including climate change, is predicated by the development and dissemination of the indigenous knowledge possessed by the local residents who have long utilized relevant biological resources in a sustainable manner.

The sustainability of the Dadohae area can only be ensured when the biosphere or environmental island ecosystems and culture or human social structure coexist and are in harmony. However, as has been the case with Dadohae, a lack of discussions has occurred in Korea regarding island sustainability and related indicators. In this regard, there is a need to establish a comprehensive development plan for islands and national parks, including the UNESCO Shinan Dadohae Biosphere Reserve, and to develop the Dadohae area's outstanding biological resources and ecosystems. It is also essential that the central government, local researchers, and residents focus on promoting international use of these resources.

An urgent need exists to improve the living environment in the Dadohae area, which has to adjust to global climate changes characterized by the rise in sea level associated with changes in ocean temperature and the alterations based on agriculture and fishing brought on by island environmental changes (Hong 2011). Thus, it is necessary to establish a low carbon-based lifestyle in the Dadohae area by introducing bioenergy, securing green space, and developing biological architecture, all of which should be in keeping with the government's green growth policy. However the economic, social, and cultural systems found in big cities cannot and should not be used to develop the Dadohae area. Rather, a strategy that optimizes the advantages and disadvantages of the Dadohae area, such as its unique ecosystems, solitariness, limited resources, cultural distinctiveness, and locality should be adopted. The natural resources and ecoculture found along the southwest coast of Korea, a region represented by the Dadohae area, include many that are internationally competitive. Here, one could name the numerous islands, quality tidal ecosystems, and the fish, shellfish, and sun-dried salt that are produced therein. Nevertheless, no concrete efforts have been made to use these unique characteristics as a vehicle to improve the lives of local residents. It is necessary to strengthen the area's competitiveness and bring about the degree of industrialization needed to actively use this area as a hub for ecotourism and the health industry. Important items on the agenda related to the development of Korean island ecosystems in the 21st century should include the sustainable development and use of ecological resources, which can be regarded as the core function of the UNESCO Biosphere Reserve, establishing the support system needed to achieve sustainable development and

usage, the advent of harmony between the conveying traditional knowledge and a modern lifestyle, achieving a balance between nature and highly-advanced technology, and culture-based development (Hess 1990, UNESCO MAB 2008).

Lastly, the organisms and culture that comprise biocultural diversity may appear to be quite different from one another (Secretariat of the Convention on Biological Diversity 2010). However, as man's development has been dependent on nature and the former exists in a fatalistic relationship with nature in which existence without natural resources is not possible, the term biocultural diversity, which can be defined as coexistence of nature and man, was created (Maffi 2001, Stepp et al. 2002, Cho 2010, Hong 2010). As such, it is true that humans and nature coexist, interact, and depend on one another within the ecosystem. However, there is an urgent need to understand that the connectivity between man and nature has been negatively impacted by the rapidly changing global environment, reckless development, and decreases in biodiversity at the government, academic, civic and specialist levels (Hong et al. 2010).

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