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Significance of "Pre-Study Post-Designation" Strategy in Natural Monument Designation System: With Special Reference to Geologic Heritage

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Abstract: Many problems in naming natural monuments have been repeatedly argued by many researchers, and four different types of naming problems were identified: 1) name of unknown nationality (natural monument no. 82 and 108), 2) morphological name rather than scientific name (natural monument no. 180, 295, and 409), 3) name of fable character (local cultural property of Changnyeonggun), and 4) scientifically wrong name (natural monument no. 413). Among them, two cases (case 3 and 4) using wrong names are found in natural monument of geologic heritages, which should be ascribable to a hasty designation without an accurate and thorough scientific research. In order to solve these problems and to establish an ideal policy in designating natural monument, National Research Institute of Cultural Heritage has been carrying out a research project of "Pre-study and Post-designation (PSPD)", especially targeting the rod-shaped stromatolite. It is likely that this new strategy of PSPD is a unique and the first step to solve many problems in designating and naming geologic heritages as natural monuments. As a consequence, we strongly suggest that PSPD system must be applied to natural monument designation as an institutional arrangement.

Keywords: designation system, geologic heritage, natural monument, Pre-study Post-designation (PSPD), rod-shaped stromatolite

Introduction

"Natural Monument" is a term first coined by the German natural scientist, Alexander von Humboldt in 1800, in order to evoke local peoples' (lived in a small village, Tormero, Venezuela) efforts to protect a big tree (local name Zamang del Guatre), *Albizia saman* (reviewed in Dahem, 1988; Yee, 2008). In 1906, the original German term "Naturdenkmler (Denkmler der Natur)" was translated by a Japanese researcher (Miyoshi Manabu) into 天然記念物 (natural monument), which was also applied to Korea (reviewed in Yee, 2008). A natural monument is now defined as "a natural or natural/cultural feature of outstanding or unique value because of its inherent rarity, representative of aesthetic qualities or cultural significance" (from European Environmental Agency Glossary).

Korean government (mainly by Cultural Heritage Administration) also put great efforts to protect natural monuments as national heritage. As a result, natural monuments are being managed under three categories including animal, plant, and geologic heritages (e.g., Lee at el., 2003; Yee, 2009). Fossils, rocks and minerals, natural caves, and general geology (e.g., geographical features and sedimentary structures) are those of geologic heritages designated as natural monument. Since Geummubong tree fern fossil site (natural monument no. 146), Woonpyeongri orbicular granite (natural monument no. 69), and Gimnyeong and Manjang caves (natural monument no. 98) were first designated in 1962, a total of 81 geologic heritages have been listed as Korean natural monument up to present.

In designating natural monuments in Korea, many problems have been raised repeatedly by several

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researchers, particularly in natural monument of plant (Kim, 1966; Choi and Kim, 2010). Problems in naming is the most serious and repeatedly raised subject with natural monuments. For example, Choi and Kim (2010) pointed out such problems in natural monument of plant using Dangsan forest and Bibo forest. Geologic heritage is no exception. Particularly, Kong and Lee (2009) suggested that Mungokri stromatolite (natural monument no. 413) needs to be renamed. Here in this paper, we discuss on naming problems in designating natural monument with special reference to geologic heritage. We also introduce a newly started strategy "Pre-study Post-designation (PSPD)" as an important test to solve these problems.

History of Designation and List of Natural Monument of Geologic Heritages

Importance of natural monument was first acknowledged since early 1800s in European countries, and thereafter a kind of "Law of natural monument protection" was established in several European countries (1803 in Germany, 1827 in France, 1843 in England). In early 1900s, European countries such as Denmark, Netherlands, and Sweden established "National Department of Natural Monument Protection", in an attempt to protect natural monuments under the government control (Matten, 1993; Yee, 2008). On the other hand, the first enforcement ordinance for natural monument protection in Korea was proclaimed in 1933 by Japanese government during the period of Japanese occupation. The first law established by Korean government is "Cultural Properties Protection Law (文化財 保護法)", which was enacted as law no. 961 in 1962. Unfortunately, most systems in this law was based on 1933's enforcement ordinance made by Japanese government, and a few of systems in terms of classification, standards and management of the natural monument have developed since that time (Choi and Kim, 2010).

Practical investigation for Korean's natural monument was first conducted by Japanese government in 1913 during Japanese occupation period, and a total of 25 old big trees was first listed as natural monuments. By 1945, Japanese government continued to add the list of plant, animal and geologic heritages (e.g., Yee, 2009). In 1962, these natural monuments listed by Japanese government became a first list of "Korean Natural Monument" under the control of Korean government. Woonpyeongri orbicular granite (natural monument no. 69), Gimnyeong and Manjang caves (natural monument no. 89), and Geummubong tree fern site (natural monument no. 146) became first Korean natural monuments of geologic heritage, because they were included in the Japanese list as geologic heritages.

As of June 2014, a total of 455 natural monuments have been listed: 100 of animals, 263 of plants, 81 of geologic heritages, and 11 of protected zone (Table 1). Since three natural monuments (no. 69, 98, 146) were first designated as geologic heritage on December 3, 1962, the number of natural monument of geologic heritage has been steadily increased. It is notable that sudden increase in the number of natural monuments has been experienced since the year 2000, making up 63% (51 out of 81 natural monuments of geologic heritage). Indeed, 3.4 geologic heritages per year have

Table 1. Classification and number of natural monuments, geologic heritage, and fossil sites

Natural monument	Plant	Animal	Geologic heritage	Protected zone
	263	100	**81**	11
Geologic Heritage	Fossils and Fossil sites	Rocks and Minerals	Caves	Geography and General geology
	23	6	18	34
Fossils or Fossil sites	dinosaurs	stromatolites	bivalves	others
	14	3	2	4

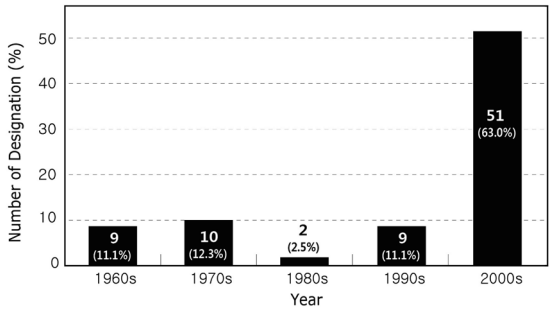

Fig. 1. Histogram showing designation number of natural monument of geologic heritage per every 10 years. Note that 63% of all the natural monuments has been designated since 2000.

been designated as natural monuments since that time (Fig. 1). This is mainly because national consensus to protect natural monuments had not been developed until the end of 1990s, due to Korean government's priority in industrialization and economic growth.

Natural monuments of fossils and/or fossil sites (23 out of 81 geologic heritages) are those of the most familiar geologic heritages, and particularly natural monuments related with fossil dinosaurs (14 out of 23 fossil related heritages) has been attracting public attentions (Table 1). Recently, stromatolites have also been gaining popular attractions because of their unique morphology and role in the formation of early Earth. Consequently, three sites related with stromatolites were designated as natural monument: "Mungokri stromatolite" in 2000 (natural monument no. 413), "Socheongdo stromatolite" in 2009 (natural monument no. 508) and "Gyeongsan stromatolite" in 2009 (natural monument no. 512).

Problems in Designating and Naming Geologic Heritages as Natural Monuments

Many problems in designating and naming Korean natural monuments have been repeatedly argued by many researchers, particularly in the case of natural monuments of plant (Yee, 2008; Choi and Kim, 2010) and geologic heritages (Kong and Lee, 2009). Using wrong name for natural monuments is one of the biggest problems repeatedly discussed, and four cases have been recognized: 1) name of unknown nationality (natural monument no. 82, 108), 2) morphological name rather than scientific name (natural monument no. 180, 295, 409), 3) name of fable character (local cultural asset of Changnyeong-gun), 4) scientifically wrong name (natural monument no. 413) (Table 2). Two cases (case 3 and 4 above) using wrong name are found in natural monument of geologic heritages, which must have been resulted from hasty designation without an accurate and through scientific investigation. A funny case seems to be "Munhojang footprint of Changnyeong-gun", because this name originated from a folktale in which Munhojang (門戶長, a character in the fable) left his footprint (Changnyeonggun, 2003). This footprint is now re-interpreted as dinosaurs footprints (Fig. 2A, B). The worst case is using a scientifically wrong name, two of which case are found in stromatolite: "Mungokri stromatolite, natural monument no. 413 (Fig. 2C, D)" and so-called RSS (rod-shaped stromatolite) that has been planned to be designated as a natural monument (Fig. 2E, F).

Stromatolite as an organo-sedimentary structure is not easy to be defined in a simple and clear sentence, and thus slightly different definitions are still used by scientists of different field (Semikhatov et al., 1979; Krumbein, 1983; Golubic, 1991; Kong and Lee, 2009). This is partly due to morphological complexity of stromatolites, ranging from columns, domes to stratiform stromatolites with diverse fine lamination. A morphological similarity to other sedimentary structures makes more difficult in identifying stromatolites in the field. In deed, more than six sedimentary structures have been reported to show similarity with stromatolite in gross morphology and even internal structures: calcrete (Wright, 1989), leothem (Thrailkill, 1976), geyserite (Jones et al., 1997), tufa (Pedly, 2000), travertine (Ford and Pedly, 1996), sinter (Jones et al., 1998). Consequently, it is not easy for laymen or even geologists to identify stromatolite-looking structures found in the field as stromatolites. This is a main reason why natural monument no. 413 was named as Mungokri stromatolite.

Fig. 2. Photographs of geologic heritages with name problems. (A) protected zone of Munhojand footprints within which re-interpreted dinosaurs' footprints (B) are clearly visible, (C) information board and outcrops (D) of Mungokri stromatolite, (E) Seonjeonri site where rod-shaped stromatolites occur forming a thick and massive bed, as isolated specimens along the bedding plane (F).

Mungokri stromatolite (together with desiccation structures) was designated as a natural monument no. 413 in 2000. It, indeed, resembles stromatolite in an external morphology mimicking LLH (laterally-linked hemispheroid) stromatolites, in which each dome is laterally connected forming Mungokri stromatolite bed (Fig. 2D). A careful re-investigation, however, revealed that any external and internal structures indicating stromatolites were not found in these structures (Kong and Lee, 2009). Particularly, no laminated structures (a diagnostic character in all stromatolites), were observed both in the field and through petrological thin sections. Any sedimentary structures without fine lamination (or even vestige of laminated structures) cannot be called stromatolite, simply by definition of stromatolite. Based on such observations, Kong and Lee (2009) suggested that natural monument no. 413 should be renamed.

A similar problem in naming is presented in elongated carbonate structures found in the Jinju Formation, Gyeongsang Basin. The structures have long been known as a so-called "rod-shaped stromatolite (RSS)" (Lee and Woo, 1996; Lee and Kong, 2004). In 2000, Seonjeonri site of Sacheon City where RSSs are found as a massive bed was suggested to be designated as a natural monument by cultural heritage committees under the name of rod-shaped stromatolite (Fig. 2E). Internal structures of RSS are, indeed,

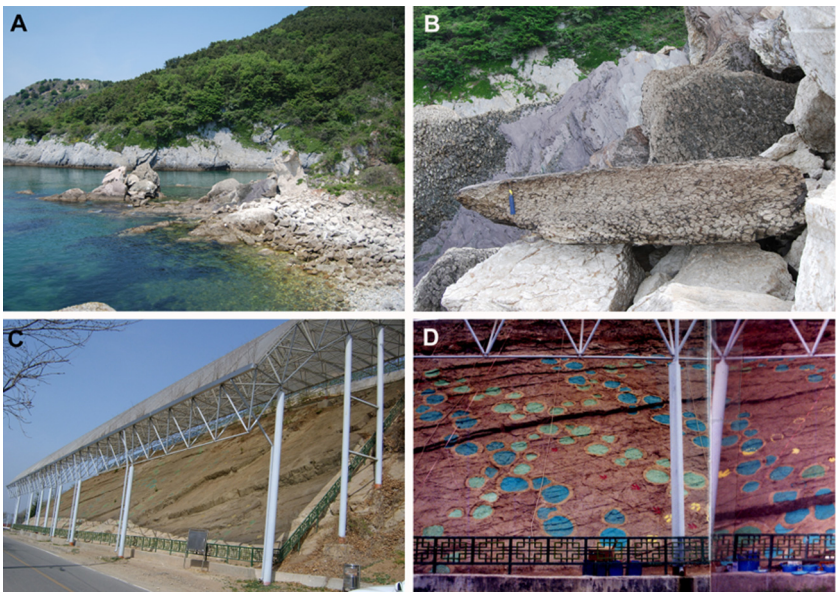

Fig. 3. Photographs showing current states of natural monument no. 508 (A, B) and 373 (C, D). Socheong stromatolites have never been protected, and thus broken pieces of stromatolite beds (B) are scattered along the coast of Socheong Island. Jaeori dinosaur footprints were recently restored with coloured paints (D).

characterized by stromatolitic fine lamination within which the structure-building microfossils are also identified. Thin section study of the structures even documented that the external carbonate coating of RSS formed through the same mechanism as a growth of stromatolite (Lee and Kong, 2004).

This structure, however, cannot be called a stromatolite, even though such characters may suggest a kind of justification in giving a name of rod-shaped "stromatolite" to these elongated structures. This is simply because a widely acknowledged definition of stromatolite is only applied to "accretionary structures away from a point or limited surface of initiation" (Semikhatov et al., 1797, p. 992). In order words, stromatolites are sedimentary structures that grow upward from water/sediment interfaces, finally forming reef-like structures. On the other hand, RSSs occur as isolated or aggregated specimens along the bedding plane (Fig. 2F), and internal structures of RSS are characterized by a typical ooid-like concentric lamination. This means that they formed through growth mechanisms of coated grains like an oncoid, which is different from that of stromatolites. RSS, therefore, cannot be regarded as stromatolites. They were interpreted as carbonate encrustations over plant twigs submerged in waters, which formed through concentric carbonate precipitation by epiphytic micro-organisms growing on the surface of plant twigs (Lee and Kong, 2004; Lee et al., 2014). Sporadical occurrences of RSS specimens showing original branched twigs (Lee and Kong, 2004) and preservation of plant tissues within the RSS strongly support this interpretation.

"Pre-study Post-designation" Strategy in Natural Monument Designation System

It is evident that many problems in designating natural monuments have been resulted from a current designation system, which is characterized by pre-designation before conducting an academic research. Simply speaking, a current system in natural monument designation follows "Pre-designation and Post-study (PDPS)". Upon a request of designation by authorized government agencies, Cultural Heritage Administration summons a cultural heritage committee, and then

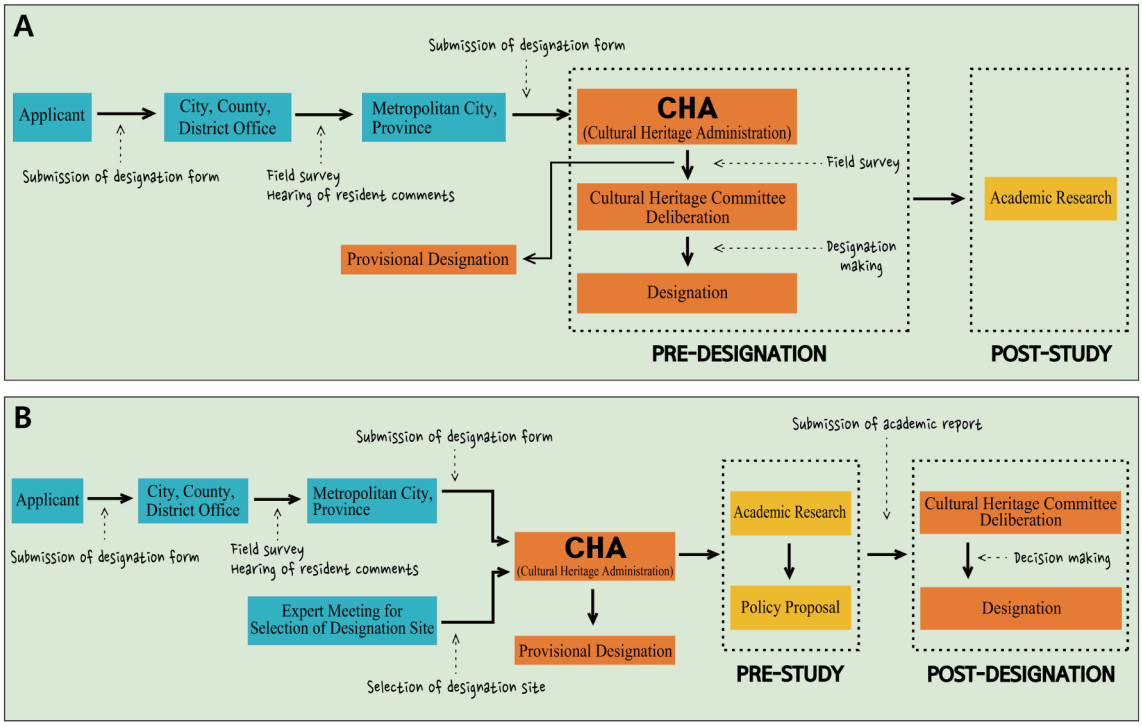

Fig. 4. Flow chart of natural monument designation system. (A) current designation system (Pre-designation and Post-study, PDPS), (B) newly suggested system (Pre-study and Post-designation, PSPD).

decisions are made through deliberation of cultural heritage committee after field investigation (Fig. 4A). Academic researches in the current system, if any, are carried out after designation. It is possible for "Post-study" to recognize problems in naming and to suggest a new name for the natural monument. However, it takes long time and costs much money to emend the name. For example, although renaming of Mungokri stromatolites was suggested in 2009, a scientifically wrong name for the monument is still used (Table 2). An additional cost (for guidebooks, information boards, road signs, and so on), if changed, will be necessary. Again, it is reality that "Pre-designation" is followed by "Post-study", which tends to yield many problems in designation natural monument.

In order to solve these problems and to establish an ideal policy in designating natural monument, National Research Institute of Cultural Heritage has been carrying out a test research of "Pre-study and Post-designation (PSPD)" from 2012, specially targeting rod-shaped stromatolite. This new strategy of "PSPD" can, at least, reduce such mistakes, if carried out by an expert or a group of experts. According to this strategy suggested in this paper (Fig. 4B), Cultural Heritage Administration, when requested to designate a natural monument, conducts a academic research before deliberation of cultural heritage committee. Then, cultural heritage committee is summoned to make a decision on the basis of the report carried out by "Pre-study". Before conducting the academic research, Cultural Heritage Administration may designate it temporarily, if necessary, in order to protect the monument. A final report of PSPD research should include at least four points: 1) evaluation of value as natural monument, 2) appropriate name of natural monument, 3) designation range of natural monument, and finally 4) protection policy and conservation method.

Suggestion of protection policy is also important for geologic heritages because they tend to be damaged

Table 2. Category and list of natural monuments with name problems

Category	Number of natural monument and current name	Remarks
Scientifically wrong name	• Natural Monument No. 413 Mungok-ri stromatolite, Yeongwol	naming problem suggested in 2004, but still used
Name of unknown nationality	• Natural Monument No. 82 Forest of Hackberry and Yeddo Hornbeam in Cheongcheon-ri, Muan • Natural Monument No. 108 Forest of Saw-leaf Zelkova, Hackberry, and Yeddo Hornbeam in Hyanggyo-ri, Hampyeong	Renamed and CHA accepted a new name in 2008
Mophological name	• Natural Monument No. 180 Weeping Pine Tree of Unmunsa Temple, Cheongdo • Natural Monument No. 295 Weeping Pine Tree of Dongsan-ri, Cheongdo • Natural Monument No. 409 Weeping Pine Tree of Haenggok-ri, Uljin	Repeatedly argued but still used
Name of fable character	• Local cultural properties of Changnyeonggun Footprints of Munhojang, Changnyeong	Re-interpreted as dinosaurs' footprints, but still used

and/or destroyed more easily by weathering, and because it is almost impossible to restore original shape and condition of the geologic heritage when damaged or destroyed. For example, Socheongdo stromatolites (natural monument no. 508), the oldest fossil record in South Korea, has been left in the field without any protection policy since 2009, the year of designation. Consequently, most of the stromatolite beds were broken and pieces of broken stromatolite beds were scattered along the coast of Socheong Island (Fig. 3A, B). Jaeori site of dinosaurs' footprint (natural monument no. 373) is another example, clearly documenting why late restoration (actually too late in this case) is useless (Fig. 3C, D). The dinosaurs' footprints were too vague to be restored into an original shape; restoration of the footprints were accomplished during two years (2012-2013), twenty years after designation, but the restored morphology looks very ugly (Fig. 3D).

On the other hand, it is not easy task to give a scientifically right name to natural monument although a research team of PDPS recognized that a wrong scientific name was given to the natural monument (e.g., natural monument no. 413, Kong and Lee, 2009). This is particularly true in the case of geologic heritage (specially fossil case) because the geological society of Korea lacks specialists as compared with the number of subjects related with geologic heritage. It is equally tough to give a new and substitutable name, particularly to a natural monument that a pre-defined general term does not exist. The rod-shaped stromatolite is the case (Fig. 2E, F). The structures are those of frequently encountered carbonate precipitates in a modern travertine-depositing water system (Lee at al., 2014, in this volume). They occur, in general, as isolated or fused sediments within a massive travertine or tufa, and thus no specific name has been given to the precipitates. Rather, a simple descriptive term has been used, for example, encrusted twigs or carbonate encrustations on plant twigs (Lee and Kong, 2004; Lee et al., 2014).

In this respect, a test research team of PSPD for rod-shaped stromatolite is trying to select a new term for RSS. Several candidates have been throughly discussed: elongated oncoid, stromatolitic rod, rod-shaped stromatolitic carbonate, and cylindrostrom (suggested by Stjepko Golubic, professor of Boston University). A new term should be not only scientifically right, but also simple and clear word easily understandable for even non-specialists. Therefore, a new term for RSS cannot be selected by a few specialists themselves, but should be decided through a series of advisory conference. We believe that this kind of procedure of PSPD is a unique and first step to solve many problems in designating and naming geologic heritages as natural monuments. Finally we

hope that PSPD system as an institutional arrangement would be applied to natural monument designation system.

Summary

Since 1962 when natural monuments no. 69, 98 and 146 were first designated as geologic heritages by Korean government, the number of natural monument of geologic heritage has been steadily increased and a total of 81 geologic heritages have been listed as Korean natural monuments up to present. 51 cases out of 81 (63% of natural monument of geologic heritage) are those designated since the year 2000. Fossils or fossil sites (23 out of 81) are most dominant among the geologic heritage, and 14 dinosaur and 3 stromatolite related heritages are in the fossil list of natural monument.

Several problems in naming geologic heritage and in protection policy were recognized, particularly from natural monument no. 413 (Mungokri stromatolite) and from rod-shaped stromatolite recently suggested to be designated as natural monument. These problems must have been resulted from a current designation system, characterized by a hasty designation without an accurate and through scientific investigation. These problems will be solved through a strategy of "PSPD", which was suggested here and was recently applied to a test research of rod-shaped stromatolite. This new strategy of "PSPD" can, at least, reduce such mistakes, if carried out by an expert or a group of experts. A final report of PSPD research should include at least four points: 1) evaluation of value as natural monument, 2) appropriate name of natural monument, 3) designation range of natural monument, and finally 4) protection policy and conservation method. We believe that this kind of procedure of PSPD is a unique and first step to solve many problems in designating and naming geologic heritages as natural monuments. Finally we hope that PSPD system as an institutional arrangement would be applied to natural monument designation system.

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