

## A Study of Utilization Patterns of Nuts and Nut-yielding Trees from the Neolithic Times through the Three Kingdoms Period in Korea Based on Plant Remains

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### Introduction

Various types of plant remains, including seeds, wood, pollen, and phytoliths, have been recovered from archaeological sites in South Korea, which have increased in number since the 1990s following a number of development projects. Even so, the results of the analyses of these plant remains typically have been published only in the excavation reports for the respective sites from which the remains were obtained. Because of these publications' dispersed nature, archaeologists have tended to overlook this significant body of data. In order to remedy this, the author has attempted to highlight the importance of this body of data by compiling analytical results published in excavation reports or in individual articles (Ahn Sung-Mo 2008). The present paper examines results from the analyses of pollen and macro plant remains (e.g., seeds, wood) in order to consider the evolving nature of the utilization of nuts and nut-yielding trees from the Neolithic times through the Three Kingdoms period when ancient states came to be established on the Korean Peninsula.

### Analyses of Seeds

Table 1 presents the number of sites and archaeological features that have yielded nut remains. Acorns occur in all Neolithic and Bronze Age sites where nut remains have been reported. However, the percentage of nut-yielding sites featuring acorns shows a marked decline to 19.2% for the Proto-Three Kingdoms and Three Kingdoms periods (1st century BCE–668). At the same time, chestnuts, which have not been reported in excavations at Neolithic or Bronze Age sites, were present at 73.1% of nut-

yielding sites from the Proto-Three Kingdoms and Three Kingdoms periods, comprising an overwhelming majority. A marked increase in the ubiquity of Manchurian walnuts can also be observed during the Proto-Three Kingdoms and Three Kingdoms periods, which is due to the high frequency of Manchurian walnuts observed at Jungdo-style pottery (中島式土器) sites in Gangwon-do Province. Other types of edible nuts, such as pine nuts, hazelnuts, and water chestnuts, do appear in archaeological contexts from the Proto-Three Kingdoms period, but their numbers are severely limited. Considering the ubiquity of acorns amongst all sites yielding crop remains (including fruits and seeds), it can be clearly observed that the ubiquity of acorns decreased significantly during the Bronze Age as farming emerged as the predominant subsistence strategy—an important point to note, as acorns had been an important component of the Neolithic diet. Even so, the acorn storage pit identified at Yongsan-ri in Hampyeong, Jeollanam-do Province demonstrates that acorns continued to be consumed during the Three Kingdoms period. Historical records from the Goryeo (高麗, 918–1392) and Joseon (朝鮮, 1392–1910) dynasties also mention the utilization of acorns. In these later eras, however, acorns tended to be used more as an emergency food source for famine relief rather than as a primary source of sustenance.

Chestnuts appear to have first been used as grave offerings at tombs of the Lelang Commandery (樂浪郡) in Pyeongyang. Apparently influenced by this practice, chestnuts were buried in Daho-ri Tomb 1 in Changwon, Gyeongsangnam-do Province, which dates to the late first century BCE. However, the earliest example of chestnuts identified at a settlement site dates to after the third century CE. Chestnuts are mainly reported at sites in Jeollanam-do Prov-

| Period  | Nuts | Acorns     | Chestnuts  | Manchurian walnuts | Pine nuts | Hazelnuts | Water chestnuts | Total number of sites and features |
|---|------|------------|------------|--------------------|-----------|-----------|-----------------|------------------------------------|
| Neolithic Age (Sites)                                   |      | 25 (100%)  | 0          | 4 (16%)            | 0         | 0         | 0               | 25                                 |
| Neolithic Age (Features)                                |      | 48 (94.1%) | 0          | 5 (9.8%)           | 0         | 0         | 0               | 51                                 |
| Bronze Age (Sites)                                      |      | 5 (100%)   | 0          | 1 (20%)            | 0         | 0         | 0               | 5                                  |
| Bronze Age (Features)                                   |      | 5 (100%)   | 0          | 1 (20%)            | 0         | 0         | 0               | 5                                  |
| Proto-Three Kingdoms & Three Kingdoms period (Sites)    |      | 5 (19.2%)  | 19 (73.1%) | 9 (34.6%)          | 2         | 2         | 2               | 26                                 |
| Proto-Three Kingdoms & Three Kingdoms period (Features) |      | 5 (17.2%)  | 19 (65.5%) | 11 (37.9%)         | 2         | 2         | 2               | 29                                 |

Table 1. Number of nut-yielding sites and features per period

ince. Interestingly, this corresponds to passages in Chinese historical texts that mention large chestnuts produced in the territory of Mahan confederacy (馬韓). Chestnuts from Baekje (百濟) and Mahan lands were renowned throughout ancient China. For example, it was recorded in both the *Sanguozhi weizhi dongyizhuan* (三國志 魏志 東夷傳, *The Book of the Three Kingdoms, Weizhi: Biography of the Eastern Barbarians*) (“出大栗 大如梨”) and *Houhanshu dongyilizhuan* (後漢書 東夷列傳, *The Book of the Later Han: Biography of the Eastern Barbarians*) (“出大栗如梨”) that the chestnuts cultivated in Mahan were as large as pears. This accords with the fact that chestnuts are abundant in the archaeological contexts from the Mahan region dating to the third century CE. The sizable chestnuts produced in Baekje are mentioned in the *Suishu dongyilizhuan* (隋書 東夷列傳, *The Book of the Sui Dynasty: Biography of the Eastern Barbarians*) (“有巨栗”) and *Beishi liezhuan* (北史 列傳, *History of the Northern Dynasties: Biography*) (“有巨栗, 其五穀, 雜果”). Among the ancient kingdoms of the Korean Peninsula, Mahan and Baekje, in particular, are recorded as producers of large chestnuts. Chestnuts have been reported at some sites located within the territory of Gaya confederacy (加耶), but they are not observed in the central or northern regions of the Korean Peninsula, apart from the area of the Lelang Commandery. This finding that acorns were the representative nut type of the Neolithic and Bronze Age, and chestnuts—particularly in the Mahan and Baekje regions—were the representative nut type of the Proto-Three Kingdoms period onward accords with the results of wood-species analyses, which are examined in the following section.

### Wood-Species Analyses

Deciduous species accounted for approximately 90% of specimens observed in finds of charcoal in Neolithic and Bronze Age dwelling sites, with oak (*Quercus* sp.) ranking as the most abundant species (Table 3). The charcoal specimens obtained from dwelling sites were mainly derived from building materials or fuel. During the Bronze Age oak continued to be utilized for such building materials as posts and rafter beams, even after cultivated crops came to replace acorns as a key component of the prehistoric diet. Oak is a hardwood known to be durable and resistant to decay. As such, it was used mainly in situations for which the durability of the wood involved would be important, as in buildings or furniture, for example. Wood from the sawtooth oak (*Quercus acutissima*) tree was also used to make charcoal for fuel.

Chestnut wood has been reported at only one Neolithic site (Bibong-ri). Chestnut wood specimens were identified from eleven of the 61 Bronze Age sites from which wood specimens were obtained. Of these eleven, five were located in the southern Chungcheong region, one in the Jeolla region, and five in the Gyeongsang region. None of the Bronze Age sites in the central region of the Korean Peninsula have yielded remains of chestnut wood, however, which suggests that neither chestnuts nor chestnut wood were of great importance to the Bronze Age communities in this area. The ubiquity of other types of wood from nut-yielding trees except oak is also extremely limited in the Bronze Age.

The Proto-Three Kingdoms period witnessed a significant change in the types of wood that were utilized, particularly in terms of oak and chestnut. Among the 58 sites from which wood specimens were obtained, oak was observed at 52 (89.7%).

| Province          | Number of sites | Quercus (Oak) | Castanea (Chestnut) | Pinus (Pine) | Other      |
|-------------------|-----------------|---------------|---------------------|--------------|------------|
| Gangwon-do        | 2               | 2             | 0                   | 0            | 0          |
| Gyeonggi-do       | 6               | 6             | 0                   | 0            | 0          |
| Chungcheongnam-do | 9               | 5             | 1                   | 3            | 0          |
| Jeollabuk-do      | 2               | 0             | 1                   | 0            | 1 (Cherry) |
| Jeollanam-do      | 12              | 4             | 8                   | 0            | 0          |
| Gyeongsangnam-do  | 10              | 7             | 3                   | 0            | 0          |
| Gyeongsangbuk-do  | 4               | 3             | 0                   | 0            | 1 (Elm)    |
| Total             | 45              | 27            | 13                  | 3            | 2          |

Table 2. Wood species demonstrating a widespread presence at Proto-Three Kingdoms and Three Kingdoms period sites yielding more than ten wood specimens

Chestnut wood was observed at 37 sites (63.8%), making it the second-most ubiquitous wood species, ahead of pine and alder wood. A similar result can be identified when wood-species analyses are restricted to sites that have yielded more than ten specimens (Table 2). Therefore, it is possible to confirm that oak and chestnut were the species most widely used as building materials in Korea's ancient communities. It should be noted, however, that the degree of utilization of chestnut wood differed from region to region.

The regional differences in the utilization of oak and pine wood can be observed in Table 2. Oak accounts for more than 80% of all wood specimens from the sites of Donghwa-ri in Wonju and Hahwagye-ri in Hongcheon, both in Gangwon-do Province. However, chestnut was not the dominant species at any of the sites, with only a single specimen being reported from the site of Samok-ri in Yeongwol. No instances of Manchurian walnut wood have been reported. Given that cultural links have been proposed between the "Jungdo-style pottery" culture and the cultures of the Dumangang River (豆滿江, also spelled Tumen River) region and Russian Primorye, it is possible that the communities of the time did not actively utilize chestnuts and chestnut wood since it was an unfamiliar species better adapted to warmer climates.

The proportion of oak wood was found to be extremely high and chestnut wood was found to be nearly absent among the wood specimens obtained from the Proto-Three Kingdoms-period sites of Gyeonggi-do Province, which is similar to the situation observed in Gangwon-do Province. By contrast, the utilization of chestnut wood appears to have in-

creased significantly at Baekje sites from the fourth century onward, with chestnut accounting for more than 50% of all wood specimens obtained from Baekje dwelling sites at the Gian-ri site in Hwaseong. Pollen analyses undertaken at the Gasu-dong site in Osan reveal that oak was the dominant species, whereas the ubiquity of chestnut pollen was low. However, based on an analysis of wood specimens from irrigation facilities constructed during the Silla (新羅) period, oak and chestnut appear to have been utilized to a similar degree.

Analyses reveal that chestnut wood was widely and intensively utilized in the Mahan region, which accords with the results of seed analyses. In Chungcheongnam-do Province, the overall percentage of oak wood decreases from the third century onward, whereas that of chestnut and pine wood increases. At five of the nine sites in this region, oak continued to be the dominant species, but the actual percentage of oak among the wood specimens analyzed was found to range between 33% and 55%. In the case of the Natmeori site in Seosan, all of the wood specimens from fourth- and fifth-century dwelling sites were composed of chestnut wood. In addition, chestnut wood accounted for more than 20% of the specimens at the Galmeo-ri site in Asan, as well as at the sites of Gajwa and East Naseong in Buyeo. However, it is in Jeollanam-do Province that the presence of chestnuts and chestnut wood is most widely observed. Of the twelve sites from which wood specimens were collected, chestnut was found to be the dominant species at eight, with oak being the dominant species at the other four. It can be observed that oak wood continued to predominate, whereas chestnut wood was rare at such sites as Sinchang-dong in Gwangju and Joseong-ri in Boseong, which date to the beginning of the first century CE. Therefore, it can be proposed that chestnut trees were deliberately cultivated and intensively utilized beginning in the third century by the Mahan communities residing in the Jeolla region, an area that afforded a favorable environment for this species. The cultivation of chestnut trees later spread to regions north of the Geumgang River (錦江), and the utilization of chestnuts continued into the Baekje period.

It is highly likely that the communities in Byeonhan (弁韓) and Gaya, which were the eastern neighbors of the Mahan and Baekje populations, also cultivated chestnut trees. The Gyeongsang region features

the second highest number of sites where chestnuts have been reported (after the Jeolla region). Within this region, chestnuts have been observed at seven sites dating to the Proto-Three Kingdoms and Three Kingdoms periods, whereas acorns were reported from only one site, Seongsansanseong Mountain Fortress (城山山城) in Haman, Gyeongsangnam-do Province. Most of the acorn-yielding sites are located within the Gaya cultural sphere. In Gyeongsangnam-do Province, oak wood was found to be the dominant species at seven of the ten sites. Oak wood was the dominant species at the fifth-to-sixth-century Pyeonggeo-dong site in Jinju, where it comprises 62.3% percent of the specimens. However, in the case of other sites where oak wood was also the dominant species, the actual proportion of oak specimens is somewhat low (see Table 3). Chestnut wood was found to represent roughly half of the analyzed specimens, making it the resoundingly dominant species at these sites. At the sites of Bonghwang-dong in Gimhae and Songhyeon-dong Tomb 7 in Changnyeong, the percentage of chestnut wood among the specimens analyzed was the second highest behind oak. At the site of Daho-ri in Changwon, which dates to the beginning of the first century CE, chestnuts were excavated from Tomb 1, but the wooden coffin was made primarily of oak wood (with chestnut wood being entirely absent). In the case of the wood specimens from the peat layer at this site, oak again was dominant and only two specimens were found to be of chestnut. Therefore, it appears that while chestnuts began to be placed as burial offerings from an early period, a result of the influence of Han (漢) Chinese culture (likely transmitted via the Lelang Commandery, as mentioned above), the deliberate cultivation of chestnut trees took place only from the third century onward, as was the case in the Jeolla region. In fact, chestnut wood may have been the preferred type of wood for beams in the pile buildings at the sites of Gwandong-ri in Gimhae, Singang-ri in Changwon, and Ga-dong in Busan. This may be because the cultivation of chestnut trees made it easier to obtain such material for wooden posts.

In contrast to the situation in Gaya, the nature of chestnut utilization in the central territory of Silla is unclear. Oak is the predominant species among the charcoal specimens obtained from three settlement sites dating to the fifth-to-sixth century, located respectively in Daegu, Pohang, and Ulsan; other

species of nut trees, such as chestnut trees, have not been reported. Chestnut wood accounts for 3.9% of the worked wood specimens and 6.5% of the natural wood specimens obtained from the Three Kingdoms-period irrigation facilities in Chilgok Area 1—an insignificant amount, making it unlikely that chestnut wood was a deliberately sought-after material. Species analysis was undertaken on worked wood recovered from the Wolseong Moat (月城垓子; Three Kingdoms period) and Anapji Pond (雁鴨池, more formally known as Wolji Pond [月池]; Unified Silla period) in the Silla capital of Gyeongju. In the case of Wolseong Moat, oak was identified as the predominant species (48.8%), followed by pine (29%), and chestnut (13%). In the case of Anapji Pond, pine was identified as the predominant species (58.1%), followed by oak (14.8%) and chestnut (10.1%). The fact that the number of mulberry trees, pine-nut trees, and Manchurian walnut (or walnut; 栲子木) trees per village was recorded in a Silla village register (新羅帳籍) discovered in the Shōsō-in Repository (正倉院) at Tōdai-ji Temple (東大寺) in Nara, Japan, indicates that these trees were cultivated for economic purposes. However, this record includes no mention of chestnut trees (Wi Eunsuk 1998, 255-256).

Proto-Three Kingdoms-period sites in the central region of the Korean Peninsula, particularly those from the "Jungdo-style pottery" cultural sphere, have not yielded any evidence of an increase in the utilization of chestnuts or chestnut wood. This is similar to the situation at the Goguryeo (高句麗) sites in Gyeonggi-do Province. However, the *Hanshu dilizhi* (漢書地理志, *Book of Han: Treatise on Geography*) contains a record of chestnuts growing in the region of the Lelang Commandery. In addition, chestnut wood has been identified in the remains of the wooden cist tombs in the Pyeongyang area, as well as in the remains of a bridge dating to the Goguryeo period. As the results of analyses on seed remains and wood species have yet to be formally reported for sites in North Korea, it is difficult to assess the nature of chestnut tree cultivation in this area.

Chestnut wood contains tannin, which resists water and retards rot. However, as it is difficult to cut, dry, and work, chestnut wood is used mainly as construction material for posts or foundations. The nut-bearing productivity of chestnut trees declines after several decades, requiring periodic renewal. This may explain why chestnut trees were intensively used

| Site name      | Region            | Period           | Context<br>(Number of samples) | Pinus<br>(Pine) | Quercus<br>(Oak) | Castanea<br>(Chestnut) | Juglans<br>(Walnut) | Alnus<br>(Alder) | Etc. |
|----------------|-------------------|------------------|--------------------------------|-----------------|------------------|------------------------|---------------------|------------------|------|
| Songsan        | Gyeonggi-do       | Neolithic        | Hearth (12)                    | 7               | 0                | 0                      | 0                   | 0                | 5    |
| Neunggok-dong  | Gyeonggi-do       | Neolithic        | Dwelling (31)                  | 0               | 23               | 0                      | 0                   | 3                | 5    |
| Hwajeon        | Gwangju           | Neolithic        | Wetland (64)                   | 0               | 44               | 0                      | 0                   | 7                | 13   |
| Bibong-ri      | Gyeongsangnam-do  | Neolithic        | Storage pit (16)               | 4               | 8                | 1                      | 1                   | 0                | 2    |
| Sangchon-ri    | Gyeongsangnam-do  | Neolithic        | Feature (10)                   | 1               | 7                | 0                      | 0                   | 0                | 2    |
| Pyeonggeo-dong | Gyeongsangnam-do  | Neolithic        | Feature (85)                   | 0               | 81               | 0                      | 0                   | 0                | 4    |
| Yongam-ri      | Gangwon-do        | Late Bronze Age  | Dwelling (11)                  | 0               | 8                | 0                      | 0                   | 0                | 3    |
| Donghwa-ri     | Gangwon-do        | Early Bronze Age | Dwelling (19)                  | 0               | 18               | 0                      | 0                   | 0                | 1    |
| Neunggok-dong  | Gyeonggi-do       | Early Bronze Age | Dwelling (11)                  | 0               | 11               | 0                      | 0                   | 0                | 1    |
| Hyeonhwa-ri    | Gyeonggi-do       | Early Bronze Age | Dwelling (741)                 | 3               | 724              | 0                      | 0                   | 14               | 0    |
| Banje-ri       | Gyeonggi-do       | Bronze Age       | Dwelling (16)                  | 0               | 16               | 0                      | 0                   | 0                | 0    |
| Wondang-dong   | Incheon           | Bronze Age       | Dwelling (88)                  | 0               | 78               | 0                      | 0                   | 2                | 8    |
| Gojaemigol     | Chungcheongnam-do | Early Bronze Age | Dwelling (15)                  | 0               | 12               | 1                      | 0                   | 0                | 3    |
| Gojaemigol     | Chungcheongnam-do | Late Bronze Age  | Dwelling (21)                  | 0               | 20               | 0                      | 0                   | 0                | 1    |
| Dujeong-ri     | Chungcheongnam-do | Early Bronze Age | Dwelling (25)                  | 0               | 24               | 0                      | 0                   | 0                | 1    |
| Wunjeon-ri     | Chungcheongnam-do | Early Bronze Age | Dwelling (1672)                | 0               | 1,642            | 0                      | 12                  | 0                | 18   |
| Gungpyeong-ri  | Chungcheongnam-do | Late Bronze Age  | Hearth, pit (66)               | 3               | 53               | 0                      | 0                   | 0                | 10   |
| Songguk-ri     | Chungcheongnam-do | Late Bronze Age  | Dwelling (63)                  | 28              | 30               | 0                      | 0                   | 2                | 3    |
| Okbuk-ri       | Chungcheongnam-do | Late Bronze Age  | Kiln (19)                      | 0               | 12               | 7                      | 0                   | 0                | 0    |
| Neunggang-ri   | Chungcheongbuk-do | Early Bronze Age | Dwelling (12)                  | 1               | 5                | 0                      | 0                   | 0                | 6    |
| Jangdae-ri     | Chungcheongbuk-do | Late Bronze Age  | Water channel (132)            | 0               | 103              | 9                      | 1                   | 6                | 11   |
| Hyoja-dong     | Jeollabuk-do      | Late Bronze Age  | Dwelling (15)                  | 6               | 3                | 6                      | 0                   | 0                | 0    |
| Dongrim-dong   | Gwangju           | Early Bronze Age | Swamp (17)                     | 0               | 7                | 0                      | 0                   | 5                | 5    |
| Yonggang-dong  | Gyeongsangbuk-do  | Early Bronze Age | Dwelling (12)                  | 0               | 8                | 0                      | 0                   | 0                | 4    |
| Daeryun-ri     | Gyeongsangbuk-do  | Early Bronze Age | Dwelling (41)                  | 0               | 41               | 0                      | 0                   | 0                | 0    |
| Chogok-ri      | Gyeongsangbuk-do  | Early Bronze Age | Dwelling (11)                  | 1               | 10               | 0                      | 0                   | 0                | 0    |
| Deokcheon-ri   | Gyeongsangbuk-do  | Early Bronze Age | Dwelling (11)                  | 1               | 9                | 0                      | 0                   | 0                | 1    |
| Jigok-dong     | Gyeongsangbuk-do  | Late Bronze Age  | Dwelling (168)                 | 0               | 168              | 0                      | 0                   | 0                | 0    |
| Munsan-ri      | Gyeongsangbuk-do  | Late Bronze Age  | Dwelling (11)                  | 0               | 9                | 0                      | 0                   | 0                | 2    |
| Oegwang-ri     | Gyeongsangbuk-do  | Late Bronze Age  | Dwelling (23)                  | 0               | 11               | 0                      | 0                   | 0                | 12   |
| Maecheon-dong  | Daegu             | Early Bronze Age | River channel (25)             | 7               | 15               | 0                      | 0                   | 0                | 3    |
| Dongcheon-dong | Daegu             | Late Bronze Age  | River channel (34)             | 4               | 3                | 0                      | 0                   | 0                | 27   |
| Yul-dong       | Ulsan             | Early Bronze Age | Dwelling (27)                  | 0               | 24               | 0                      | 0                   | 0                | 3    |
| Yeonam-dong    | Ulsan             | Early Bronze Age | Dwelling (14)                  | 0               | 8                | 0                      | 0                   | 0                | 6    |
| Hyomun-dong    | Ulsan             | Early Bronze Age | Dwelling (27)                  | 0               | 24               | 0                      | 0                   | 0                | 3    |
| Gajaegol       | Ulsan             | Early Bronze Age | Dwelling (11)                  | 0               | 8                | 0                      | 0                   | 0                | 3    |
| Beondapdul     | Ulsan             | Bronze Age       | Dwelling (82)                  | 0               | 45               | 0                      | 0                   | 0                | 37   |
| Sangan-dong    | Ulsan             | Late Bronze Age  | Dwelling (39)                  | 0               | 34               | 0                      | 0                   | 0                | 5    |
| Dongcheon-ri   | Ulsan             | Late Bronze Age  | Dwelling (18)                  | 6               | 7                | 1                      | 0                   | 0                | 4    |
| Jungsan-dong   | Ulsan             | Late Bronze Age  | Dwelling (16)                  | 0               | 7                | 0                      | 0                   | 1                | 8    |
| Gamakmot       | Ulsan             | Late Bronze Age  | Dwelling (11)                  | 0               | 9                | 0                      | 0                   | 0                | 2    |
| Pyeonggeo-dong | Gyeongsangnam-do  | Early Bronze Age | Dwelling (229)                 | 0               | 198              | 8                      | 0                   | 0                | 23   |
| Pyeonggeo-dong | Gyeongsangnam-do  | Late Bronze Age  | Dwelling (49)                  | 0               | 38               | 0                      | 0                   | 0                | 11   |
| Ilisan Area 1  | Gyeonggi-do       | Early Iron Age   | Peat layer (49)                | 0               | 0                | 0                      | 0                   | 26               | 23   |
| Ilisan Area 2  | Gyeonggi-do       | Early Iron Age   | Peat layer (18)                | 0               | 3                | 0                      | 1                   | 6                | 8    |
| Dalcheon       | Gyeongsangbuk-do  | Early Iron Age   | Dwelling (9)                   | 0               | 8                | 0                      | 0                   | 0                | 1    |

| Site name           | Region            | Period         | Context<br>(Number of samples) | Pinus<br>(Pine) | Quercus<br>(Oak) | Castanea<br>(Chestnut) | Juglans<br>(Walnut) | Alnus<br>(Alder) | Etc. |
|---------------------|-------------------|----------------|--------------------------------|-----------------|------------------|------------------------|---------------------|------------------|------|
| Changchon           | Gyeongsangnam-do  | Early Iron Age | River channel (11)             | 0               | 3                | 0                      | 0                   | 4                | 4    |
| Sinchang-dong       | Gwangju           | 1st c. BCE     | Swamp (25)                     | 0               | 15               | 3                      | 0                   | 1                | 6    |
| Sinchang-dong       | Gwangju           | 1st c. BCE     | Swamp (61)                     | 0               | 25               | 1                      | 0                   | 2                | 33   |
| Joseong-ri          | Jeollanam-do      | 1st c. CE      | Swamp (18)                     | 0               | 10               | 0                      | 0                   | 2                | 6    |
| Daho-ri             | Gyeongsangnam-do  | 1st c. CE      | Swamp (24)                     | 0               | 9                | 2                      | 0                   | 6                | 7    |
| Donghwa-ri          | Gangwon-do        | 2-4c. CE       | Dwelling (26)                  | 0               | 24               | 0                      | 0                   | 1                | 1    |
| Hahwagye-ri         | Gangwon-do        | 2-4c. CE       | Dwelling (1696)                | 117             | 1,400            | 0                      | 0                   | 173              | 0    |
| Juwol-ri            | Gyeonggi-do       | 3-4c. CE       | Dwelling (10)                  | 0               | 10               | 0                      | 0                   | 0                | 0    |
| Jangji-dong         | Gyeonggi-do       | 3-4c. CE       | Dwelling (13)                  | 0               | 11               | 0                      | 0                   | 0                | 2    |
| Baran-ri            | Gyeonggi-do       | 3c. CE         | Dwelling (31)                  | 1               | 30               | 0                      | 0                   | 0                | 0    |
| Bullo-dong          | Gyeonggi-do       | 3-4c. CE       | Feature (10)                   | 0               | 7                | 3                      | 0                   | 0                | 0    |
| Gasu-dong           | Gyeonggi-do       | 6-7c. CE       | River channel (108)            | 8               | 32               | 24                     | 1                   | 14               | 28   |
| Horogoru            | Gyeonggi-do       | 6-7c. CE       | Feature (17)                   | 0               | 15               | 0                      | 0                   | 1                | 1    |
| Gapyeong 4          | Chungcheongbuk-do | 5-6c. CE       | Feature (527)                  | 0               | 453              | 63                     | 0                   | 11               | 0    |
| Galmae-ri           | Chungcheongbuk-do | 3-4c. CE       | Swamp (359)                    | 37              | 168              | 84                     | 0                   | 8                | 62   |
| Gajwa               | Chungcheongnam-do | 3-4c. CE       | Dwelling (10)                  | 0               | 5                | 4                      | 0                   | 0                | 1    |
| Natmeori            | Chungcheongnam-do | 4-5c. CE       | Dwelling (12)                  | 0               | 0                | 12                     | 0                   | 0                | 0    |
| East Naseong, Buyeo | Chungcheongnam-do | 4-5c. CE       | Rice paddy (43)                | 24              | 4                | 14                     | 0                   | 0                | 1    |
| Gwanbuk-ri          | Chungcheongnam-do | 5-6c. CE       | Swamp (42)                     | 22              | 1                | 2                      | 0                   | 0                | 17   |
| Gungnamji           | Chungcheongnam-do | 5-6c. CE       | Swamp (172)                    | 47              | 57               | 16                     | 0                   | 2                | 52   |
| Neungsa Temple      | Chungcheongnam-do | 5-6c. CE       | Temple site (16)               | 7               | 1                | 1                      | 0                   | 0                | 7    |
| Ssangbuk-ri         | Chungcheongnam-do | 6-7c. CE       | Water channel (18)             | 4               | 0                | 9                      | 0                   | 0                | 5    |
| Gwanjang-ri         | Chungcheongnam-do | 3-9c. CE       | Water channel (99)             | 2               | 36               | 4                      | 4                   | 38               | 15   |
| Noeun               | Daejeon           | 3-6c. CE       | Swamp (31)                     | 0               | 17               | 0                      | 0                   | 14               | 0    |
| Yongheung-ri        | Jeollabuk-do      | 3-4c. CE       | Dwelling (16)                  | 0               | 0                | 12                     | 1                   | 0                | 3    |
| Naeheung-dong       | Jeollabuk-do      | 3c. CE         | Pit (49)                       | 0               | 0                | 4                      | 5                   | 3                | 47   |
| Naeheung-dong       | Jeollabuk-do      | 3c. CE         | Swamp (12)                     | 0               | 3                | 0                      | 0                   | 0                | 9    |
| Oechon              | Gwangju           | 3-4c. CE       | Swamp (21)                     | 0               | 4                | 6                      | 0                   | 1                | 10   |
| Yangjang-ri         | Jeollanam-do      | 3-4c. CE       | Swamp (21)                     | 2               | 4                | 11                     | 0                   | 1                | 3    |
| Gun-dong            | Jeollanam-do      | 3c. CE         | Dwelling (10)                  | 0               | 0                | 9                      | 0                   | 0                | 0    |
| Oryang-dong         | Jeollanam-do      | 5c. CE         | Kiln (27)                      | 13              | 1                | 13                     | 0                   | 0                | 0    |
| Yangyu-dong         | Jeollanam-do      | 3-5c. CE       | Dwelling (17)                  | 1               | 0                | 15                     | 0                   | 1                | 0    |
| Dongrim-dong        | Jeollanam-do      | 3-5c. CE       | Swamp (41)                     | 6               | 6                | 13                     | 1                   | 5                | 10   |
| Singeum             | Jeollanam-do      | 3-5c. CE       | Dwelling (62)                  | 14              | 17               | 3                      | 0                   | 0                | 28   |
| Jangsan-ri          | Jeollanam-do      | 4c. CE         | Dwelling (40)                  | 2               | 0                | 31                     | 0                   | 0                | 7    |
| Guam-dong           | Daegu             | 5-6c. CE       | Feature (11)                   | 1               | 7                | 0                      | 0                   | 0                | 3    |
| Wolseong Fortress   | Gyeongsangbuk-do  | 5-6c. CE       | Moat (55)                      | 12              | 24               | 6                      | 0                   | 1                | 12   |
| Yangdeok-dong       | Gyeongsangbuk-do  | 5c. CE         | Dwelling (37)                  | 9               | 28               | 0                      | 0                   | 0                | 0    |
| Pyeongcheon         | Ulsan             | 5c. CE         | Feature (16)                   | 0               | 12               | 0                      | 0                   | 0                | 4    |
| Gwandong-ri         | Gyeongsangnam-do  | 3-4c. CE       | Swamp(64)                      | 1               | 11               | 39                     | 0                   | 0                | 13   |
| Sinbang-ri          | Gyeongsangnam-do  | 3-5c. CE       | Wooden posts (63)              | 0               | 37               | 23                     | 0                   | 0                | 3    |
| Hoengcheon-ri       | Gyeongsangnam-do  | 4c. CE         | Dwelling (23)                  | 0               | 7                | 10                     | 0                   | 0                | 6    |
| Pyeonggeo-dong      | Gyeongsangnam-do  | 4c. CE         | Dwelling (551)                 | 0               | 327              | 15                     | 10                  | 0                | 209  |
| Pyeonggeo-dong      | Gyeongsangnam-do  | 5-6c. CE       | Dwelling (440)                 | 5               | 274              | 2                      | 7                   | 0                | 152  |
| Bonghwang-dong      | Gyeongsangnam-do  | 5-6c. CE       | Swamp (56)                     | 17              | 19               | 9                      | 0                   | 0                | 11   |
| Songhyeon-dong      | Gyeongsangnam-do  | 5c. CE         | Burial (61)                    | 10              | 16               | 11                     | 0                   | 1                | 23   |
| Ga-dong             | Busan             | 4-5c. CE       | Dwelling (78)                  | 1               | 13               | 37                     | 0                   | 0                | 27   |

Table 3. Compilation of key tree species identified at sites (limited to sites yielding more than ten analyzed samples)

as construction materials in the pile buildings and dwellings of the Proto-Three Kingdoms and Three Kingdoms periods.

As previously mentioned, the Silla village register from the Shōsō-in Repository contains records of pine-nut trees (栲子木) and walnut trees (秋子木). The pine nuts of Silla were famous throughout China and Japan, to the degree that such trees came to be referred to as Silla pine trees (新羅松). Even so, remains of pine nuts have been recovered only from the sites of Gangmun-dong in Gangneung, Gangwon-do Province and Gungnamji in Buyeo, Chungcheongnam-do Province. Pine-nut tree or Korean pine (*Pinus koraiensis* S. et Z.) has also rarely been identified through wood-species analysis. As pine-nut trees grow in cold climates—occurring only in highland environments at an altitude of 1000 meters or above in southern Korea and in environments above 300 meters in northern Korea, the relative absence of this species from archaeological sites may be expected. It is unclear whether the walnut trees mentioned in the Silla village register are walnut trees (*Juglans sinensis*) or Manchurian walnut trees (*Juglans mandshurica*). However, all of the nut remains from trees of the genus *Juglans* formally analyzed have been found to be associated with the Manchurian walnut tree. Therefore, it has yet to be confirmed whether walnut trees—which were introduced into Han China (漢, 206 BCE–220) from the Western Regions (西域, Xiyu)—spread into the Korean Peninsula during the Proto-Three Kingdoms period via Lelang, or whether they were introduced during the Goryeo Period or later.

It does not appear that other types of nut-yielding trees were actively cultivated or utilized. Hazelnuts have been recovered only from the Galmaeri site in Asan, Chungcheongnam-do Province and from the Sinchang-dong wetland site in Gwangju. Water chestnuts have been reported only from the sites of Gangmun-dong and Anin-dong in Gangneung, Gangwon-do Province. Hazelnut wood is absent at most sites, apart from Galmaeri, and water-chestnut wood has yet to be reported at any site in Korea.

### Change in Vegetation and Chestnut Trees

It is also possible to examine changes in vegetation

and the cultivation of chestnut trees through the results of pollen analysis. Pollen analysis results reported from various sites throughout South Korea indicate that the period between 2300 BP–1400 BP (3rd century BCE–6th century) was dominated by pine trees (*Pinus* sp.) or by pine trees (*Pinus* sp.) and herbaceous plants (Kim Choonmin et al. 1980, 40–50). In the eastern coastal regions, a vegetation shift from Quercus-Pinus forests or Quercus forests to Pinus coniferous forests or open grasslands has been identified as having occurred around 2000–1400 BP (1st–6th century) in Pohang, Gyeongsangbuk-do Province and the region in Gangwon-do Province east of Daegwallyeong Pass, commonly referred to as Yeongdong (嶺東), and around 2300 BP (3rd century BCE) in Ulsan (Yoon Soonock et al. 2008, 791–793). This transition in the dominant vegetation from Quercus to Pinus, or from forests to open grasslands, is believed to have resulted from a combination of factors including falling sea levels and the subsequent expansion of land along the coast, a cooler and drier climate, and human alternations to the landscape (the deforestation of hilly and wetland areas due to the expansion of farmland, for example). A similar process appears to have taken place in western coastal areas. In the southern Chungcheong region, where pollen analysis has been intensively carried out, the transition from Quercus or Alnus to Pinus as the dominant vegetation is mainly observed around 2000–1400 BP (Park Jihoon and Yi Sanghyeon 2008, 66–72; Jang Byeongo et al. 2006, 573–580). This is also the stage during which a decline in secondary forest vegetation occurred, and both grasses and red pine expanded.

From an archaeological point of view, the chronological period during which the transition to secondary forests primarily comprising Pinus, a pioneer species, took place within open landscapes—in particular, around 2000–1400 BP—is significant. This is because it coincides with the Proto-Three Kingdoms to Three Kingdoms period, which witnessed a marked increase in the number of settlements and an accompanying expansion in the need for both additional farmland and fuel. The results of pollen analysis for this period frequently illustrate a rapid decrease in the amount of Quercus pollen, a rapid increase in Pinus pollen, and an increased presence of Castanea (chestnut) pollen.

Based on the above, it is possible to confirm that Quercus forests declined as the result both of

climate change and of the deliberate felling of trees, while secondary forests consisting of Pinus and Platycarya trees spread, accompanied by an increase in the quantity of Castanea trees (Platycarya trees are part of the walnut family but are the sole member of the Platycarya genus). Since Castanea pollen, once released, does not diffuse over a wide area—unlike Quercus or Pinus pollen—and the amount of pollen produced is quite low, it is most likely that the proportion of Castanea trees within the vegetation was greater than the proportion represented in the pollen record. However, Castanea did not naturally become the dominant species in the forest—even the secondary forests—of the Korean Peninsula. In the pollen record for the eastern coastal areas, an increase in Castanea can be noted starting from 2000 BP (1st century CE), but the active use of chestnuts or chestnut wood is not observed through the analysis of seed remains or wood specimens. On the other hand, in the southern regions, climate change, human-driven deforestation, and the expansion of farmland resulted in a shift in vegetation that includes a marked increase in Castanea trees. This is accompanied by the appearance of chestnut wood as the dominant species at several sites, a phenomenon that can be explained as a result of the deliberate cultivation of chestnut trees.

It is highly likely that chestnuts, which can be stored for long periods of time and which are both flavorful and nutritious, were welcomed as a new food type that served as both a delicacy and an emergency food resource. In addition, it is possible to propose that as chestnuts became ritually significant through their use in ceremonies, the trees came to be deliberately cultivated and protected. As was the case with other types of nuts and fruits, chestnuts also would have been regarded as a supplementary cash crop. Polyculture and the secondary cultivation of nut- and fruit-yielding trees were practiced in pre-modern times as a means of preparing against famine. The economic cultivation of trees also served to mitigate the effects of environmental degradation brought about by the reclamation of farmland (Wi Eunsuk 1998, 273).

The increase in Castanea trees among the natural vegetation does not necessarily indicate that all communities in ancient times participated in the cultivation of chestnut trees. Communities in the central region of Korea during the Proto-Three King-

doms period did not favor chestnut trees; their cultivation is most noticeable in the southern region—particularly in the Jeolla region—which afforded the most favorable climatic conditions for the cultivation of chestnut trees. The “large chestnuts” produced in Mahan and Baekje mentioned in Chinese historical texts can be understood in this context. In the *Dongguk yeoji seungnam* (東國輿地勝覽, *Survey of the Geography of Korea*) published in 1530, chestnuts are recorded as regional specialty products of the Gyeongsang and Jeolla regions and of Jeju Island, while walnuts are indicated as regional specialty products of the Gyeongsang and Jeolla regions.

The results of pollen analyses indicate that pine trees came to dominate forests from around 2000–1400 BP, but the results of wood-species analyses show that broad-leaved trees, such as oak, remained the dominant species, and pine trees were nearly absent (apart from the capital areas of the Three Kingdoms, such as Buyeo). Of course, these results should not necessarily be taken to suggest that pine trees, which were abundant, were deliberately avoided for use as wood; rather, it may be that oak trees continued to dominate the forests in the mountains or upper sections of hills but were not well represented in the pollen record, which was obtained from lowland areas such as wetlands and alluvial fields. Indeed, an expansion of farming into mountainous areas began to take place in the Goryeo period, and it is recorded in the economy section (食貨志) of the *Goryeosa* (高麗史, *History of the Goryeo Dynasty*) that chestnut, pine nut, and jujube trees were widely cultivated from mid-Goryeo times onward. *Goryeosa jeolyo* (高麗史節要, *Essentials of the History of the Goryeo Dynasty*) also notes that the Goryeo King Myeongjong (明宗, r. 1170–1197) indicated a need to promote the cultivation of chestnut, pine nut, and jujube trees, along with grain crops, among the masses. The section on taxes (藤科田) of the *Goryeosa* also contains records of administrators collecting or wrongly appropriating chestnuts, pine nuts, and jujubes from the populace in the form of taxes (Park Jongjin 2006, 44–54).

### Diachronic Change in Nut Utilization

#### Neolithic Period: Intensive Use of Acorns and Oak Wood

The Neolithic period witnessed the establishment of

forests dominated by deciduous trees, particularly oak trees, throughout most areas of the Korean Peninsula. The majority of specimens identified through wood-species analyses were also found to be of oak. A great number of sites throughout the Neolithic period, from the central region of the peninsula to the southern coastal areas, have yielded acorn remains; storage pits containing acorns have been discovered at the sites of Sejuk in Ulsan, Bibong-ri in Changnyeong, Gyeongsangnam-do Province, and Naeheung-dong in Gunsan, Jeollabuk-do Province. Foxtail and broomcorn millet began to be cultivated in the Neolithic period, but acorns remained the main source of carbohydrates for the population at that time. A high percentage of acorns were derived from *Quercus acutissima* (sawtooth oak), which bears large nuts. The results of wood-species analyses also show that *Quercus subge. Lepidobalanus sect. Aegilops* trees (e.g., sawtooth oak and cork oak) predominated over *Quercus subgen. Lepidobalanus sect. Prinus* trees (e.g., Manchurian oak, konara oak, oriental chestnut

oak, and daimyo oak). In the case of Manchurian walnuts (*Juglans mandshurica*), only a small number of remains have been identified at a few sites, such as Bibong-ri in Changnyeong, Sangchon-ri in Jinju, and Bonggye-ri in Hapcheon, all in Gyeongsangnam-do Province. Wood-species analyses have identified Manchurian walnut at only one site: Gunggeunjeon-ri in Ulsan. Chestnut wood has not been observed at any sites pertaining to this period, and only a single specimen, from Storage Pit 10 of the Bibong-ri site, has been identified as having come from a *Castanea* tree.

#### Bronze Age: Continued Use of Oak Wood as a Building Material; Dramatical Decline in the Use of Acorns as a Food Source

The Bronze Age on the Korean Peninsula witnessed the establishment of farming societies in which rice came to be cultivated alongside other crops such as foxtail and broomcorn millet, soybeans, adzuki beans, barley, and wheat. As a result, the dietary

| Site                     | Period       | Number of specimens | Oak         | Site                    | Period | Number of specimens | Oak           |
|--------------------------|--------------|---------------------|-------------|-------------------------|--------|---------------------|---------------|
| Yongam-ri, Hwacheon      | Early        | 11                  | 8 (72.7%)   | Donghwa-ri, Wonju       | Early  | 19                  | 18 (94.7%)    |
| Neunggok-dong, Siheung   | Early        | 11                  | 10 (90.9%)  | Hyeonhwa-ri, Pyeongtaek | Early  | 741                 | 724 (97.7%)   |
| Wondang-dong, Incheon    | Early / Late | 88                  | 78 (88.6%)  | Banje-ri, Anseong       | Early  | 16                  | 16 (100%)     |
| Gojaemigol, Cheonan      | Early        | 15                  | 12 (80%)    | Gojaemigol, Cheonan     | Late   | 21                  | 20 (95.2%)    |
| Dujeong-ri, Cheonan      | Early        | 25                  | 24 (96%)    | Wunjeon-ri, Cheonan     | Early  | 1,672               | 1,642 (98.2%) |
| Gungpyeong-ri, Asan      | Late         | 66                  | 53 (80.3%)  | Okbuk-ri, Seocheon      | Early  | 19                  | 12 (63.2%)    |
| Songguk-ri, Buyeo        | Late         | 63                  | 30 (47.6%)  | Jangdae-ri, Cheongwon   | Late   | 132                 | 103 (78%)     |
| Neunggang-ri, Jecheon    | Early        | 12                  | 5 (41.7%)   | Hyoja 4, Jeonju         | Late   | 15                  | 3 (20%)       |
| Dongrim-dong, Gwangju    | Early        | 17                  | 7 (41.2%)   | Maecheon-dong, Daegu    | Early  | 25                  | 15 (60%)      |
| Dongcheon-dong, Daegu    | Late         | 34                  | 3 (8.8%)    | Oegwang-ri, Ulju        | Late   | 23                  | 11 (47.8%)    |
| Daeryeon-ri, Pohang      | Early        | 41                  | 41 (100%)   | Jigok-dong, Pohang      | Late   | 168                 | 168 (100%)    |
| Chogok-ri, Pohang        | Early        | 11                  | 10 (90.9%)  | Hwacheon-ri, Gyeongju   | Late   | 11                  | 9 (81.8%)     |
| Younggang-dong, Gyeongju | Early        | 12                  | 8 (66.7%)   | Munsan-ri, Gyeongju     | Late   | 11                  | 9 (81.8%)     |
| Gajaegol, Ulsan          | Early        | 21                  | 14 (66.7%)  | Yeonam-dong, Ulsan      | Early  | 14                  | 8 (57.1%)     |
| Hyomun-dong, Ulsan       | Early        | 27                  | 23 (85.2%)  | Yul-dong, Ulsan         | Early  | 27                  | 24 (88.9%)    |
| Cheongok-dong I, Ulsan   | Early        | 36                  | 21 (58.3%)  | Cheongok-dong II, Ulsan | Early  | 18                  | 12 (66.7%)    |
| Dongcheon-ri, Ulsan      | Late         | 18                  | 7 (38.9%)   | Sangan-dong, Ulsan      | Late   | 39                  | 32 (82.2%)    |
| Beondapdeul, Ulsan       | Early / Late | 82                  | 45 (54.9%)  | Gamakmot, Ulsan         | Late   | 11                  | 9 (81.8%)     |
| Pyeonggeo-dong, Jinju    | Early        | 229                 | 198 (86.5%) | Pyeonggeo-dong, Jinju   | Late   | 49                  | 38 (77.6%)    |
| Sangchon-ri, Jinju       | Early        | 10                  | 7 (70%)     | Total (percentage)      |        | 3,860               | 3,477 (90.1%) |

Table 4. The presence of oak wood at Bronze Age sites yielding more than ten specimens

importance of acorns plunged. Remains of seeds and fruits have been reported from over one hundred Bronze Age sites, but only five have yielded the remains of acorns. The results of the analysis of charcoal and waterlogged wood specimens, however, demonstrate that deciduous oak trees continued to dominate, as was the case in the Neolithic period. Of the 61 sites from which wood specimens were analyzed, oak was found to be the main wood species at the majority. In the 30 sites where more than ten specimens were analyzed, the presence of oak wood can be estimated to be around 90% (Table 4). Of the various types of oak trees, *Quercus subge. Lepidobalanus sect. Aegilops* trees continued to predominate over *Quercus. subgen. Lepidobalanus sect. Prinus* trees, as was the case in the Neolithic period—it is only at the site of Sangin-dong in Ulsan that the opposite was observed.

As in the Neolithic period, nuts—apart from acorns—were rarely present in archaeological contexts. Manchurian walnut remains were recovered from Gajaegol House 16 in Ulsan, but chestnut remains have yet to be reported. Chestnut wood, on the other hand, was identified at 11 of 61 sites, albeit on a very limited scale. It was only at the sites of Okbuk-ri in Seocheon (36.8%) and Hyoja 4 in Jeonju (40%) that a high ubiquity of chestnut wood was observed. All of the Okbuk-ri wood specimens came from pottery kilns; in the case of the six specimens from Kiln 8, five were found to be chestnut wood, which had been used as fuel for heating kilns and firing ceramics. Taking this result into consideration, along with the results of the analysis of seed and fruit remains, it appears highly likely that the utilization of chestnuts and chestnut wood in the Bronze Age was opportunistic in nature: Bronze Age populations do not appear to have actively utilized chestnuts and chestnut wood as a source of food or building materials. The ubiquity of other wood species is low. An extremely limited presence of wood from Manchurian walnut, pine-nut, and *Quercus myrsinaefolia* Bl. (an evergreen broad-leaved species) trees has been identified at a few sites.

#### Proto-Three Kingdoms and Three Kingdoms Periods: Consumption of Chestnuts and the Deliberate Cultivation of Chestnut Trees

Chestnut remains, which are absent from prehistoric contexts, suddenly appear in large quantities

in archaeological contexts dating to the Proto-Three Kingdoms period. Chestnuts deposited as grave offerings have been identified at Lelang tombs such as Chaehyeopchong Tomb (彩篋塚) in Pyeongannam-do Province and Wangganmyo Tomb (王肝墓) in Pyeongyang; Daho-ri Tomb 1 in Changwon, Gyeongsangnam-do Province; and Songhyeondong Tomb 7, which is a Gaya tomb in Changneung, Gyeongsangnam-do Province. Chestnut remains from everyday contexts, including dwelling sites, have been mainly reported in the southern Chungcheong, Jeolla, and Gyeongsang regions. In the case of the central areas of the peninsula, chestnuts have yet to be reported, but the ubiquity of Manchurian walnut remains is relatively high. Manchurian walnuts were reported from Donglim-dong in Gwangju, Gangmun-dong in Gangneung, and Galmae-ri in Asan, all of which are wetland sites. Pine nuts were reported from the Gangmun-dong wetland site in Gangneung, Gangwon-do Province and the Gunnamji site in Buyeo, Chungcheongnam-do Province. As with sites from the Bronze Age, while their presence was limited, acorns do appear to have continued to be used as an emergency food supply. Indeed, two storage pits containing acorns were discovered at an inter-valley swamp at the Yongsan-ri site in Hampyeong, Jeollanam-do Province, which dates to the third- to sixth-century period.

Of the 58 sites dating to the Proto-Three Kingdoms and Three Kingdoms periods from which wood specimens were obtained, oak wood was identified at 52 sites (89.7%), making it the dominant species. The second-most widely identified type of wood was chestnut, which was recovered from 37 sites (63.8%). Other types of wood from nut-yielding trees include Manchurian walnut, which was observed at seven sites, and *Castanopsis cuspidata var. sieboldii*, which was observed at two sites. If analysis is limited to sites yielding more than ten specimens in order to enhance the reliability of the results, it is possible to observe that among the resulting 37 sites, wood from *Quercus* trees was identified at 34 (91.9%), and wood from *Castanea* trees was identified at 26 (70.3%). In terms of the dominant species, out of a total of 58 sites *Quercus* was found to be the dominant species at 37 sites (63.8%), *Castanea* the dominant species at 12 (20.7%), and *Pinus* the dominant species at 4. As for the dominant species among the 37 sites that yielded more than ten specimens, *Quercus* was

found to be the dominant species at 24, *Castanea* the dominant species at 11, and *Pinus* the dominant species at 4. The sites where *Pinus* was the dominant species are mostly located around Buyeo, where the final capital of Baekje was located. The above results thus illustrate that oak and chestnut trees were the most heavily utilized species of trees in ancient times. The intensive use of chestnut trees, however, is mainly observed in the southern reaches of the peninsula (including the southern Chungcheong, Jeolla, and southern Gyeongsang regions) from the third century onward.

### Conclusion

The utilization of nuts and nut-yielding trees was examined through analyses of seed and fruit remains and wood specimens recovered from archaeological sites. Summarizing the examination results, during the Neolithic period acorns were a key component of the diet, and oak wood was used for building materials. With the full-scale adoption of grain cultivation during the Bronze Age, acorns ceased to be employed as a key source of food, but oak trees continued to be overwhelmingly used as a source of wood. Chestnuts, which were not present in Neolithic or Bronze Age contexts, became a component of burials beginning in the first century BCE; they appear in dwelling sites in the third and fourth centuries CE. The results of wood-species analyses also reveal that the ubiquity of chestnut trees increased dramatically from the third and fourth centuries onward. The key distribution areas for chestnuts and chestnut-tree remains were in the southern Chungcheong and Jeolla regions, which represent Mahan and Baekje territory. This coincides with historical records that mention large chestnuts from Mahan and Baekje. The importance of chestnuts and chestnut trees also appears to have increased at third- and fourth-century sites in Gyeongsangnam-do Province. It is very likely that chestnut trees were deliberately cultivated and maintained from this time onward in these regions. However, evidence of the deliberate cultivation of chestnut trees has not been found north of the Hangang River (漢江) in the “Jungdo-style pottery” cultural sphere of central Korea. Acorns continued to be used as an emergency food source in ancient times and, while the presence of oak trees dropped significantly, oak

wood continued to be used as an important source of building material, as well as for the production of wooden vessels. The presence of other types of nuts among plant remains is severely limited. The ubiquity of Manchurian walnuts (*Juglans mandshurica*) was found to be relatively high in Gangwon-do Province, but it is unclear whether or not walnuts (*Juglans sinensis*) were also present. The utilization of pine nuts and hazelnuts is difficult to assess, since their presence is nearly non-existent in the results of the wood-species analyses. The onset of cooler and drier climatic conditions and the expansion of settlements and fields during this period brought about a dramatic decline in the proportion of oak trees within forests, accompanied by an increase in pine trees and other species that represent secondary forest vegetation. The dramatic increase in the percentage of chestnut trees within secondary forest vegetation indicates that chestnuts, which were nutritious, flavorful, and easy to prepare, came to be regarded as a new food source in the third and fourth centuries. As a result, chestnut trees were actively protected and managed. Wild chestnuts and cultivated chestnuts can be differentiated based on the size of the chestnut seeds and fruits and the results of DNA analysis; even so, because the size of the chestnut seeds and fruits recovered from remains has been reported from only a limited number of sites, and because DNA analysis of chestnut remains has yet to be undertaken, it is difficult at present to establish precisely when the domestication of wild chestnut trees took place. ㄸ

TRANSLATED BY KO ILHONG

This paper is an abridged and revised English version of “Exploitation Patterns of Nuts and Nut-yielding Trees from Neolithic to Ancient Periods in Korea Based on Plant Remains,” (식물유체로 본 선사·고대 견과류 이용의 변화: 도토리·참나무와 밤·밤나무를 중심으로), previously published in 2012 in *The Journal of the Honam Archaeological Society* (호남고고학보) 40.

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