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The Funga of Higher Fungi of Mt. Jeombong in Korea: A Survey of Mongolian Oak Forest in 2017

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This research was conducted to determine the biodiversity of higher fungi at the supersite of Mt. Jeombong from July to October 2017 during the second long-term ecology research by the National Institute of Ecology under the management of the Ministry of Environment of Korea. Forty-three families, 74 genera, and 130 species of higher fungi were found within the permanent square area of Mt. Jeombong and a 10 m radius of the ecological flux tower. Russulaceae (54 species, 21.9%), Amanitaceae (17 species, 6.9%), and Boletaceae (17 species, 6.9%) were the top three species taxa found in mycorrhizal mushrooms. Mycenaceae (nine species, 8.5%), Polyporaceae (11 species, 4.5%), and Strophariaceae (11 species, 4.5%) were the top three species taxa found in saprophytic mushrooms. These results were analyzed and compared with those of previous fungal mushroom studies.

Keywords: Funga, Higher fungi, Korea, Mongolian oak, Mt. Jeombong

1. Introduction

The Ministry of Environment of Korea began a national long-term ecological research project in 2004 to protect the changing and declining ecosystem. The national long-term ecological research project monitored changes in ecosystems, including long-term changes, and the maintenance, preservation, and purification of the ecosystem via interactions among organisms. The project was divided into a first phase (2004-2013) and a second phase (2014-2023). The first phase focused on office establishment, data accumulation, infrastructure, and international network establishment. The second phase focused on finding solutions via the analysis

of the current state and prediction using accumulated data collected from the primary research project (Joo et al., 2013). As part of the second long-term ecological research, the biodiversity of higher fungi distribution in the Mongolian oak forest area of Mt. Jeombong was investigated (National Institute of Ecology, 2017).

2. Main subject

2.1 Project description

Title is Research on soil microbial biodiversity and its interrelationship with the environment. During the second-phase long-term national ecological research, the interrelationship between soil microbial biodiversity and the environment at the Mt. Jeombong Main Research Center was investigated in 2017. The community ecology of soil microorganisms was investigated to identify the role of microorganisms in the forest ecosystem and elucidate the interactions among microorganisms. A biodiversity survey of higher fungi that form visible fruiting bodies was conducted, and survey data on the distribution status of the higher fungi in the Mongolian oak (*Quercus mongolica* Fisch. Ex Ledeb.) forest of Mt. Jeombong were collected.

2.2 Methods

This survey was conducted within a 10 m-radius of the ecological tower and the permanent square area (100×100 m [1 ha]) of Mt. Jeombong. The host plants and the surrounding environment were inspected, and the color and shape of the fruiting bodies were observed. The higher fungi were identified according to macroscopic traits, such as the shape, color of caps and structure of stems, and microscopic traits, such as the shape of spores. For the identification of higher fungi, Korean mushrooms (Park and Lee, 2010) and Japanese mushrooms (Imazeki, 2011) were referenced. Data were obtained according to the data standards

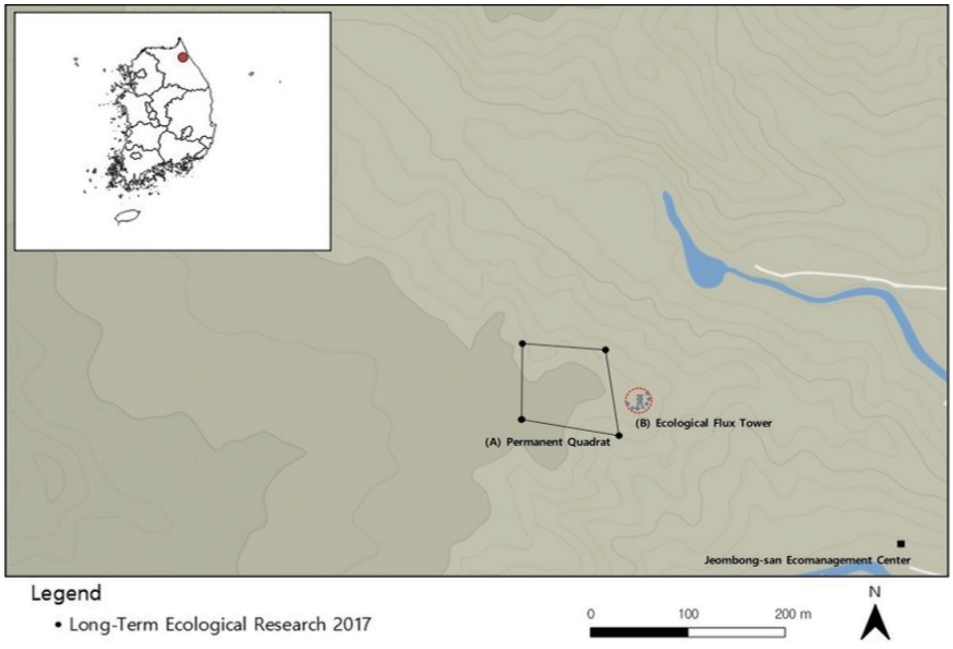

Fig. 1. Map of the research site at Mt. Jeombong in Gangwon-do (shown as a red circle in the inset). Biodiversity of higher fungi obtained within (A) the permanent 1 ha quadrat (100×100 m) indicated by black lines and (B) within a 10 m radius (red dotted circle) of the ecological flux tower.

Table 1. List of higher fungal species collected from the Mongolian oak forest of Mt. Jeombong

Family name	Genus name	Scientific name	Korean name[c]
Agaricaceae	*Agaricus*	*Agaricus abruptibulbus*	등색주름버섯[a]
	Cyathus	*Nidula niveotomentosa*	새둥지버섯[a]
	Lycoperdon	*Lycoperdon pyriforme*	좀말불버섯[a]
	Macrolepiota	*Cyathus stercoreus*	좀주름찻잔버섯[a]
	Nidula	*Macrolepiota procera*	큰우산버섯[b]
Albatrellaceae	*Albatrellus*	*Albatrellus* sp.	방패버섯속[a]
Amanitaceae	*Amanita*	*Amanita fulva*	고동색광대버섯[a,b]
		Amanita melleiceps	파리버섯[a]
		Amanita pantherina	마귀광대버섯[a,b]
		Amanita porphyria	암회색광대버섯[a,b]
		Amanita rubrovolvata	붉은주머니광대버섯[a]
		Amanita spissacea	뱀껍질광대버섯[a]
		Amanita vaginata	우산광대버섯[a,b]
		Amanita virosa	독우산광대버섯[a]
Auriculariaceae	*Exidia*	*Exidia thuretiana*	뭉게좀목이[a]
Auriscalpiaceae	*Artomyces*	*Clavicorona pyxidata*	좀나무싸리버섯[a]
Bankeraceae	*Hydnellum*	*Hydnellum concrescens*	고리갈색깔때기버섯[a]
Boletaceae	*Boletus*	*Boletus pseudocalopus*	산속그물버섯아재비[a]
	Leccinum	*Leccinum extremiorientale*	접시껄껄이그물버섯[a,b]
	Pulveroboletus	*Pulveroboletus ravenelii*	갓그물버섯[a,b]
	Tylopilus	*Tylopilus eximius*	은빛쓴맛그물버섯[a,b]
		Tylopilus felleus	쓴맛그물버섯[a]
		Tylopilus neofelleus	제주쓴맛그물버섯[a]
		Tylopilus vinosobrunneus	포도쓴맛그물버섯[a,b]
		Tylopilus virens	녹색쓴맛그물버섯[a,b]
Cantharellaceae	*Cantharellus*	*Cantharellus cibarius*	꾀꼬리버섯[a]
Ceratiomyxaceae	*Ceratiomyxa*	*Ceratiomyxa fruticulosa*	알산호점균[a]
Clavariaceae	*Ramariopsis*	*Ramariopsis kunzei*	쇠뜨기버섯[a]
Cortinariaceae	*Cortinarius*	*Cortinarius alboviolaceus*	흰보라끈적버섯[a]
		Cortinarius purpurascens	풍선끈적버섯[a,b]
		Cortinarius rubicundulus	크림끈적버섯[a]
		Cortinarius tenuipes	노랑끈적버섯[a]
		Cortinarius traganus	연자색끈적버섯[a,b]
		Cortinarius variicolor	다색끈적버섯[a]
		Cortinarius violaceus	끈적버섯[a,b]
Crepidotaceae	*Crepidotus*	*Crepidotus herbarum*	풀귀버섯[a,b]
Dacrymycetaceae	*Calocera*	*Calocera cornea*	황소아교뿔버섯[a]
	Dacrymyces	*Dacrymyces chrysospermus*	손바닥붉은목이[a,b]
Dermateaceae	*Mollisia*	*mollisia ventosa*	연한살갗버섯[a]
Diatrypaceae	*Diatrype*	*Diatrype disciformis*	요버섯[a]
		Diatrype stigma	넓은요버섯[a]

Table 1. (Continued) List of higher fungal species collected from the Mongolian oak forest of Mt. Jeombong

Family name	Genus name	Scientific name	Korean name[c]
Entolomataceae	*Entoloma*	*Entoloma album*	흰꼭지외대버섯[a]
		Entoloma chalybaeum	흑청색외대버섯[a]
		Entoloma rhodopolium	삿갓외대버섯[a]
Fomitopsidaceae	*Antrodia*	*Antrodia malicola*	사과주름구멍버섯[a]
	Climacocystis	*Climacocystis borealis*	시루버섯[a]
Gomphaceae	*Ramaria*	*Ramaria formosa*	붉은싸리버섯[a]
Gyroporaceae	*Gyroporus*	*Gyroporus longicystidiatus*	큰둘레그물버섯[a]
Helotiaceae	*Bisporella*	*Bisporella citrina*	황색고무버섯[a]
Hydnaceae	*Hydnum*	*Hydnum repandum*	턱수염버섯[a,b]
Hydnangiaceae	*Laccaria*	*Laccaria amethystea*	자주졸각버섯[a]
		Laccaria laccata	졸각버섯[a]
Hymenochaetaceae	*Hymenochaete*	*Hymenochaete tabacina*	소나무비늘버섯[a]
	Inonotus	*Inonotus hispidus*	시루뻔버섯[b]
	Phellinus	*Phellinus tremulae*	버들진흙버섯[a]
Lyophyllaceae	*Asterophora*	*Asterophora lycoperdoides*	덧부치버섯[a,b]
	Hypsizygus	*Hypsizygus marmoreus*	느티만가닥버섯[a]
Marasmiaceae	*Marasmius*	*Marasmius maximus*	큰낙엽버섯[a]
		Marasmius nigripes	검은대낙엽버섯[a]
		Marasmius rotula	낙엽버섯[a]
	Rhodocollybia	*Rhodocollybia butyracea*	버터철쭉버섯[b]
Mycenaceae	*Mycena*	*Mycena alcalina*	악취애주름버섯[a]
		Mycena alphitophora	흰애주름버섯[a,b]
		Mycena filopes	가마애주름버섯[a,b]
		Mycena haematopus	적갈색애주름버섯[b]
		Mycena macrocystidiata	소녀애주름버섯[a]
		Mycena polygramma	세로줄애주름버섯[b]
	Panellus	*Panellus stipticus*	부채버섯[a,b]
	Roridomyces	*Mycena rorida*	젤리애주름버섯[a]
	Xeromphalina	*Xeromphalina campanella*	이끼살이버섯[a]
Omphalotaceae	*Gymnopus*	*Gymnopus confluens*	밀꽃애기버섯[a]
	Lentinula	*Lentinula edodes*	표고[a]
Ophiocordycipitaceae	*Ophiocordyceps*	*Cordyceps nutans*	노린재동충하초[a]
Physalacriaceae	*Armillaria*	*Armillaria solidipes*	다발뽕나무버섯[a,b]
		Armillaria mellea	뽕나무버섯[a]
	Cylindrobasidium	*Cylindrobasidium evolvens*	담자고약버섯[a]
	Oudemansiella	*Oudemansiella mucida*	끈적끈끈이버섯[a]
Physaraceae	*Physarum*	*Physarum polycephalum*	황색망사먼지[a]
Pleurotaceae	*Pleurotus*	*Pleurotus pulmonarius*	산느타리[a]
Pluteaceae	*Pluteus*	*Pluteus cervinus*	난버섯[a]

Table 1. (Continued) List of higher fungal species collected from the Mongolian oak forest of Mt. Jeombong

Family name	Genus name	Scientific name	Korean name[c]
Polyporaceae	*Datronia*	*Datronia mollis*	미로구멍버섯[a,b]
	Microporus	*Microporus vernicipes*	메꽃버섯부치[a]
	Polyporus	*Polyporus brumalis*	겨울구멍장이버섯[a]
	Trametes	*Trametes pubescens*	흰융털구름버섯[a,b]
		Trametes versicolor	구름송편버섯[a,b]
Pyronemataceae	*Sowerbyella*	*Sowerbyella imperialis*	황금대접시버섯[a]
Russulaceae	*Lactarius*	*Lactarius aspideus*	보라변색젖버섯[a]
		Lactarius chrysorrheus	노란젖버섯[a,b]
		Lactarius piperatus	젖버섯[a,b]
		Lactarius subplinthogalus	얇은갓젖버섯[a]
		Lactarius subzonarius	당귀젖버섯[a,b]
		Lactarius sumstinei	우산주름젖버섯[a]
		Lactarius volemus	배젖버섯[a]
	Russula	*Russula alboareolata*	목련무당버섯[a]
		Russula amoena	가지무당버섯[a]
		Russula azurea	하늘색무당버섯[a,b]
		Russula compacta	담갈색무당버섯[a]
		Russula cyanoxantha	청머루무당버섯[b]
		Russula emetic var. clusii	냄새무당버섯[a]
		Russula emetica	무당버섯[a,b]
		Russula exalbicans	색바랜무당버섯[a,b]
		Russula foetens	깔때기무당버섯[a,b]
		Russula nigricans	절구무당버섯[a,b]
		Russula sanguinea	혈색무당버섯[a,b]
		Russula senecis	흙무당버섯[a,b]
		Russula vesca	조각무당버섯[a]
		Russula violeipes	자줏빛무당버섯[a]
		Russula xerampelina	포도무당버섯[a,b]
Schizoporaceae	*Hyphodontia*	*Hyphodontia sambuci*	석회돌기고약버섯[a]
Sclerotiniaceae	*Lanzia*	*Lanziza echinophile*	털밤껍질버섯[a]
Stereaceae	*Stereum*	*Stereum ostrea*	갈색꽃구름버섯[a]
	Xylobolus	*Xylobolus frustulatus*	거북꽃구름버섯[a,b]
Strophariaceae	*Gymnopilus*	*Gymnopilus liquiritiae*	미치광이버섯[a]
		Gymnopilus penetrans	침투미치광이버섯[a]
		Gymnopilus spectabilis	갈황색미치광이버섯[a]
	Hypholoma	*Hypholoma fasciculare*	노란개암버섯[a]
		Hypholoma lateritium	개암버섯[a]
	Kuehneromyces	*Kuehneromyces mutabilis*	무리우산버섯[a]
	Pholiota	*Pholiota adiposa*	검은비늘버섯[a]
	Stropharia	*Stropharia rugosoannulata*	턱받이포도버섯[a]

Table 1. (Continued) List of higher fungal species collected from the Mongolian oak forest of Mt. Jeombong

Family name	Genus name	Scientific name	Korean name[c]
Suillaceae	*Suillus*	*Suillus bovinus*	황소비단그물버섯[a]
		Suillus viscidus	녹슬은비단그물버섯[a,b]
Thelephoraceae	*Polyozellus*	*Polyozellus multiplex*	까치버섯[a]
	Thelephora	*Thelephora multipartita*	많은가지사마귀버섯[a]
		Thelephora palmata	단풍사마귀버섯[a,b]
Tricholomataceae	*Clitocybe*	*Clitocybe fragrans*	흰삿갓깔때기버섯[b]
		Clitocybe infundibuliformis	깔때기버섯[a]
	Collybia	*Collybia cirrhata*	흰무리애기버섯[a]
	Resupinatus	*Resupinatus applicatus*	꽃무늬애버섯[a]
Tubiferaceae	*Lycogala*	*Lycogala epidendrum*	분홍콩점균[a]

[a]Permanent quadrat.

[b]Ecological flux tower.

[c]Korean names of the mushrooms were obtained from "National Species List of Korea," "Wild Fungi of Korea."

and quality control procedures of EcoBank, a comprehensive ecological information system of the National Institute of Ecology.

2.3 Temporal coverage

The data used in this study were the biodiversity survey results of higher fungi obtained from the study of soil microbial biodiversity and its interaction with the environment during the second national long-term ecology study (2017) from July to October 2017.

2.4 Spatial coverage

The research area Mt. Jeombong is 1,424 m above sea level, and it is located on the border between Inje-gun and Yangyang-gun, Gangwon-do. Mt. Jeombong is geographically a transition zone between the northern and southern regions and topographically (Jeong et al., 2016); it is a mountainous area where various flora can be observed owing to its wide steep slope and high flat surface (Kim et al., 2017). The higher fungi were investigated within a permanent square area (100×100 m [1 ha]) of the western slope of the ecological tower of the Key Ecological Research Center and within a 10 m radius of the ecological tower (Fig. 1).

3. Results and discussion

In 2017, 43 families, 74 genera, and 130 species were identified during the investigation of the higher fungi of Mt. Jeombong (National Institute of Biological Resources, 2019) (Table 1). The investigated higher fungi were divided into mycorrhizal and saprobic and organized according to the number of genera. Accordingly, 15 families, 22 genera, and 65 species of mycorrhizal mushrooms were found. Among them, four genera and eight species in Boletaceae accounted for the highest proportion. In addition, three genera and four species belonged to Tricholomataceae; two genera and 22 species belonged to Russulaceae; two genera and three species belonged to Thelephoraceae; one genus and eight species belonged to Amanitaceae; one genus and seven species belonged to Cortinariaceae; one genus and three species belonged to Entolomatacea; one genus and two species belonged to each of Hydnangi-

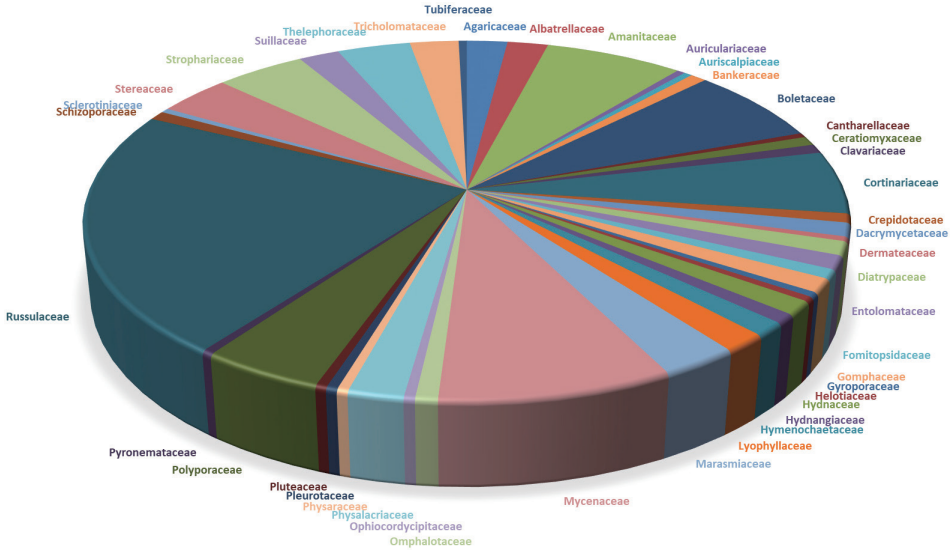

Fig. 2. Taxonomical structure of families of higher fungi of Mt. Jeombong, Korea in 2017. Russulaceae (54 species, 21.9%), Amanitaceae (17 species, 6.9%), and Boletaceae (17 species, 6.9%) are the top 3 taxa by species found in mycorrhizal mushrooms. Mycenaceae (nine species, 8.5%), Polyporaceae (11 species, 4.5%), and Strophariaceae (11 species, 4.5%) are also the top 3 taxa by species found in saprophytic mushrooms.

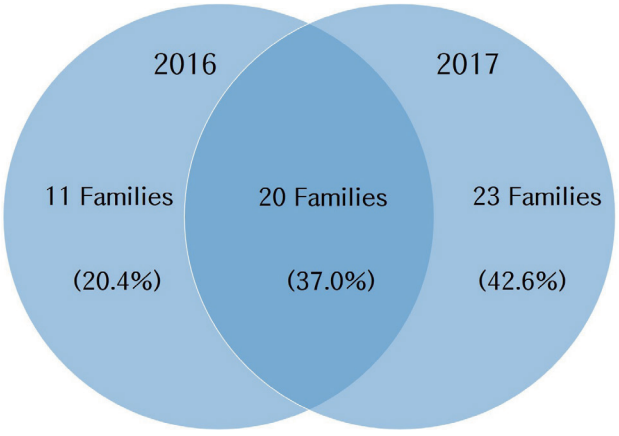

Fig. 3. Higher fungi at the family level collected from Mt. Jeombong in 2016 and 2017. Fifty-four taxa were identified: 11 in 2016, 23 in 2017, and 20 in both 2016 and 2017. Compared with 2016, there were an increase of 12 new taxa (38.7%) in 2017. Environmental data that can be linked to this result will be useful for the interpretation of the fluctuation in mushroom species.

aceae and Suillaceae; and one genus and one species belonged to each of Bankeraceae, Cantharellaceae, Gomphaceae, Gyroporaceae, and Hydnaceae.

Saprobic mushrooms belonging to 28 families, 52 genera, and 65 species were found. Among them, five genera and eight species in Strophariaceae accounted for the highest proportion. In addition, five genera and five species belonged to Agaricaceae, four genera and nine species belonged to Mycenaceae, four genera and five species belonged to Polyporaceae, three genera and four species belonged to Physalacriaceae, three genera and three species belonged to Hymenochaetaceae, two genera and four species belonged to Marasmiaceae. Two genera and two species belonged to Dacrymycetaceae, Fomitopsidaceae, Lyophyllaceae, Omphalotaceae, and Stereaceae; one genus and two species belonged to each of Diatrypaceae; and one genus and two species belonged to each of Auriculariaceae, Auriscalpiaceae, Ceratiomyxaceae, Clavariaceae, Crepidotaceae, Dermateaceae, Helotiaceae, Ophiocordycipitaceae, Physaraceae, Pleurotaceae, Pluteaceae, Pyronemataceae, Schizoporaceae, Sclerotiniaceae, and Tubiferaceae (Fig. 2).

The higher fungi in the study area were compared by year at the family level (Fig. 3). Fifty-four families were identified, of which 11 (20.4%) were distributed only in 2016 and 23 (42.6%) only in 2017, while the remaining 20 (37.0%) were distributed in both years (Eo et al., 2021).

Conflict of Interest

On behalf of all authors, the corresponding author states that there is no conflict of interest.

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Metadata for Dataset

Sort	Field	Subcategory#1	Subcategory#2
Essential	*Title	The funga of higher fungi of Mt. Jeombong (2017)	Dataset1
	*DOI name	10.22756/GEO.20230000000821	
	*Category	Biota	Macrofungi
	Abstract		
	*Temporal Coverage	July to October 2017	Acquisition period
	*Spatial Coverage	Address	Mt. Jeombong
		• Permanent quadrat	Point
		- Upper left: N 38°02′18.90″ E 128° 28′00.96″	World Geodetic System (WGS84)
		- Upper right: N 38° 02′18.65″ E 128° 28′04.46″	
		- Lower right: N 38° 02′15.65″ E 128° 28′04.99″	
		- Lower left: N 38° 02′16.25″ E 128° 28′00.89″	
		• Ecological flux tower	
		- Center: N 38° 02′16.87″ E 128° 28′05.94″	
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	*CC License	Open data	Open data
Optional	*Project	Soil microbial biodiversity and its environment	LTER (2017)
	*Instrument	Collection bag	26×15×19 cm