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# Biogeographical Studies in Korea

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**Abstract** : In this paper, three general academic issues in Korean biogeographical studies were comprehensively reviewed: 1) relationship between environmental factors and plant distribution, 2) past vegetation and climate 3) interaction between humans and environment. Biogeography in Korea is poorly developed field and has been generally ignored by geographers in Korea. The future for biogeography in Korea however seems promising and Korean biogeographers have a great opportunity to develop their field. To attract more prospective graduate students into biogeography and train them would be very important for the gradual and persistent development of geographical biogeography in Korea.

**Key Words** : biogeographical studies, Korea, vegetation, humans, environment

**요약 :** 본 논문에서는 지금까지의 국내 생물지리학 연구를 세 분야로 구분하여 검토하였다: 1) 환경 인자와 식물 분포 간 관계, 2) 과거 식생과 기후, 3) 인간과 환경 간 상호작용. 과거 한국(국내) 지리학계에서 생물지리학은 중시되지 않았다. 이로 인해 현재 저변은 매우 얕은 실정이다. 그러나 생물지리학의 향후 전망은 나쁘지 않으며 앞으로 더욱 발전할 수 있는 가능성을 내재하고 있다. 국내에서 생물지리학을 점진적으로 꾸준하게 발전시키기 위해서는 보다 많은 학생들을 생물지리학 분야로 유도하는 것이 중요하다.

**주요어 :** 생물지리학 연구, 한국, 식생, 인간, 환경

## 1. Introduction

Biogeography is the study of past and present geographic distributions of species and is devided into two main fields of study: ecological biogeography and historical biogeography. Ecololgical biogeography studies the current relationships between organism and environment whereas historical biogeography does past distributions and the evolution of life. Recently, conservation biogeography which studies the protection and restoration of natural environments developed and became recognized for its importance.

In Korea, geomorphology has been a main field of physical geography for a long time so as to be considered entire physical geography until very recently. Biogeography in Korea is poorly developed field and has been largely ignored by geographers in Korea. Unfortunately, geography collegues are still confused between biogeography and ecology. Korean ecologists underestimate biogeographers pointing out their lack of training in the basic biological sciences. As a conse-

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quence, Korean geographers who identify themselves as biogeographers commonly feel isolated and insecure. Moreover, many prospective graduate students who are interested in physical geography, do not know what biogeography exactly is and feel unqualified to undertake advanced work in biogeography since their preparatory studies have been mainly in geomorphology.

Biogeography is a multidisciplinary study which seeks to describe geographic differences in plants and animals and explain them using various scientific methods. It is usually challenging to work with highly diverse group of scientists even though the strength of biogeography comes from its broad scope. Korean physical geographers who did not have confidence in multidisciplinary biogeographical research, hesitated to enlarge the academic territory of physical geography in the past.

These days, the number of Korean climatologists rapidly increases as global warming becomes a serious issue; whereas, biogeography still remains an unpopular field of geography and very few scholars call themselves as biogeographers. Nevertheless, it is highly possible that biogeography will soon occupy a fairly good position in Korean geographical society because multidisciplinary biogeographical research in the world doubtlessly plays an important role solving current global environmental problems such as loss of biodiversity and deforestation. The future for biogeography in Korea seems promising and Korean biogeographers have a great opportunity to develop their field.

Three general academic issues have been so far dealt with in Korean biogeographical studies: 1) relationship between environmental factors and plant distribution, 2) past vegetation and climate 3) interaction between humans and environment.

## 2. Relationship between environmental factors and plant distribution

The relationship between environmental factors and plant distribution is one of main issues in biogeographical studies. The importance of biogeography however has not been recognized by Korean geographers until recently. The study on plant distribution therefore was initially led by ecologists, who aimed dividing into number of different vegetation zones (Uyeki, 1933; Nakai, 1935; Chung and Lee, 1965; Lee and Yim, 1978) and relating the distribution of forest vegetation to climate parameters (Yim and Kira, 1975; 1976) in Korean peninsula.

Only a few geographers have been interested in the study of plant distribution. Kang(1978) may be the first Korean geographer dealing with vegetation zones. Kong (1984, 1985) found that the distributional range of Korean bamboos was determined by the January temperature. He also attempted to divide the Korean peninsula into eight vegetation regions (Kong, 1989) and describe characteristics of each (Kong, 1990). Chung and Kong (1984) studied the distribution of evergreen broadleaved trees in West Sea islands.

Highland areas have been the main target for biogeographical studies in Korea probably because other areas have been seriously affected by human beings. The study on the distribution of highland plants has been actively carried out, mostly by Kong (1998, 1999, 2000, 2002, 2005). For example, Kong (1998, 1999) examined horizontal and vertical distributions of eight highland species in Mt. Halla. Koo *et al*. (2001a) investigated geographic distributions of cold-hardy evergreen broadleaved plants and heat-hardy evergreen broadleaved plants in Korean peninsula. Also, Koo *et al*. (2001b), using tree-ring analysis, found that growth rates of Korean Fir in Mt. Halla continuously slowed

down due to current global warming.

Additionally, the distribution of gymnosperms in Korean peninsula was studied by Kong (1995, 2004, 2006). Kim and Yu (2009) recently investigated sand dune vegetation in the west coast and suggested that patterns of coastal dune vegetation were associated with soil conditions.

## 3. Past vegetation and climate - palynological studies

The reconstruction of past vegetation in Korea using pollen analysis has been carried out mainly by Ecologists and Geographers. Ecologists' influential papers include Yasuda *et al*. (1979), Fujiki and Yasuda (2005), Chang and Kim (1982), Choi *et al*. (2005), Jang *et al*. (2006), and Chung (2007). This chapter primarily focuses on reviewing geographers' palynological studies to infer the past vegetation and climate. Pollen records produced by geographers are mostly confined to the Holocene period although some attempted to reconstruct paleovegetation during the late Pleistocene (Yoon and Jo, 1997; Kim *et al*., 2012; Lee *et al*., 2006).

In Korea, the east coast where many lagoons are distributed has long been the target for paleoenvironmental studies due to scarcity of interior natural lakes. Jo (1979), the first Korean geographer who used a palynological approach, analyzed 30m long sediment core from Pohang on the east coast and reconstructed the history of vegetation since ca. 10,000 $^{14}$C BP. He also analyzed 2.7 m thick peat in Joomunjin to establish paleovegetational changes during late Holocene. After quite a while, Yoon *et al*. (2008) provided the information on the vegetation change since ~ 6000 cal yr BP examining fossil pollen in 6.7 m long sediment core from lake Gyeongpoho. Recently, Park *et al*. (in press(a)) analyzed 3.1 m long sediment core from lake Soonpogaeho and produced multiproxy data to infer paleovegetation and paleoclimate since ca. 8000 cal yr BP. Other geographical studies on the east coast using palynolgical method include Yoon (1998) and Yoon and Hwang (2010, 2011).

According to palynological data from the east coast, the importance of *Quercus* steadily decreased, but that of *Pinus* increased from ca. 7600 - 6000 cal yr BP, indicating that pines expanded their distribution as climate conditions became more and more unfavorable to mesic hardwood species. After 2000 cal yr BP, agricultural plants such as Poaceae and of disturbance indicators such as *Artemisia* and fern spores increased.

In the western part of Korea, geographers commonly used backswamp sediments for paleoenviornmental research. They have produced more than a few pollen data in the western part; for example, Pyeongtack (Hwang *et al*., 1997), Ilsan (Yoon, 1997), Asan (Park, 2010; Park and Jang, 2010), Cheonan (Park, 2004), Gwangju (Park and Kim, 2011). Their thin and discontinuous sediments however did not allow them to provide influential pollen records.

Instead, Choi *et al*. (2005) and Jang *et al*. (2006), Korean ecologists, provided continuous and well-dated records of vegetation change during the entire Holocene period. The vegetational history clearly reconstructed in these studies show that the importance of *Pinus* increased from ca. 6600 - 6000 cal yr BP in the western part of Korea.

In addition, quantitative reconstruction of paleotemperature was attempted using pollen-temperature transfer function (Park, 2011). Yoon *et al*. (2012) reconstructed isopollen maps using pollen records at 28 sites to infer Holocene vegetation and climate change. Recently, geographers used new paleoenvironmental proxy data such as phytolith (Yoon *et al*. 2009; Hwang *et al*., 2012), carbon isotope (Park and Park, 2011), and carbon isotope and C/N ratio (Park and Shin, 2010). Park *et al*. (in press (a), (b)), in their papers, empha-

sized the value of multiproxy data for accurate interpretations of pollen data.

Although paleovegetational and paleoenvironmental studies have been increasingly conducted by Korean geographers, many of them are unsastisfactory. In order to provide powerful information on the paleoenvironment, they should make more efforts to find undisturbed and thick sediments and raise accuracy and precision in sediment chronologies.

## 4. Interaction between humans and environment

Korean paleoenvironmental studies using proxy data have not sufficiently dealt with human activities but rather focused solely on climate and vegetation change. Korean scholars in human geography, however, have long been interested in the past human impact on the environment and the origin and spread of rice agriculture (Lee, 1963).

Yasuda *et al*. (1979)'s pollen studies of coastal sediments provided the first palynological records on the origin of agriculture of Korea. Korean geographers thereafter using pollen data estimated when crop agriculture began in Korea and suggested the diffusion routes of rice within Korean peninsula (Yoon, 1996; Yoon, 1998; Park, 2007). Agricultural disturbance, as indicated by pollen records, presumably began around 2200 $^{14}$C BP in Wolhamji, Buyeo (Chang and Kim, 1982), 2300 $^{14}$C BP in Bangeojin, Ulsan (Jo, 1979), 1900 $^{14}$C BP in Pohang (Jo, 1979), 2000 $^{14}$C BP in Hyangho and Gyungpoho, Gangneung (Fujiki and Yasuda, 2004; Yoon *et al*., 2008), 1800 $^{14}$C BP in Joomunjin and Unsan (Jo, 1979; Yoon, 1998), 1400 $^{14}$C BP in Youngrangho, Sokcho (Yasuda *et al*., 1979), and 1300 cal yr BP in Bongpo marsh, Gosung (Park *et al*., in press(b)). Ahn(2010), Korean archaeologist, based on archaeobotanical records, recently suggested that rice was introduced from the Liaodong region of China around 1300 BC. Despite archaeologists and geographers' much effort, the origins and diffusion routes of rice cultivation in Korean peninsula still remains ambiguous (Park, 2007). It has been generally believed that rice first arrived at central Korea, spread south and then east and north along the coastline.

It is also interesting that approximate start dates of rice agriculture on the east coast of Korea are widely different despite the absence of any geomorphic barrier to hinder the spread of rice cultivation along the coast (Yoon, 1998). Yoon *et al*. (2008) raised the possibility that the Youngrangho chronology could be wrong; whereas, Kim and Park (2011) explained this discrepancy on the basis that the pollen did not directly indicate the earliest date of rice cultivation and just represented the beginning of agricultural intensification. .

Many scientists are increasingly interested in the impact of past climate change on human beings and their responses due to the focus on recent global warming and its results. Various proxy data suggest that past climate changes have been powerful enough to determine the rise and fall of ancient dynasties in the world. Human responses to late-Holocene climate change such as the Little Ice Age may be one of the hottest research topics among Korean historians, archaeologists, and geographers. For example, Park *et al*. (in press(b))'s study recently demonstrated the impact of late-Holocene climate change on human beings and their responses in Korea.

## 5. Conclusion

Korean peninsula has a long history of human residence. Current human population is seriously dense. Natural vegetation is little left except several highland

areas and coastal areas. Most of all, the significance of biogeography has been ignored. As a consequence, the study of ecological biogeography has been little practiced. The number of its articles are much less than geomorphology or climatology.

It is also difficult to find sediment samples worthy of paleoenvironmental analysis in the Korean peninsula due to the scarcity of natural lakes and the severe human impact. Although several lake sediments from the coastal lagoons along the east coast have been investigated through palynological and other geophysical analyses, continuous reconstruction of the past vegetation and climate over last 20,000 years has never been successfully performed. Even lake sediments from lagoons just provide paleoenvironmental histories covering mid- to late- Holocene time since they were disturbed by late Quaternary sea level change.

Limitation in the study of human impact on paleoenvironment is the lack of sediment layers with information on recent environmental change. Low sedimentation rates and subsequent agricultural disturbance of the upper layers of sediment make it difficult to obtain proxy data showing the mutual interaction between humans and the environment during the late Holocene.

Indeed, appropriate sites for the biogeographical studies are seemingly difficult to find in Korea. A small group of enthusiastic Korean biogeographers, nevertheless, have slowly but steadily provided interesting and valuable academic information on the geography of plants. The review over previous Korean biogeographical studies in this paper clearly shows an impressive recent expansion of the biogeographical knowledge base.

Biogeography is relatively unknown in Korea and is still visualized as just a part of ecology even among geography colleagues, let alone other scientists. For the future development of biogeography in Korea, biogeographers should bear in mind that biogeography is always a branch of geography, not of ecology or other biological sciences and try to attract more prospective graduate students into biogeography and train them.

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