

5. DISCUSSION

5.1 The distribution of the Family Ganodermataceae and characteristics of forest ecosystem

It was found that the Ganodermataceae was highly distributed at site 2 up to 91.80% (Table 6) while site 1 and site 3 had the Ganodermataceae distribution 6.35 and 1.95 respectively. From these percentages, *Ganoderma lucidum* was abundant at site 2 (98.79%), *G. applanatum* was 63.64% distributed at site 2, *G. tsugae* was 100% distributed at site 2 but *Amauroderma* spp. was the most abundant at site 1 (64.38%). The different distribution of the Ganodermataceae might be due to the study sites of different altitudes with the different forest types. *Ganoderma lucidum* was found on the base or on the trunk of living or dead broad-leaved tree; *G. applanatum* was found on the trunk of broad-leaved trees or pine trees; while *Amauroderma* spp. was found in the vast area on the ground, at the base of broad-leaved and pine trunk. This result might come from the different forest types having their own distinctive fungi. So individual species may be found growing only under a particular tree, because many forest fungi have undoubtedly developed a specific requirement for certain types of leaf or wood. Moreover, fungi in the forest can also be separated into those which grow on the leaf litter or soil of the forest floor and those which grow on woody (lignicolous) substrates including twigs, stumps, roots and tree trunks. Wherever they grow, all the fungi living off dead materials perform a vital function in breaking it down into nutrient-

rich humus, so helping to form an all-important link in the ecosystem. Despite the fact that the fungal distribution depends on the soil and green plants, these two factors are clearly influenced by the conditions provided by the site, while the decomposers- the fungi are influenced very much by the green plants which provide their main nutrients. So that the fungal population is less diverse than the green plant species (Dickinson and Lucas, 1979) as it was shown that in each study site there was a large number of species of trees but a lower number of the species of macrofungi.

5.2 The composition of the family Ganodermataceae and balance of forest ecosystem

From the study, study site 1 composed of at least 3 species (Table 7) i.e. *G. lucidum* (15.38%), *G. applanatum* (12.31%) and *Amauroderma* spp. (72.31%). Study site 2 consisted of at least 4 species that were *G. lucidum* (95.53%), *G. applanatum* (2.23%), *G. tsugae* (0.96%) and *Amauroderma* spp.(1.28%). For study site 3, although the composition of the Ganodermataceae was similar to those of study site 1 but the percentages of each composition in this study site was different from those of site 1. Study site 3 composed of at least 3 species i.e. 5.26% of *G. lucidum*, 21.05% of *G. applanatum* and 73.69% of *Amauroderma* spp. There was no *G. tsugae* at study site 1 and study site 3. The composition varied in the different study sites, since Doi Suthep-Pui National Park is situated so close to Chiang Mai, this area has always suffered from disturbance, because this park was also northern Thailand's most important tourist attraction that leads to another major threat to the park's integrity.

Doi Suthep supports a wide range of useful organisms such as plants and mushrooms which are still collected in large quantities by local residents, although National Park regulations officially forbid such activity (Davis *et al.*, 1995). The main threat to the organisms of Doi Suthep is encroachment by tourist development, government offices and villagers which have already destroyed about 44% of the park's forest (Elliott, 1993; Banziger,-).

Study site 1 and study site 2 which were, the most species-rich habitat in the park (Davis *et al.*, 1995; Elliott and Beaver, 1993) and also moist gullies at lower elevations. They were particularly favoured for the construction of roads and tourist resorts, a way of destroying forest of the mixed evergreen-deciduous association. The suitability of the habitat of the Ganodermataceae, and the species richness would be decreased in the disturbed areas by construction.

Another cause that might affect the number of the species in the Family Ganodermataceae in each study site was mushroom collecting. As Doi Suthep has served as a valuable sources of forest products for local people and continues to do so. Products such as mushrooms may be collected without damaging the forest ecosystem or endangering species, provided they are collected on a sustainable basis for subsistence purposes. Problems arise when these fungi are collected for trade (Chom Rom Phua Chiang Mai, 1991) especially at study site 1 which is closed to the base of the mountain. People still always take advantage on other organisms for many purposes, including the functions that they may play in regulating or carrying out ecological processes (Freedman, 1989). For example, *G. lucidum* (Ling Chih) is an attractive fungus regarding its shape and color, then it is collected for the decorative

purpose. Moreover, *G. lucidum* is now a well known macrofungus claimed to cure several diseases, especially AIDS. So this fungus highly attracted the mushroom hunters. If it is overcollected, the decomposition in forest ecosystem will slow down. If the collected rate is faster than the reproduction rate of *G. lucidum*, the serious problem of losing this species may occur. In this case, the most important influences that may cause the extirpated loss of species richness of fungi are overcollecting and habitat destruction (Freedman, 1989).

Another threat that might cause the composition of the macrofungi in the family Ganodermataceae is the forest fire, including the man-made fire. From the field investigation, it was observed that the forest fire disturbance always occurred in the dry season in the lower part of forest (site 1). If the forest fire frequently occurs, some species of fungi might not be able to recover themselves to produce the new generation. Consequently, the composition of the mushroom species in that site was affected. Thus site 1 where at least three species was found, the number of species might be reduced in the future.

5.3 The relationship between species and study site.

Each study site, had its own characteristic for the growth of the specific fungi. From the study, *Amauroderma* spp. was mainly found at site 1 and site 3. Although the environmental conditions were quite different, the occurrence of the macrofungi was somewhat similar. At site 1, being at the lowest altitude, the highest temperature and the strongest light intensity at the ground level, the abundance of mushroom species

was similar to site 3, with the highest altitude, the lowest temperature, the lowest soil moisture and the highest soil pH. While at the site 2, which had the highest RH, the lowest light intensity at the ground level and the denser canopy than site 1 and site 3, *Ganoderma lucidum* was the dominant species but the number of *Amauroderma* spp. was lower. It was therefore evident that *Amauroderma* spp. preferred the drier conditions, stronger sunlight and the sparser canopy than *Ganoderma lucidum*.

As mentioned earlier, site 1, situated near the tourist point, had more disturbances by man, three species were found similar to those at site 3 where the climatic condition for the growth of macrofungi was quite unsuitable. The richness of the Ganodermataceae at site 2 and site 3 were the same (3 species) but the number of individuals at site 1 was higher than that at site 3 because of the higher RH and soil moisture.

5.4 Problems related to the study of the Ganodermataceae.

When collecting specimens of the Ganodermataceae, it was advised by Thompson and Lim (1965) to collect very young, older and old basidiocarps of any one species because the youngest basidiocarps, e.g. of *Ganoderma applanatum*, or *G. lucidum* might bear some morphological resemblance to the mature basidiocarp. However, sometimes the practical way in the actual field study, only one basidiocarp was found at one site. If that basidiocarp was young, it was very difficult to identify. The macrofungi growing at one site with every growth stage were hardly found.

The fungi are particularly difficult to study in ecological terms because of our imperfect understanding of the relationship between fruiting body formation and vegetative growth of different species. The occurrence of fruiting bodies obviously means that the fungus becomes established and grows for prolonged periods without any visible signs of its presence. Collecting must be extended over several seasons, as an allowance for varied weather conditions which will favour a wide range of species. Some study had suggested that it was necessary to continue for up to eight years to get a complete list of the fungi present. It is also important to survey regularly, at weekly or even shorter intervals (Dickinson and Lucas, 1979). However, in this study, the field investigation was done within four months from October 1996 to January 1997 because of the limitation of time, so the results might not be completed. Nevertheless it might be used as the basis for the study of the Ganodermataceae in the whole study areas.

The apparent distribution of fungi may be associated with the interests of collectors and observers. A person based in a community such as a university campus may collect intensively within a specific range of that campus based on his own personal schedule and capabilities, or a person living in an area and not being able to leave may collect the specimens in that area intensively leaving those reading his report to assume restricted distribution for the species collected or observed, while actually the fungus may have a much wider distribution (Cooke, 1979). Since this study focused on the Ganodermataceae distributed in the study sites, the collecting is dependent on the numbers of investigators, the schedule and the area. The more investigators, the greater number of macrofungi found in the area, particularly when the investigators focused on the same kind of macrofungi. The schedule is one of the important factors in the

macrofungi study. If it was done in the growing season, the more macrofungi would be found. The investigated area is also another important factor. The easier trekking way and the bigger investigated area give more chance of finding more macrofungi.

The problems that the researchers have to face undoubtedly is the identification of fungi. At present, the search for indications of relationship has been restricted to the characters, mainly the morphology of the sporophores (Nobles, 1958), including the general habit, the hymenial configuration, and the texture of the upper surface, but the consistency of the sporophore is also considered. The color of its context and its spores at the microscopic level of observation, the presence or absence and character of cystidia were also taken into account. Eventhough identification has improved further with a very complex study based on several characteristics, including the macroscopic, microscopic and chemical reaction study, the identification is still too complex and difficult to identify the fungi, because the result of each method cannot identify exactly to the correct species. However, the result will indicate some characteristics which overlap with the other species. Therefore the classification of fungi has to be confirmed by several methods to indicate the correct species. For example, in this study, the growth rate of different species of the Ganodermataceae were overlapping with the same growth rate, so the identification could not depend only on the characteristics of macrofungi. In this study, the macrofungi were identified according to several researchers as mentioned in the previous part. However, the characteristics and the method used for the identification were not the only problem that the researchers have to face. The different researchers have their own opinion on the identification of their fungi based on the characteristics that they assumed to be. Finally, one fungi will have

several names or be renamed to the new species. These listed problems are very common in the fungal classification study, but create so much confusion for the identification.

5.5 The relationship between the species of the Ganodermataceae and the climatic conditions.

While both climate, -in particular rainfall, and temperature - and soil conditions affect fungi distribution (Arms, 1990) , more often than not it is the trees themselves which have most influence. The trees of course, are also affected by the same environmental conditions as the fungi.

Throughout site 3 (pine dominated), vast areas of relatively poor land in cold regions are clothed with dark-green forests dominated by pines. Their capacity to withstand the extremes of cold and wind are often remarkable. This habitat is, in addition to being climatically hazardous, caused by their relatively poor soils. This means that general plant nutrients are in short supply and the soils tend to be more acidic than the loams found in site 2.

Partly as a result of the climatic conditions, and partly because of these soil deficiencies, the third notable feature of many pine forest is the clear failure of macrofungi to deal effectively with the litter produced by the trees (Dickinson and Lucas, 1979).

In site 2, where the trees are taller, the canopy denser and it is cool and shady (Elliott, 1991), the soil also changes from a hard-baked brick-red (site 1) to a rich, dark

brown. This soil is more efficient at holding water and retains moisture for a longer period. Hence *Ganoderma lucidum* which prefers the lower temperature, less light intensity at the ground level, and the higher relative humidity could grow better and produce more individuals (Huston, 1994) than *Amauroderma* spp. which prefer the contrast conditions. Moreover, *G. tsugae* which had never been found in the other sites except at site 2 might be caused by the higher RH, lower light intensity at the ground level according to the denser canopy of the trees at this site. They were not found at site 1 and site 3.