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Island ecology on biological-cultural diversities and human adaptation in seascapes

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The Asian cultural landscape is a mirrored ecosystem of great complexity, formed by the interaction of man and nature, coupled with a host of ecological processes. The human dependencies on and environmental adaptation of the bio-organisms and the surrounding landscape constitute the typical cultural landscape. Islands are a good example of a cultural landscape, and each mosaic pattern of marine and coastal ecosystems reflects bio-cultural diversity. Along with land-use patterns, wise use of biological organisms and indigenous knowledge has expanded to islands in the Asia-Pacific region in several ways (sea current and human impact, etc.). Loss in biodiversity and landscape diversity as well as cultural diversity owing to global warming and rapid urbanization are emerging issues for island ecosystems all over the world. In order to sustain the historical coexistence between man and natural systems, we ecologists must continue to search for a holistic solution for academic consilience. In this paper, I present the vision and practical characteristics of island ecology with a view toward the conservation of the traditional landscape and bio-cultural diversities in the seascape.

Key words: Asia-Pacific region, bio-cultural diversity, human adaptation, island ecology, seascape, traditional landscape

ISLAND ECOLOGY – HOPES AND CHALLENGES

While the Galapagos Islands were the inspiration of Darwin's theory of evolution, which lies at the heart of modern evolutionary biology (MacArthur and Wilson 1967), biogeographical studies conducted on Asia-Pacific islands have become the basis for island biogeography (Whittaker and Fernández-Palacios 2007) which has, in turn, served as the foundation for modern landscape ecology (Forman 1995). Meanwhile, the islands in the Mediterranean and Aegean Seas constitute the very cradle of human civilization. For their part, the numerous islands in the Indochina region comprised the hub of a maritime Silk Road. Finally, Easter Island has helped biologists and anthropologists alike to understand the crucial importance of making optimal use of the resources found in isolated places such as islands (Beller et al. 1990). Ongoing changes in maritime features and climate, as well as ocean currents, have resulted in serious alterations of the geopolitical value, ecological specificity, and biological diversity of islands. Nevertheless, the isolation of islands from the mainland tends to result in their ecological and cultural uniqueness (Quan et al. 2010). Put another way, islands showcase not only the terrestrial ecology and biodiversity of an ocean-surrounded area, but also humans' ability to survive and adjust to an environment that features limited space. This can be referred to as traditional ecological knowledge (Berkes et al. 2000, Stepp et al. 2002). As such, the study of islands inherently differs from studies of terrestrial ecology, in that it involves the simultaneous study of seascapes and landscape ecology (Hong et al. in press). To this end, the study

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of island ecology, which is a fairly complex issue, should be addressed in a holistic manner, in which islands are perceived as components of a landscape system.

A recent report of the Intergovernmental Panel on Climate Change (IPCC) has shown that the surface of the earth covered by glaciers and ice has decreased by 10% since the 1960s. As a consequence, global sea levels have risen by 0.1-0.2 m and seawater temperatures have also been on an upswing. Should this trend continue, it is anticipated that, by 2100, the glaciers in Antarctica will have melted away, while sea levels will have risen by approximately 50 cm. This would put the great majority of coastal areas around the world at risk. In the Korean case, such a scenario would in all likelihood result in the submersion of the West coast, with its gradual incline, as well as the islands on the south coast, and in the flooding of much of the mainland. Furthermore, the continued onslaught of global warming is anticipated to result in the movement of vegetation belts northward by 100-550 km, from the middle latitudes toward the North Pole. Korea would also face ecological chaos in the form of marked increases in the existing vegetation, which is currently dominated by temperate deciduous broad-leaved forests, as well as in subtropical vegetation. While islands are the first places in which the effects of climate change are felt, the biological organisms inhabiting such islands can be regarded as environmental indicators of nature's responses to climate change (Hong 2008).

THE NATURAL AND ECOLOGICAL VALUES OF ISLANDS

Islands are of value not only from an ecological standpoint, but also in terms of their maritime cultures (Hong 2008). Ecological uniqueness is a basic characteristic of islands in general. Although they lack resources useful for humans, uninhabited islands serve as an important habitat for biological organisms. The ecological values of uninhabited islands include the rough geographical features that function as a migrating place for seasonal birds, the vegetation that develops under the influence of a maritime environment and isolation from the mainland, and biological organisms, including insects and plants, that have adjusted to maritime weather (Lee et al. 2010).

Isolation

The element most salient to the uniqueness of islands is their isolation, which derives from their being surrounded on all sides by seas (MacArthur and Wilson 1967). Islands have been isolated from the outside for so long that the biological organisms on the island have adjusted to this state of isolation. The modes of existence of biological organisms, which evidence characteristics different from those of the biological organisms found on peninsulas and the mainland, represent crucial resources for researchers.

Unique ecosystem landscape

The influence of the maritime environment results in the development of unique ecosystems on isolated uninhabited islands (Whittaker and Fernández-Palacios 2007). Here, the maritime climate and tidal range can be identified as the most important environmental factors affecting islands. Islands that feature high winds and humidity tend to develop a terrestrial ecosystem that is adjusted to such conditions. The terrestrial plants that have developed on uninhabited islands in the southwest sea of Korea consist of evergreen broad-leaved trees. The adjustment mechanisms of plants that can exist in high-temperature and humid climates, and land containing high levels of salt has resulted in the formation of broad-leaved evergreen vegetation, such as magnolias and cinnamon trees. The expected northing of evergreen trees on the Korean peninsula caused by the progression of global warming is anticipated to highlight the role of islands as important research materials for the study of ecosystems. The islands along Korea's southeast coast, including Bigeum-myeon and Docho-myeon in Shinan-gun of Jeonnam Province, share in common the feature that their surroundings are connected to the tidal flat ecosystem (Hong et al. in press). Such tidal flats are regarded as ecotones, or the ecological point of contact between the terrestrial and marine ecosystems. The biological diversity of intertidal organisms on uninhabited islands differs depending on the spatial arrangement of the relevant tidal flats. Such island ecosystems surrounded by tidal flats are quite rare in the world. Dadohae Maritime National Park in Shinan-gun was, in May 2009, placed on the UNESCO Biosphere Reserves list. However, the ecosystems in the majority of island areas have been destroyed as a result of factors such as the closure of cultivation grounds, the abandonment of fishing areas, maritime waste, animal pasturage, and the invasion of foreign plants.

Values as maritime territory

The uninhabited and inhabited islands located along

the sea base point, which are critically important in terms of the outer limits of a country's maritime territory (territorial waters, EEZ, and continental shelf, etc), also perform an important role in determining and strengthening maritime jurisdiction. The uninhabited islands located along the sea base point can be regarded as an advance guard that protects the national territory of a country (Ministry of Environment 2005). Recently, China and Japan have respectively asserted their territorial sovereignty over Korea's Iodo and Dokdo Islands. Countries the world over have increasingly considered the expansion of maritime territory as a means to solidify their grasp over their territory as a whole. Gageodo-ri in Heuksan-myeon, Shinan-gun is an island that is located at the southeast sea base point. Although uninhabited, this island's location makes it an important part of Korea's maritime territory.

Use of maritime resources

Islands are treasure troves of maritime organisms. Marine products including seaweed, kelp, and laver, invertebrate animals, and various types of fish have long served as food sources for island residents. As marine products such as seaweed, kelp, octopus, and shellfish have been collected by the residents on the basis of indigenous methods, the sustainable management of maritime resources has generally been carried out by nature. It has also been reported that the catching of octopus with one's hands results in the repeated mixing of organic matter in tidal flats, which in turn contributes to the smooth functioning of the tidal flat ecosystem.

Use of amenity resources

Rural amenities is a term that encompasses elements such as a clean agricultural landscape, natural environment, unique local culture, and handicraft products which create aesthetic satisfaction amongst the public and function as recreational facilities (source: Korea Research Institute for Human Settlements). The Ministry of Environment and the Ministry of Land, Transport, and Maritime Affairs has recently implemented rural amenity projects that have attempted to permit the public to make use of rural landscapes and resources as recreational facilities, and to provide outlying areas with opportunities for rural rejuvenation. However, attempts to develop regional activation and amenity resources--including the Green Village, Eco-village, and Traditional Village projects--have thus far been limited to agricultural areas; meanwhile, fishing villages and islands have largely been left outside the scope of such projects. Islands are of unlimited value as amenity resources. More to the point, their potential use toward such ends as maritime eco-tourism (Gössling 1999), maritime organism observation, and maritime food culture can help to enhance cultural diversity.

Threats to the ecosystem

Threats relevant to Korea's island ecosystem include natural disturbances such as global warming and typhoons. However, the destruction of the ecosystem has, by and large, been the result of human activities such as pasturage and the abandonment of fishnets and traps in uninhabited islands. Additionally, reckless aggregates, tourists' illegal collection of rare plants and rocks, and fishermen's disposal of waste have also contributed to the steady destruction of maritime landscapes and ecosystems. The destruction and disruption of ecosystems has also been apparent in the waters surrounding the islands that are related ecologically to the mainland.

PERCEPTION AND NECESSITY OF INTERDISCIPLINARY RESEARCH ON ISLAND ECOLOGY AND ISLAND CULTURE

Ecological adjustment to island environments

Islands are not, strictly speaking, isolated from the biological or ecological perspectives, but are rather simply open spaces that exist alongside the ocean. The isolation of islands is a notion that originates from human's own ecological adjustment processes. Cultural diffusion can be considered the consequence of humans' adjustment to the natural environment. Toward this end, the cultural diversity of a given region is reflective of its natural environment. The effective understanding of the culture of a region requires a comprehensive consideration of its natural environment, including its geography, topography, and ecology (Hong et al. in press). The ecological environments of oceans and islands have long represented places of adventure and challenge for members of mainland society, and have also provided the essential resources required for the maintenance of the lives and cultures of residents of coastal areas. Additionally, peninsulas have long served as a path through which island residents could make their way to the mainland, and as the source of resources (i.e., ships and food) required by

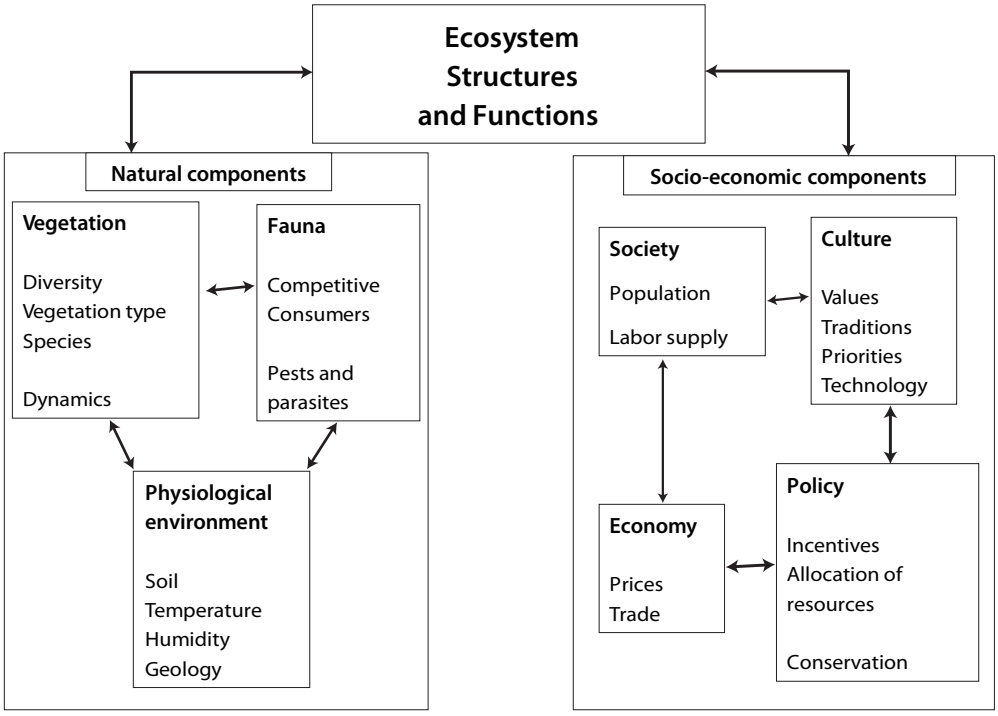

Fig. 1. Composition of cultural landscape. Nature and socio-economic components influencing ecosystem structure and functions in the landscape (particularly in human-dominated islands and island villages). The sustainable use of natural components as biological diversity resources is related significantly to capacities and balancing among society, economy, culture, and political situations in limited areas in human-influenced areas, even on small islands.

pioneers from the mainland, questing to reach further-off oceans and islands. As such, humans' lifestyles in the ocean are dependent on the eco-geographic characteristics of islands and peninsulas. Humans' ability to adjust to various ecological environments has resulted in the production of a variety of lifestyles and cultures. Humans' cultural behaviors in island and ocean regions are rooted in their use of the ecological environment. They also profoundly influence the coevolution between humans and biological organisms. As such, there exists a close relationship between the ecological environment of islands and oceans and humans' cultural behaviors. However, in Korea, a peninsular country that includes more than 3,000 islands, a paucity of eco-cultural studies and academic analyses of the environmental history as relates to the seas. Such a task can be compared to previous studies of Okinawa in Japan, the Mediterranean islands of Italy and Greece, the islands of Indonesia and Malaysia, and islands in Alaska. The ecological complexity inherent to the interaction between humans and nature, as well as the balance and diversity between ecology and culture generated via the process of human adjustments to the ecological environment, have expanded from island-to-peninsula-to-mainland, been reproduced, or made extinct as the result of the peninsular effect (Hong 2008). This can be demonstrated from the perspective of maritime environmental history and the bio-geology of islands. The Dadohae area of Korea is a vast, broad ecological space in which human's ecological behavior vis-à-vis oceans can be observed.

Diversity of the cultural landscape of islands

As the resources of islands are limited, the prudent use of resources has always been related closely to the survival of island residents (Hess 1990). This has been made apparent by a number of previously discovered historical materials and remains. Easter Island has been held up by some as a representative case of man's reckless use of resources, a situation that resulted in the destruction of human culture and ultimately to the disappearance of man from the island altogether. Meanwhile, places such as Greece, Italy, Lebanon, and England were once covered in forests. However, these forests disappeared, after falling victim to the great demand for the building of ships for use in maritime wars and for the establishment of overseas colonies. Anthropological studies and ecological history make abundantly clear the differences in terms of the national traits of countries with forests and deserts, as well as in terms of their denizens' lives and culture. As such, understanding the ecology of islands can serve as a parameter by which the cultural heritage

Fig. 2. Grazing is one of traditional landscape management in Mediterranean islands. How to sustain the balance of resource use and ecosystem, especially in small islands, is common question to ecologists (*Palea Kameni* near Santorini, Greece. This islet was created by eruptions of 46-47AD and 726AD. Photo by SK Hong).

of the future can be evaluated. Estimations of past and present environments based on indigenous knowledge of the use of the natural environment and bio-resources found on islands, as well as studies of humans' influence on the environment have become the principal research agenda in terms of overcoming the ecological crisis faced by mankind on the large island we call Earth (Fig. 1). Landscape ecology and ecological geography have conciliatory characteristics, in that they simultaneously link man's past and present land use, ecology, and the cultural spaces that lie between regions (Hong 2007, in press). With some limited exceptions, very few ecological and eco-geographic studies of islands have been conducted thus far in Korea. In particular, no interdisciplinary exchanges have ever been conducted between these fields.

It is critically important that interdisciplinary research regarding the interaction between humans and nature through the ecological cultures of islands and peninsulas be conducted at the academic level. This research will involve estimations of the ecological environments of islands based on the past, present, and future.

Resources and indigenous knowledge of islands

Generally, people assume that islands have isolated and unique characteristics. However, islands simultaneously perform as cultural filters that sift out a variety of heterogeneous ocean-based cultures, and as ecological membranes that engage in selective communication with the mainland (Berkes et al. 2000). According to island biogeography, islands become, depending on geographical characteristics such as their distance from the mainland or peninsula, the shortest distance between islands, and the size and shape of the island, a source or sink of biological organisms (Forman 1995). The conveyance of culture can be regarded from this ecological perspective. Islands are intertwined closely not only with the imaginative materials used in the humanities, but also with the conveyance of culture and indigenous knowledge (Stepp et al. 2002, Hakim et al. 2009). There are many islands in Shinan-gun, Jeonnam Province. The islands located in Heuksan-myeon boast eco-culturally unique features that differentiate them from other islands in Shinan-gun. The Dadohae area of Sinan-gun exhibits differences in terms of island specificity; these are determined by whether the area surrounding the relevant islands consists of the 'sea' or 'tidal flats.' The indigenous knowledge of an island varies, changes, and evolves on the basis of the environment surrounding the island. Ecological imagination can be employed in human studies regarding the cultural differences between the islands surrounded by sea and those surrounded by

tidal flats (Hong 2008).

A comparison of characteristics among Hong Kong, Hawaii, and many islands in the Mediterranean and Aegean Seas makes it amply evident that Korean islands are characterized by more than mere isolation (Fig. 2). Islands can generate unique cultures because of their isolation, but can also facilitate cultural exchanges through the sea. The examples of Easter Island, Hawaii, and the Galapagos make clear that the destinies of islands and humans are determined by the manner in which people utilize the resources of islands. To this end, serious discussions should be held with regard to the tasks that should be conducted in order to conserve the natural environment and land in the Dadohae area and make use of it sustainably. Recently, the Dadohae area in Shinan-gun has been listed as a UNESCO Biosphere Reserve. Korea is probably the only place remaining on Earth where people continue to collect organisms in tidal flats with their hands. The process of catching the common octopus referred to in Korea as *nakji* involves more than the simple collection of biological organisms (Lee et al. 2010). Rather, it is also a process via which the organic materials inside the tidal flats are mixed. In other words, it is a process that involves the heightening of the functional cycle of the ecosystem. In this regard, a concrete understanding of the coexistence of cultural diversity and biodiversity in island spaces can only be made possible by increased interdisciplinary communication, as well as a comprehensive research process.

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