Journal of Biodiversity and Ecological Sciences
(JBES©)
Vol. 3, Issue 3
ISSN: 2008-9287
Summer 2013 JBES

Original Article

The effect of trees diameter on establishment, diversity and richness of Bracket fungi in Golestan province forest, North of Iran

Received Date:10/24/2012
Accepted Date:04/03/2013

M. Rostamian*1
M.R. Kavosi2

[1*] *M.Sc. Graduate of Silviculture and Forest Ecology, Faculty of Forest Sciences, Gorgan University of Agricultural Sciences and Natural Resources. Lorestan, Iran, Islamic Republic of Iran.*
[2] *Assistant Professor Department of Silviculture and Forest Ecology, Faculty of Forest Sciences, Gorgan University of Agricultural Sciences and Natural Resources*

ABSTRACT

In forest ecosystems, organism biodiversity in ecosystem cycle is attentioned for forest and genetic resources preservation. Presences and diversity of bracket fungi have an important role as an important dissociating factor of wood in the forest. The aim of this study is considering of the effect of trees diameter on establishment, diversity and richness of bracket fungi. Two transects with a width of 50 meters had conducted randomly in the district level, in educational and research of Shastkolateh forest. And all stand and fallen trees bearing bracket fungi were considered. Results indicated that fungi establishment increased by increasing the trees diameters, and the stand trees with more than 80m diameter and fallen trees with more than 40m diameter have more bracket fungi than other trees. The consideration of richness with margalef index, indicated the most richness in diameter class > 80cm of stand trees and 40cm of fallen trees. The examination of relationship of host trees diameter class with bracket fungi diversity indicated that there is significant difference between diameter class and bracket fungi diversity in 99% reliance level, comparison of bracket fungi diversity in stand and fallen trees characterized that there is significant difference between bracket fungi diversity in stand and fallen trees. Also it is characterized that in fallen trees, bracket fungi diversity is more than that of stand trees. That one of its causes is the quality of woods, which this fungi diversity increased by increasing the decaying and disintegrating.

KEYWORDS: *diameter, bracket fungi, diversity, richness and fungi establishment.*

INTRODUCTION

In forest ecosystems, organism biodiversity in ecosystem cycle, is attentioned for forest and genetic resources preservation. Presence and diversity of bracket fungi have an important role as an important dissociating factors of wood in the forest, bracket fungi diversity can be different in stand and fallen trees (Ylläsjärvi et al., 2011; Markkanen & Halme, 2012). One of the problem which is brought up is the establishment of macroscopic fungi on forest trees. The trees being to rot after reaching to oldness and the end of plant life. In fact the numbers of trees wither up every day, environmental stress, pests and illnesses, human interference and physiological age of trees are of important reasons of trees withering up and death, but with the end of tree's physiological age, tree's ecological tasks continue in ecosystem. Stand withered up trees provide habitat for organism in the forest. And also fallen trees meanwhile effect on reproduction, provide new ecologic nest for plants and living animals and have an important role in materials cycle in the forest ecosystem (Sittonen et al., 2005). Habitat and establishment place of wood-inhabiting fungi are different on the stand and fallen trees. And some of them have special host furthermore to trees quality, diameter classes com be effective in fungi establishment and diameter classes are less and more than 40cm, have significant difference in 1% level in the rate of wood-inhabiting fungi establisjment. Researches showed that fungi abundance has the incremental process in high diameter classes and diameter class is more than 40cm, will has the most fungi abundance (Stokland and Kauserud, 2004). The type of tree species has a role in the combination and variation of ascomycet and basidiomycet fungi, and variation of fungal species is different, with respect to the host quality, so that the variation of fungal species on fallen trees is more than that on living trees (Astrid and Gregory, 2003). Also, in the forest, the type of trees species and diameter of host trees have relationship with the abundance rate of fungi responsible for wood decaying and the establishment of fungal species and most of host trees are located in the high diameter classes (Kuffer et al., 2008). Bracket fungi make three grades damages, included that (1) fresh damaged, (2) intermediate damage and (3) very damaged. The amount of made damage has a

significant difference in different species and the presence of the most of fungi observed on very damaged trees (Yamashita et al., 2009). Fungi abundance is more on rotted trees than healthy trees and fungi abundance on withered up trees with over 40cm diameter, is more than on the other ones (Sweeney et al., 2010). Horse hoof fungi have significant difference in the terms of abundance and number, in different diameter classes and fungi are more established on the stand trees with over 80cm diameters, than the other diameters and organisms abundance will be more and there is significant difference in the terms of number of wood-inhabiting fungi on infected and healthy trees (Vuidot et al., 2010). Sittonen et al., (2005) examined bracket fungi on the fallen and stand trees and determined that meanwhile difference in the terms of abundance in fallen woods with over 30cm diameter, diversity and richness of macroscopic fungi is very much. The dead woods are important components of forest ecosystem that the nest of these forest animals

depends on it. Magnitude of dried woods is effective on the diversity and richness of fungi so that, there is significant relationship between the dead wood content and fungi richness. Moreover to significant difference between stand and fallen trees in diversity and richness of fungi, tree's wood dissociation classes are one of cases that are effective on diversity and richness of fungi (Lassauce et al., 2011; Hattori et al., 2012). Trees diameter is one of the most original examined factor in uneven-aged forests. Trees diameter increased during different growth stages and enter to higher diameter classes. Bracket fungi or horse hoof fungi are of wood-inhabiting fungi which lead to trees decaying, some of these fungi are trees parasites and are one of the most important factors of trees illness and damage and the others are saprophyte and lead to the decay of dead woods and withered up trees. Diameter and the age of trees are of cases that influence on bracket fungi establishment richness and diversity, the aim of this study is consider the bracket fungi abundance as well as diversity and richness of bracket fungi is association with host trees diameter.

MATERIALS & METHODS

Above research conducted in an uneven-aged forest and mixed with tree species of Fagus orientalis, Carpinus betulus, Quercus castaneafolia, Alnus spp, Populus caspica, Tilia platyphllos, Diospyrus lotus, Fraxinus sp, ... situated in district I of shastkolateh in 30˚ latitude and 41 minutes to 36˚ and northern 54˚ longitude and 20 minutes to 54˚ and eastern 24 minutes. Strip transects sampling method has been used in order to conducting statistic for purpose of examining bracket fungi. For this purpose two transects had been conducted randomly with a width of 50m in northern- southern direction of district level (fig 1).

RESULTS

Results of variance analysis of factorial design are given in the table (1).

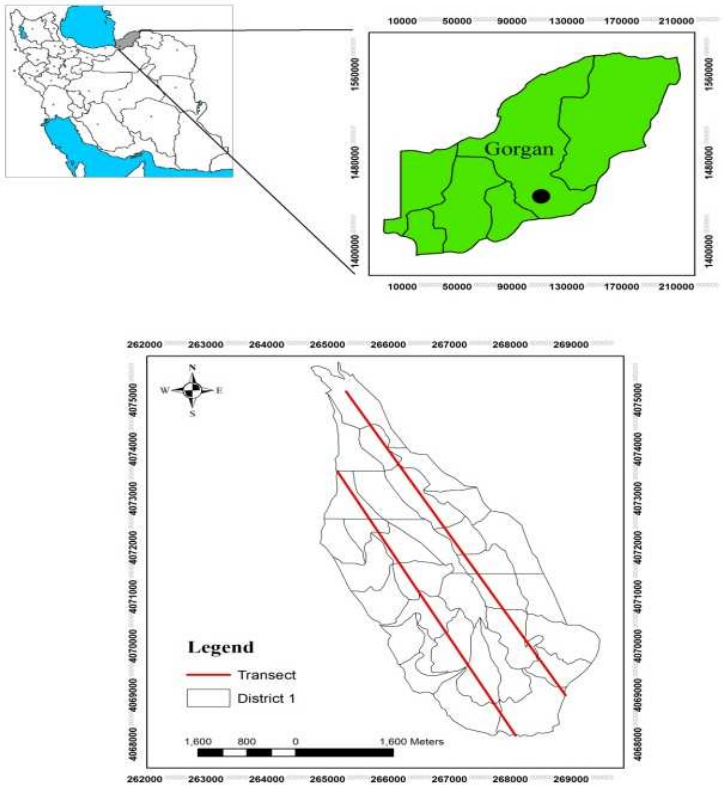

Fig. 1. The studied region and transects situation in educational and research Shastkolateh forest

All of trees bearing bracket fungi identified in to the two strip transects and the kind of hosts and their quality (stand and fallen trees), fungus name, number and abundance on every hosts were obtained. Diameter tape and 1cm diameter classes were used for measuring the tree diameter.

Experimental examinations and the use of valid identification keys (Alexopoulos *et al*., 1996; Ingold, 1996; Behdad, 1988; Abbasi and Ali Abadi, 2010) and morphologic characteristics, were used for fungi identification, and X_2 test were used for comparing bracket fungi diversity in tree diameter classes and also comparing the diversity of fungi on fallen and stand trees (Mesdaqy, 1999). Spss17 software was used for conducting statistical calculations and margaloof and menhinig indices were used for calculating bracket fungi richness (Ardakani, 2011).

Formula ($D_{mg}=\frac{S-1}{lnN}$) used in Margalef index; that is: S: total species number; N: sample content or size or total individuals number in sample; ln N is: natural logarithm N[6] or $\log_e$ N. and formula ($D_{mn}=\frac{S}{\sqrt{N}}$) used in Menhinic index.

Shannon-Wiener diversity index and Simpson diversity index were used for determining the diversity of bracket fungi (Ijtihadi, 2009). Formula ($H'=-\sum_{i=1}^{s} Pi \ln pi$) used in shannon-wiener diversity index, that; pi: individual share in species I relative to total sample which is in the form of ($Pi=\frac{ni}{N}$) and H': is species diversity index and formula (1-D= $1-\sum_{i=1}^{s} Pi^2$) was used in simpson species diversity index, that 1-D: is simpson diversity index.

CONCLUSION

In this examination, 51 trees were identified as hosts of bracket fungi which are related to 5 trees species of *Fagus orientalis*, *Carpinus betulus*, *Quercus castaneifolia*, *Parrotia persica* and *Acer velutinum* , and bracket fungi related to 9 species. All of identified bracket fungi are related to *Basidiomycota* branch and are orders of *Aphyllophoral*, included 4 families and 5 genuses (table1).

Table 1. family, genus and fungi identified on stand and fallen trees, in Shastkolateh forest, Gorgan

Family	Genus	Species
Polyporaceae	*Fomes*	*Fomes fomentarius*
	Trametes	*Trametes gibbosa*
		Trametes versicolore
Fomitopsidaceae	*Fomitopsis*	*Fomitopsis pinicola*
Ganodermataceae	*Ganoderma*	*Ganoderma australes*
		Ganoderma applanatum
		Ganoderma resinaceum
		Ganoderma locidum
Meripilaceae	*Rigidoporus*	*Rigidoporus ulmarius*

The most abundant identified fungi, are *Ganodermataceae* and *Polyporaceae*. Totally bracket fungi identified on stand and fallen trees in the studied region are observed on tree species of fagus orientalis, Carpinus betulus, Quercus castanifolia, Acer velutinum and Parrotia persica, that hosts with bracket fungi are existed in table 2.

Table 2. host tree with fungal species established on then

Host tree	**Fungal species established on every host**
Fagus orientalis	*Fomes fomentarius, Ganoderma applanatum, G. resinaceum, Trametes gibbosa, T. versicolor, Fomitopsis pinicola*
Carpinus betulus	*Fomes fomentarius, Ganoderma applanatum, G. resinaceum, G. australe, G. locidum, Trametes gibbosa, T. versicolor, Fomitopsis pinicola*
Acer velutinum	*Rigidoporus ulmarius*
Quercus castaneifolia	*Fomes fomentarius*
Parrotia persica	*Trametes versicolor*

With respect to that host trees of bracket fungi observed in two forms of stand and fallen, considering of establishment and fungi diversity done for hosts separately.

In fig 2 and 3, the number of bracket fungi observed in diameter classes of stand and fallen trees. X_2 test showed significant difference between the numbers of bracket fungi in diameters classes of host trees (table 3). In fig.2 that shows the number of host stand trees of bracket fungi, it's observed that the number of fungi increases in the higher diameter classes, so that most of them are present in 85cm to up diameter class and this diameter class

has significant difference with diameter classes are lower than itself.

Bracket fungi are more found on fallen trees with high diameter and fungi establishment increases by increasing the diameters of fallen trees. It is displayed in fig.3 that the number of bracket fungi is more in diameter class over 40cm, than the other classes. Bracket fungi have not been found in two diameter classes, 10-20, 20-30 centimeters. There is significant difference between diameter classes 30-40, > 40cm in the terms of bracket fungi establishment.

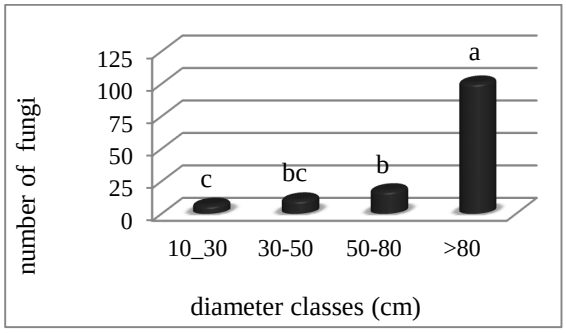

Fig. 2. The number of fungi on stand trees diameter classes.

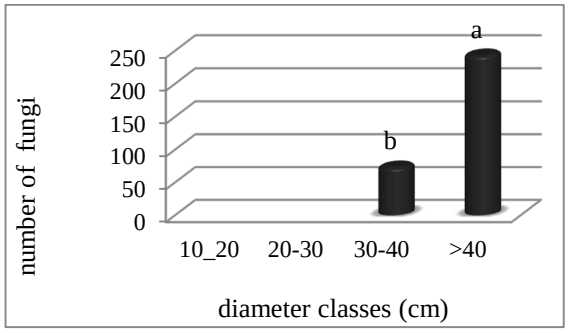

Fig. 3. The number of fungi on fallen trees diameter classes

Table 3. X_2 test for relationship between stand and fallen trees diameter classes with bracket fungi

Host trees	value	df	significant
stand	1.77	3	0.000
fallen	91.45	1	0.000

It is determined in examination of fungi richness with margalef index, that the highest richness is in the diameter classes of 80cm< of stand trees and diameter classes of 40cm < of fallen trees. Menhinic index shows the highest amount of richness in diameter class of 50-80cm of stand trees and diameter class of >40cm of fallen trees. The diameter class of 30-50 cm had the lowest amount of margalef richness and diameter class of 10-30 cm had the lowest amount of menhinic richness on stand trees. And the lowest amount of menhinic and margalef richness was in diameter class of 30-40 cm of fallen trees (fig. 4 and 5).

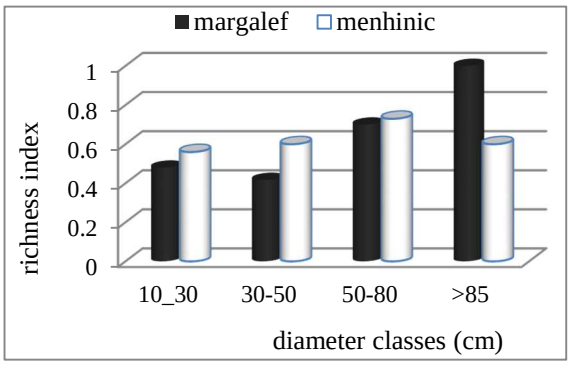

Fig. 4. Bracket fungi richness on stand trees.

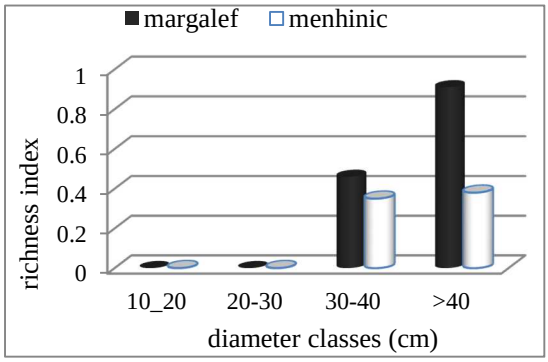

Fig. 5. Bracket fungi richness on fallen trees.

Amounts calculated from shannon-wiener index show that class of 50-80 cm and >80cm have the highest bracket fungi diversity, simpson diversity index shows the highest amount of bracket fungi diversity in diameter class of 50-80 cm of stand trees. Diameter class of 30-50 cm had the lowest amount of diversity (fig.6). Shannon-wiener and simpson indices show the highest amount of diversity in the diameter class of >40 cm (fig.7).

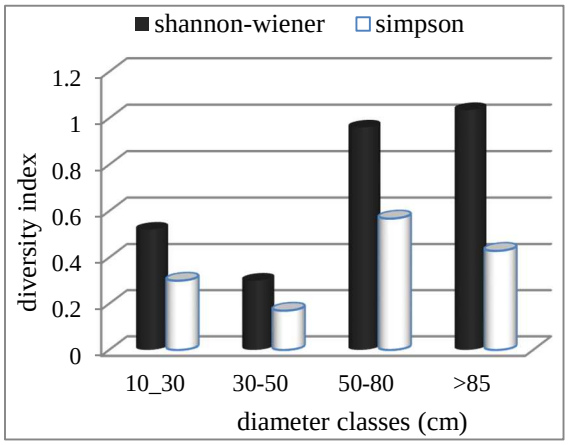

Fig. 6. Bracket fungi diversity on stand trees.

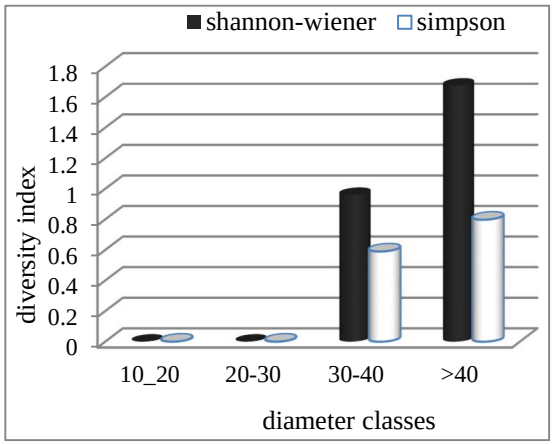

Fig. 7. Bracket fungi diversity on fallen trees.

The comparison of diameter class of host trees with bracket fungi diversity shows that there is significant difference between diameter classes and bracket fungi diversity. This comparison for stand trees showed that the highest diversity is in diameter class of >80cm, and the lowest fungi diversity is in diameter class of 30-50 cm (table 4). The highest amount of diversity on fallen trees is related to the diameter class of >40cm (table 5).

Table 4. comparison of stand trees diameter with bracket fungi diversity in diameter classes.

Diameter classes (cm)	t	df	Std. Deviation	Mean	Std. Error Mean	Significant
10-30	14.719	2	2.75	29.32	1.94	0.012
35-50	11.96	4	5.94	41.57	3.43	0.023
55-80	20.56	10	7.85	65.95	3.2	0.005
>85	27.36	38	17.51	107.18	3.91	0.000

Table 5. comparison of fallen trees diameter with bracket fungi diversity in diameter classes.

Diameter classes (cm)	t	df	Std. Deviation	Mean	Std. Error Mean	Significant
30-40	27.25	10	2.85	32.16	1.16	0.009
>40	14.96	26	20.95	82.74	5.5	0.000

Comparison of bracket fungi diversity on stand and fallen trees shows that there is significant difference between fungi diversity on stand and fallen trees. With respect to calculated amounts, it com be said that bracket fungi diversity is more on fallen trees than that on stand trees (table 6).

Table 6. comparison of fallen and stand trees diversity.

t	df	Mean	Std. Deviation	Std. Error Mean	Significant
27.25	49	0.2	0.21	0.037	0.000

DISCUSSION

Bracket fungi are the most important factor of woods dissociation and wood are required bed of fungi for living. This group of fungi have both parasitic and saprophytic life on both fallen and stand trees. Saprophyte fungi cause the withered up and dead woods to be dissociated and accelerate the velocity of material's returning to soil. Woods have influence on their establishment, richness and diversity, as a bed for growth of fungi. Fungi establishment increases by increasing the trees diameter. And trees in high diameter classes are more hosts of fungi, rather than trees in the low diameter classes. Because of increasing the diameter, the age of these trees increased and their longevity beings, these fungi can reduce the of trees longevity and dissociation beings in younger ages. Bracket fungi abundance increases on stand trees with diameter over 80cm and increases on fallen trees with diameter over 40cm (Stokland and Kauserud, 2004; Sittonen *et al*., 2005; Kuffer *et al*., 2008; Vuidot *et al*., 2010 and Sweeney *et al*., 2010), the highest number of bracket fungi observed in diameter classes over 80cm that its bean is 107.18 (diameter class of 150cm). Fungi abundance increased in old trees these trees weakened literally by increase of diameter and the power of battling with illnesses is reduced and will be suitable bed for fungi responsible for wood rotting. Also the results of this research show that the increasing the trees diameter results in fungi diversity. Richness calculated from margalef and menhinic indices and fungi diversity calculated from diversity Shannon- wiener indices show that by increasing the trees diameters, bracket fungi richness increases too. It seems that the suitable and

larger bed provided for fungi, by increasing the diameter of trees. And this increase of level is effective on fungi richness and diversity (Sittonen *et al*., 2005). Another factor which is effective on fungi diversity and richness, is wood quality, rotted woods result in increasing the diversity and richness of bracket fungi, bracket fungi are most important rotting factor of the wood of stand and fallen trees, and by increasing the dissociation and rotting, the diversity of these fungi increased, because these is significant difference between stand and fallen trees (Yamashita *et al*., 2009 ;Sweeney *et al*., 2010 and Lassauce *et al*., 2011; Hattori *et al*., 2012).

In order to preventing the bracket fungi abundance it is good and necessary to conducting health operation and harvesting thick trees on time and in the age of utilization whereas lack management in removing bracket fungi, the rate of valuable stand trees such as *Fagus orientalis* and *Acer velutinum* will be decreased.

ACKNOWLEDGEMENTS

Therefore I express gratitude to any ones who is useful in my life.

REFRENCES

Abbasi, M. & Ali Abadi, F., 2010. List reported in the Proceedings of the twelfth to eighteenth fungi Iranian Plant Protection Congress (1996-2009), 276pp.

Alexopoulos, C.J, Mims, C.W., Blackwell, M. 1996. Introductory mycology 4th ed. Jhon Wiley & Sons, INC. p. 823.

Ardakani , M.R., 2011. Ecology. University of Tehran Press, 13th Edition, 340 pp.

Astrid, F and Gregory, S.G. 2003. Effect of tree host species on fungal community composition in a tropical rain forest in Panama. Diversity and Distributions A Journal of Conservation Biogeography. 9(6): 455-468.

Behdad, E., 1988. Pests and diseases of forest trees and shrubs and ornamental plants of Iran. Neshat Esfahan Press. 807 pp.

Hattori, T., Yamashita, S. & Lee, S.S. 2012. Diversity and conservation of wood-inhabiting polypores and other aphyllophoraceous fungi in Malaysia. Biodivers Conserv 21:2375–2396.

Ijtihadi, H., Sepehri, A. and Akafy, H.R. 2009. Methods of measuring biodiversity. Publisher: University of Mashhad, first edition, 228 p.

Ingold, C.T., 1996. The biology of fungi. Translated by Zokaei, M. Ferdowsi University Press. 244 pp.

Kuffer, N. Gillet, F. Senn-Irlet, B. Aragno, M. and Job, D. 2008. Ecological determinants of fungal diversity on dead wood in European forests. Journal of Fungal Diversity. 30: 83-95.

Lassauce, A. Paillet, Y. Jactel, H. and Bouget, C. 2011. Deadwood as a surrogate for forest biodiversity: Meta-analysis of correlation between deadwood volume and species richness of saproxylic organisms. Journal of Ecological Indicators. 11(2011): 1027-1039.

Markkanen, A. & Halme, P. 2012. Polypore communities in broadleaved boreal forests. Silva Fennica 46(3): 317–331.

Mesdaqy, M., 1999. Statistical Methods in Natural Resources and Agricultural Research. Publication of Gorgan University of Agricultural Sciences and Natural Resources, 261pp.

Sittonen, P. Lehtinen, A. and Sittonen, M. 2005. Effects of forest edges on the distribution, abundance, and regional persistence of wood-rotting fungi. Journal of Conservation Biological. 19: 150-260.

Stokland, J and Kauserud, H. 2004. *Phllinus nigrolimitatus*-a wood- decomposing fungus highly influenced by forestry. Journal of Forest Ecology and Management. 187 (2004): 333-343.

Sweeney, O; Martin, R; Irein, S; C.Kelly, T; O'Halloran, J; W.Wilson,M and M.Mcevoy, P. A. 2010. lack of large- diameter logs and snags characterizes dead wood patterns in Irish forests. Journal of Forest Ecology and Management. 259(2010): 2056-2064.

Vuidot, A; Paillet, Y; Archaux, F and Gosselin, F. 2010. Influence of tree characteristics and forest management on tree microhabitats. Journal of Biological Conservation. 144(2011): 441-450.

Yamashita, S. Hattori, T. Ohkubo, T. and Nakashizuka, T. 2009. Spatial distribution of the basidiocarps of aphyllophoraceous fungi in a tropical rainforest on Borneo Island, Malaysia. Journal of Mycological Reaserch. 113(2009): 1200-1207.

Ylläsjärvi, I., Berglund, H. & Kuuluvainen, T. 2011. Relationships between wood-inhabiting fungal species richness and habitat variables in old-growth forest stands in the Pallas-Yllastunturi National Park, northern boreal Finland. Silva Fennica 45(5): 995–1013.