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Investigation on Macrofungi in Zhanjiang City

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Abstract: Macrofungi are an important group of mycorrhizal species, many of which have high nutritional and medicinal values and are the most promising category of mycorrhizal species for development and application. In order to improve the understanding of the biodiversity of Zhanjiang, more than 100 specimens collected from research in the region were used as materials, and the macrofungi species in the region were judged to belong to 8 orders, 19 families, 31 genera and 45 species by reviewing relevant literature. In terms of family and genus composition, the most dominant family was Polyporaceae and the most dominant genus was Polyporaceae. In terms of geographic distribution, the world-wide species were dominant, followed by subtropical-tropical genera. The macrofungal system of Zhanjiang has a high degree of similarity with that of Yunyang County, Yunnan Province, with a similarity of 41.67%, indicating that there may be a close relationship between these two places. Many macrofungi in this region have important economic value, with the edible and medicinal macrofungi species, accounting for 16.22% and 18.92% of the total species respectively. In addition, the ecological diversity and community diversity of the macrofungi in Zhanjiang were counted and analysed, aiming to serve as a guide for further research on the macrofungi in Zhanjiang.

1. Introduction

The diversity of macrofungi is an important component of biodiversity. It is reported that there are 4250 species of macrofungi in Chinese forest ecosystems, which belong to 21 orders in the Basidiomycota and Ascomycota. Macrofungi are an important group of fungi and one of the more promising categories of fungi, many species have high nutritional and medicinal values.

Zhanjiang City is in the southernmost part of China, between 109 °31'-110 °55'E and 20 °-21 °35'N. It is bordered by the South China Sea to the east, across the sea is Hainan Island to the south, Beibu Gulf to the west, Guangxi Zhuang Autonomous Region to the northwest, and Maoming City to the northeast of the province, and belongs to the tropical northern edge of the monsoon climate, with no winter, no summer heat, pleasant climate, concentrated precipitation, and rich subtropical crops and marine resources. It has a pleasant climate with concentrated precipitation, abundant subtropical crops and seafood resources, and an annual average relative humidity of 82-84% [1], which is suitable for the growth of macrofungi. Studies on the Zhanjiang area have involved fern resource surveys [2], climbing plant resource surveys [3], and greenland groundcover plant surveys [4], but no literature related to macrofungi in the Zhanjiang area has been published, so macrofungal

resource surveys in the Zhanjiang city area are important for studying the biodiversity of the area. In this study, the macrofungal resources surveys in Dinghushan [5, 6], Guangdong, Shenzhen [7], Bangliang Nature Reserve [8], Xinping County [9] and Yuanyang County [10], Yunnan Province were used as references to investigate the species composition, morphology, zonation, ecological diversity, economic value and community diversity of macrofungi in Zhanjiang area in detail, in order to understand the ecological characteristics of macrofungi in Zhanjiang area. This study laid the foundation for understanding the ecological characteristics of macrofungi in Zhanjiang and screening fungal resources with economic value.

2. Materials and Methods

2.1 Study Materials

All research materials in this paper are large fungal specimens collected by the authors in the Zhanjiang area between September 2021 and December 2021, totalling over 100 specimens.

Silicone gloves, self-sealing bags, spatulas, baskets, pocket knives, breathable envelopes, and filming equipment [9].

2.2 Sample Collection

The macrofungi survey areas were mainly six parks and the wild mountain forests near the parks in the Zhanjiang area, which are all rich in overall vegetation resources: Cunjinqiao Park, Ruiyun Lake Park, Southland Tropical Garden, Nanqiao Park, Jinshawan Sea Watch Promenade, and Zhanjiang Forest Park. In the field survey, photographic and written records were used to document the geographical information, ecological information and natural growth state of the macrofungi. Specimens were numbered after sample collection, dried and stored in a cool place under seal [11].

2.3 Specimen Identification

The identification of the specimens was mainly done by traditional morphological observation. According to the recorded morphological information and photographs of the specimens, the observed microstructural features are compared with tools such as the large fungal illustration and morphological identification [12-16], and the fungal species are initially identified with the help of relevant literature. Morphological observations include macroscopic morphology and microstructural features [17]. For microscopic morphological observations, tissue from different parts of the specimen was selected for sectioning or direct filming using forceps and a dissecting blade. Fresh specimens of Streptomyces were filmed using pure water as the medium, while dry specimens were filmed using 5% KOH solution [18]. The microstructure of the ascospores was observed under a light microscope [19], and the morphological features of the spores, stretchers, hyphae and capsules were recorded, and the relevant traits were identified with the help of relevant reagents. Cotton blue reagent was used to detect whether the spores were cyanophilic and to observe the surface of the cyanophilic spores, and May's reagent was used to detect whether the spores were starchy.

2.4 Species Composition Analysis

Statistical analysis of macrofungi families and genera was carried out based on specimen data from the Zhanjiang area, counting the number of species in each group and their proportions, and ranking them in decreasing order of the number of species in the family and genus.

2.5 Measurement Methods

Diversity analysis was carried out using a combination of Simpson's diversity index D [20] and Shannon-Weaver's diversity index H' [21] and Menhinick's richness index R and Pielou's evenness index E [22]. The similarity coefficient S of D. Szymkiewicz was used for similarity comparisons [23].

3. Results and Analysis

3.1 Morphology of Macrofungi

As shown in Fig 1, this macrofungi study recorded eight items such as species name, cap colour size, gill/tube colour size, stalk colour length, presence of rings, location of rings, presence of receptacles, size of receptacles, latitude and longitude records, number records, etc.

(1) C.hobsonii(Berk.&Br.)Orton; (2) Trametes orientalis (Yasuda) Imaz; (3) Aphelariadeflectens(Bres.) Corn.; (4) Daedaleopsispurpurea(Cooke)Imazeki&Aoshima; (5) Sebacinaincrustans(Pers.)Tul.&C.Tul.

Figure 1: Photographs of some of the macrofungi in the Zhanjiang area

3.2 Macrofungal Composition and Abundance

After preliminary investigation and identification, this research initially identified macrofungi belonging to 1 phylum, 8 orders, 19 families, 31 genera and 45 species, the species composition is shown in Tab 1.

The samples collected belonged to the Basidiomycota, Polyporales, Agaricales, Cantharellales, Boletales, Hymenochaetales, Russulales, Sebacinales and Gomphales, Gomphales. From the above species composition table, the constituent species are Polyporaceae (9 genera and 15 species), Agaricaceae (3 genera and 3 species), Ganodermataceae (2 genera and 3 species), Cantharellaceae (1 genus and 1 species), and Tricholomataceae (1 genus and 1 species). Tricholomataceae (one genus and three species), Marasmiaceae (one genus and three species), Mycenaceae (one genus and three species), Clavariaceae (one genus and one species), Bloetaceae (one genus and one species), Hymenochaetaceae (2 genera and 2 species), Bolbitiaceae (1 genus and 1 species), Psathyrellaceae (1 genus and 1 species), Russulaceae (1 genus and 1 species), Fomitopsidaceae (1 genus and 1 species), Gomphaceae (1 genus and 1 species), Lycoperdaceae (1 genus and 1 species), Lycoperdaceae (1 genus and 1 species). Lycoperdaceae (1 genus and 1 species), Amanitaceae (1

genus and 1 species), Pluteaceae (1 genus and 2 species), and Sebacinaceae (1 genus and 1 species).

Table 1: Composition of macrofungal species in the Zhanjiang area

Family	Genus	Species
Polyporaceae	Polyporus	6
	Trametes	2
	Phellinus	1
	Hexagonia	1
	Serpula	1
	Earliella	1
	Perenniporia	1
	Coriolopsis	1
	Psathyrella	1
Agaricaceae	Daedaleopsis	1
	Leucocoprinus	1
	Lepiota	1
Ganodermataceae	Haddowia	1
	Ganoderma	1
Cantharellaceae	Cantharellus	1
	Gomphus	1
Tricholomataceae	Clitopilus	3
Marasmiaceae	Marasmius	3
Mycenaceae	Mycena	3
Clavariaceae	Clavaria	1
Boletaceae	Boletus	1
Hymenochaetaceae	Coltricia	1
Bolbitiaceae	Bolbitius	1
Fomitopsidaceae	Fomitopsis	1
Russulaceae	Russula	1
Agaricaceae	Agaricus	1
Hymenochaetaceae	Hymenochaetopsis	1
Lycoperdaceae	Calvatia	1
Amanitaceae	Amanita	1
Pluteaceae	Pluteus	2
Sebacinaceae	Sebacina	1

3.3 Analysis of Dominant Families and Genus

The families and genus that contain the greatest number of genus and species in the phylum are called the dominant families and genus and form the bulk of the species in the corresponding phylum. The analysis of the dominant families and genus gives an idea of the nature and richness of the diversity of the fauna.

3.3.1 Analysis of Dominant Family

As can be seen from Fig 2, 12 families in Zhanjiang contain only one species of macrofungi, accounting for about 60% of the total number of families and 26.67% of the total number of species; seven families contain two to four species of macrofungi, namely Agaricaceae, Ganodermataceae,

Cantharellaceae, Tricholomataceae, Marasmiaceae, Mycenaceae, Hymenochaetaceae and Hymenochaetaceae, accounting for 55.88% of the total number of families. Tricholomataceae, Marasmiaceae, Mycenaceae, Hymenochaetaceae, accounting for 55.88% of the total number of families and 42.23% of the total number of species, with only one family containing more than 10 species of macrofungi, the family Polyporaceae Polyporaceae, with 15 species, accounting for about 33.33% of the total number of species.

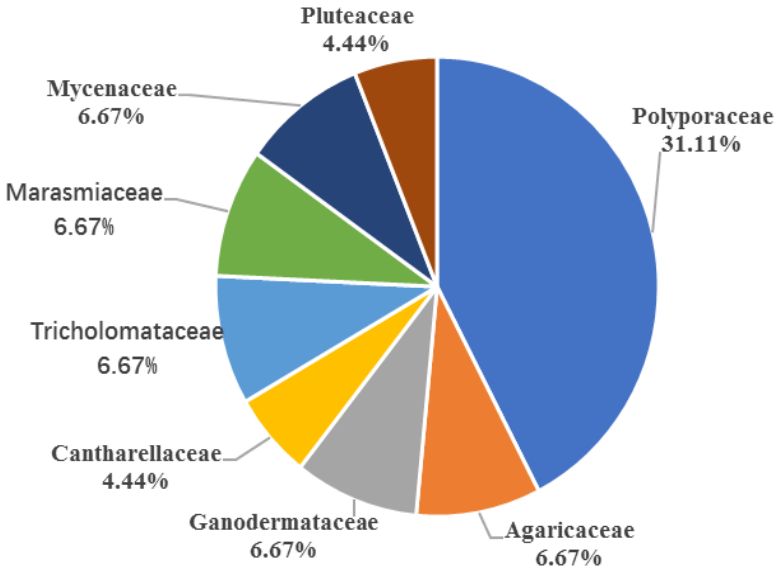

Figure 2: Distribution of dominant families of macrofungi in the Zhanjiang area

3.3.2 Analysis of Dominant Genus

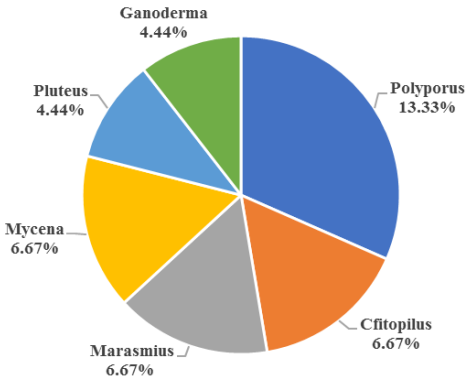

Figure 3: Distribution of dominant genus of macrofungi in the Zhanjiang area

As can be seen from Fig 3, the most dominant family is the Porifera, with six species, accounting for about 13.33% of the total number of species; except for the Porifera, the remaining families have no more than five species, followed by the dominant genus, Cfitopilus, Marasmius, Mycena, Pluteus, Ganoderma, and Trametes. The number of species accounted for approximately 6.67%, 6.67%, 6.67%, 4.44%, 4.44%, 4.44% of the total number of species, respectively.

In Zhanjiang, 26 genus contain only one species of macrofungi, accounting for 77.42% of the total number of genus and 53.33% of the total number of species; six genus contain two to four species of macrofungi, namely Cfitopilus, Marasmius, Mycena, Pluteus, Ganoderma, Ganoderma and Trametes, accounting for 19.35% of the total number of genus and 33.33% of the total number

of species, The family Polyporus, with six species, accounts for 13.33% of the total number of species, and only one genus contains more than five species of macrofungi.

3.4 Zone Analysis

3.4.1 Geographical Composition Analysis

Geographical distribution analysis shows [18; 24-30] that the 32 genus of macrofungi in the Zhanjiang area can be broadly classified into the following types (Figure 4).

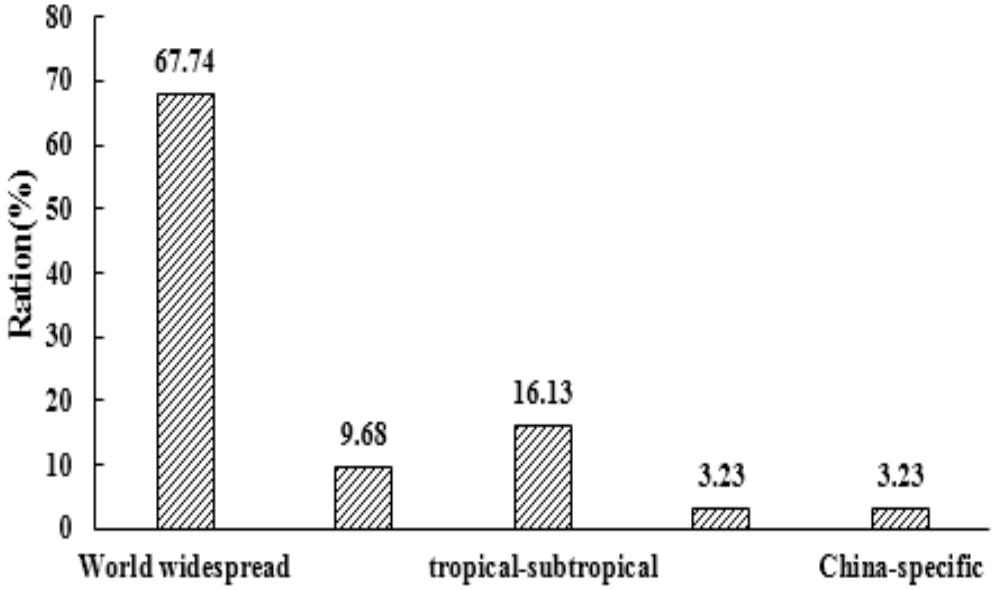

Figure 4: Geographical composition of the species range of macrofungi in the Zhanjiang area

World widespread genus: genus that are widely distributed in all continents of the world with no particular centre of distribution. Among the stretcher macrofungi found in Zhanjiang are Amanita, *Lepiota, Russula, Calvatia, Agaricus, Mycena, Marasmius, Polyporus, Trametes, Clavaria, Cantharellus, Hexagoni, Fomitus. Clavaria, Chantharellus, Hexagoni, Fomitopsis, Bolbitius, Coltricia, Daedaleopsis, Perenniporia, Psathyrella* There are 21 genuses, including *Psathyrella, Haddowi, Sebacina and Hymenochaetopsis*. The world-wide genus account for 67.74% of all genus of macrofungi in the Zhanjiang area.

Temperate distribution genus: including North America and Eurasia and other temperate regions, as well as Australia and other regional distribution genus. There are 3 genuses in the genus *Clitopilus, Phellinus and Boletus*, which account for 9.68% of the total number of genus of macrofungi in Zhanjiang.

Tropical-subtropical distribution genus: the genus *Coriolopsis, Leucocoprinus, Gomphus, Earliella, Ganoderma*, a total of five genus, accounting for 16.13% of the total number of large fungi in Zhanjiang. They account for 16.13% of the total number of macrofungi in Zhanjiang. Most of the species in the genus are mostly found in subtropical and tropical areas, but some species can also be found in temperate areas.

East Asian distribution genus: mainly include those found in Japan, Korea, Korea, China and the Philippines. There is only one genus, Pluteus, which accounts for 3.23% of the total number of genus.

China-specific distribution genus: refers to the genus distributed only in China, as one genus, Serpula [31], accounting for 3.23% of the total number of genus.

3.4.2 An Analysis of the Relationships between Macrofungi Fauna in Zhanjiang Park and other Regions

To explore the origin of fungal lineage diversity in the region and the lineage affinities of the areas concerned, comparisons of fungal lineage similarities were made with available data from Parks of Shenzhen [7] Dinghushan, Guangdong [5], Yuanyang County, Yunnan Province [32], and Fanjingshan National Nature Reserve [33], respectively (Table 2).

Table 2: Comparison of the fungal fauna of Zhanjiang Park with related areas

Project	Parks of Zhanjiang	Parks of Shenzhen	Dinghu mountain	Yuanyang County, Yunnan Province	Fanjing Mountain National Nature Reserve
Latitude	110 °20'	114°05′	112 °32'	102.83	108°45′
Longitude	21 °16'	22°38′	23 °10'	23 °23'	27°49′
Tropical genusl number of the total genus flora	16.13	23.39	15.6	10.34	14.46
Temperate genus number of the total genus flora	9.68	8.87	19.50	13.79	23.69
Similarity coefficient with Zhanjiang Park genus	100	18.18	5.90	41.67	3.4
Similarity coefficient of Tropical genus	100	13.30	7.10	75.00	11.10
Similarity coefficient of temperate genus	100	36.40	9.10	30.80	0

The macrofungal system of Zhanjiang is mainly world-wide, accounting for 67.74% of the total number of genus. The next most distributed genus is the subtropical-tropical distribution, which is closely related to the subtropical region in which Zhanjiang is located, and the temperate distribution is second to the subtropical-tropical distribution, while the other distribution components account for very few genuses.

From Tab.2, the macrofungal system of Zhanjiang City has a high degree of similarity with that of Yunyang County, Yunnan Province, with a similarity of 41.67%, indicating that there may be a closer connection between these two places. The reason for this analysis is that Zhanjiang City and Yuanyang County, Yunnan Province, are close in latitude and have similar climatic conditions, and the growth of macrofungi is closely related to climatic conditions and so on [34]. In addition, the macrofungal system of Zhanjiang is also similar to that of Shenzhen, second only to that of Yuanyang County, with a similarity of 18.18%, mainly because they are close to each other and their natural geography is also similar, and most of Zhanjiang and Shenzhen are low hilly land, gently terraced, and both have a subtropical monsoon climate, indicating that there is some connection between the macrofungal system of Zhanjiang and the above two places.

The similarity between the macrofungal system of Zhanjiang City and Dinghu Mountain in Guangdong is low, with a similarity of 5.9%, probably because Dinghu Mountain is at a higher altitude, ranging from 800 m to 1000 m, while Zhanjiang City is only at an altitude of about 200 m. The differences in environmental factors (e.g. temperature, light, moisture, soil) and vegetation types at different altitudes have led to differences in the distribution of macrofungi [8], so the similarity is low. The similarity coefficient between Fanjingshan National Nature Reserve and Zhanjiang City was only 3.4%, probably due to the distance between the two areas, the large

difference in latitude and the complex topography of Fanjingshan, which resulted in some differences in the macrofungi fauna between the two areas.

3.5 Ecological Diversity Analysis

Ecological diversity refers to the diversity of organisms in terms of ecology and habitats, and the habitats of macrofungi can basically be divided into forest habitats, grassland habitats and field habitats [35]. In this study, most of the macrofungi found were in forest habitats, which are consistent with the growth habits of macrofungi. The ecological habits of macrofungi are best reflected by the way they obtain nutrients and the type of substrate or host in which they grow. They are classified as saprophytic, parasitic and symbiotic fungi according to the way they obtain nutrients. Each of these groups is divided into different ecological types according to their substrate, host or symbiont.

3.5.1 Saprophytic Macrofungi

A saprophytic macrofungus is a way of life in which saprophytic bacteria use plant and animal remains as sustenance to maintain their normal life. These include:

1) Wood-rotting fungi: fungi born on wood or trees are collectively known as wood-rotting fungi, most of which can lead to a decrease in the economic value of wood, and different wood-rotting fungi have certain differences in the species of wood suitable for growth. For example, the broad-ribbed wood laminaria found in the study are found on the base of poplar, oak, Quercus, cherry and other tree trunks or on dead standing trees or dead branches, while the tongue laminaria are found on dead standing trees, fallen trees and felled stumps of poplar, birch, willow, oak and other broad-leaved trees.

2) Soil-borne fungi: There are more species of soil-borne fungi, some of which are saprophytic types and some of which have a parasitic or symbiotic relationship with other life in the soil. A total of 26 species of soil-borne fungi were collected in the study, and in addition to some saprophytic fungi, there are also some symbiotic fungi, such as Boletus and Fomitopsis, but the specific symbiotic relationship is not yet known.

3) Leaf litter and herbaceous fungi: Leaf litter and herbaceous fungi are an important group of saprophytic fungi. Many fungi decay on the leaf litter in forests, and the fungi that decay on leaf litter play a very important role in the decomposition of leaf litter. The deciduous and herbaceous fungi in the Zhanjiang area are M. stenophyllus (Mont.) Sing, Marasmius rotalis, Mycena rosea (Bull.) Gramberg, Mycena galericulate (Scop.: Fr.) and Gray., etc.

4) Faecal fungi: Faecal fungi use the faeces of animals (especially herbivores) as a substrate for growth and break down faecal matter. Although they do not have a unique economic value, faecal fungi (such as Trichoderma, Rhizoctonia, Ginkgo, Mucor, Aspergillus, etc.) are closely related to human beings, for example Trichoderma used in the preparation of hairy tofu, and also the water jade mould, which is often used to study fungal phototropism. Faecal fungi therefore represent a specific ecological group and are an essential object of study. There is only one species of faecal fungus in the Zhanjiang area, Conocybe apala (Bolbitius).

3.5.2 Parasitic Macrofungi

Saprophytic bacteria are microorganisms that live in a saprophytic state. They draw nutrients from dead animals, plants or other organic matter to maintain their normal life style, including dedicated and parthenogenic parasitism. Plants are the most common hosts of macrofungi, followed by insects, while some other macrofungi use other fungi as hosts. Only two species of plant-parasitic fungi were found in this study, Laminaria and some macrofungi of the Ganoderma,

3.5.3 Symbiotic Macrofungi

Symbiosis is a phenomenon in which two different organisms live together and are mutually beneficial and interdependent. Fungi that live in symbiosis are called symbiotic fungi, and are classified as lichen type fungi, ectomycorrhizal fungi, fungal symbiotic fungi, aspergillus symbiotic fungi and insect symbiotic fungi. There are two species of symbiotic fungi located in the Zhanjiang area, namely Boletus aureomycetinus (ectomycorrhizal fungus) [36].

According to the mode of nutrition, the macrofungi in Zhanjiang can be divided into three categories: those that grow in the land, wood, leaf litter, grass and manure as saprophytes, with 43 species, accounting for 95.56% of the total number of species; those that can infest live trees as parasites, with one species, accounting for 2.22% of the total number of species; those that can form a symbiotic relationship with trees as symbiotic fungi, with one species, accounting for 2.22% of the total number of species. The species that can form a symbiotic relationship with the trees are symbiotic fungi, with one species, accounting for 2.22% of the total species.

3.6 Economic Value Analysis

A review of available information [2; 7; 17; 31; 35; 37-40] revealed that there are many species of edible and medicinal macrofungi available in Zhanjiang. According to the economic utilization value of macrofungi, they are classified into six categories: toxic fungi, edible fungi, edible and medicinal fungi, medicinal fungi, wood-rotting fungi and fungi of unknown economic value. As can be seen from Fig.5, there are six species of edible fungi, accounting for 16.22% of the total number of surveys; seven species of medicinal fungi, accounting for 18.92% of the total number of surveys; two species of medicinal and food fungi, accounting for 5.41% of the total number of surveys; two species of toxic fungi, accounting for 5.41% of the total number of surveys; seven species of wood-rotting fungi, accounting for 18.92% of the total number of surveys; and another 11 species of unknown economic value in the area. In the Micang Mountain Nature Reserve, edible fungi accounted for 36.96% of the total surveyed, more than in the Zhanjiang area; medicinal fungi accounted for 6.52% of the total surveyed, less than in the Zhanjiang area; and medicinal and food fungi accounted for 2.17% of the total surveyed, about the same proportion as in the Zhanjiang area [32].

3.6.1 Edible Fungi

A systematic survey of macrofungi in the Zhanjiang region revealed that wild edible fungi in the region include *Boletus auripes Peck, Clitopilus prunulus (Scop.) P. Kumm., Clavulina coralloides (L.) J. Schrt., Clitopilus crispus Pat, Psathyrella candolleana (Fr.) A. H. Smith, Agaricus inicroinegethus Peck*. Some of these important edible fungi, such as *Psathyrella candolleana (Fr.) A. H. Smith*, although the flesh is thin, are often wild in large quantities and easy to collect and eat, and are best eaten when fresh. However, there are no records of domestication and cultivation, and research on artificial domestication and cultivation can be carried out in conjunction with the local environment.

3.6.2 Medicinal Fungi

The medicinal fungi include *Ganoderma.brownii, Haddowia, Trametes orientalis (Yasuda) Imaz, Russula nigricans (Bull.) Fr., Earliella scabrosa, Aphelaria debndroides, Ganoderma lucidum (Curtis) P. Karst.* Among them, the *Haddowia* contains woolly steroid triterpene active ingredients that inhibit acetylcholinesterase and has neuroprotective effects; The *Russula nigricans (Bull). Fr.* can treat rheumatic joint pain, and bruises, treat backache and leg pain, numbness in the hands and

feet, and anti-tumour [13].

3.6.3 Medicinal and Edible Fungi

The medicinal and edible fungi include *Mycena galericulate (Scop.: Fr.) Gray* and *Calvatia craniiformis (Schw.) Fries*. It can be used as an edible and medicinal fungi in its juvenile stage and a medicinal fungus in its mature stage. It can also be studied in depth to explore the feasibility of artificial domestication, and combined with local farming cuisine to develop a series of dishes to attract tourists and genuste economic benefits for local residents.

3.6.4 Wood-rotting Fungi

These macrofungi that genuslly contain cellulolytic or ligninolytic enzymes that cause white or brown decay of the woody parts of trees [41]. They include *Perenniporia ochroleuca, Coriolopsis glabro-rigens, Polyporaceae, Daedaleopsis purpurea (Cooke) Imazeki & Aoshima, Phellinus torulosus (Pers.) Bourdot & Galzin, M. cohortalis var. hymeniicephalus (Speg.) Sing, Serpula similis.* The use of these fungi in an effective and sustainable way needs to be further strengthened.

3.6.5 Poisonous Fungi

The survey found that two species of poisonous fungi are known in the area, namely *Leucocoprinus birnbaumii (Corda) Sing* and *Lepiota cristata (Bolt.:Fr.) Quél*. The *Leucocoprinus birnbaumii (Corda) Sing*, has brightly colours and although small in size, it is highly poisonous. If accidentally ingested, it can cause poisoning such as hallucinations, dizziness and, in severe cases, shock, requiring prompt medical attention, so more publicity is needed to avoid poisoning by poisonous fungi.

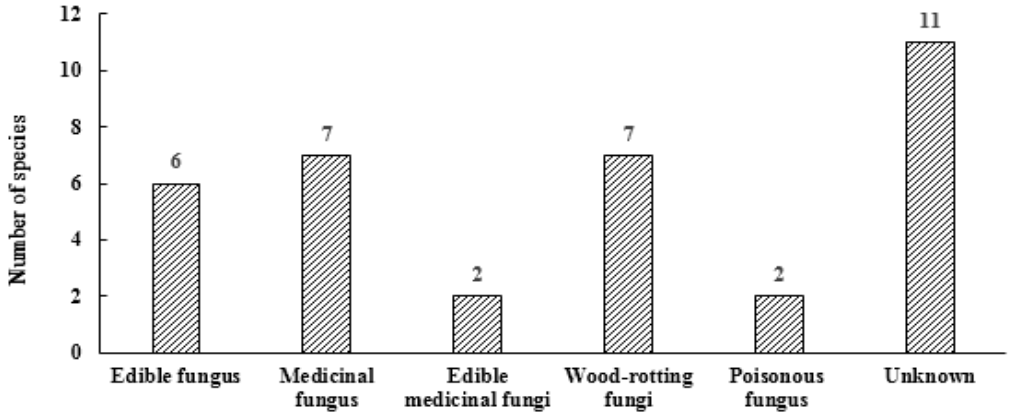

Figure 5: Economic value of macrofungi in the Zhanjiang region

3.7 Macrofungal Community Diversity Studies

As can be seen from Tab.3, in the five different vegetation communities, the size of the macrofungal species richness index R was ranked as: I > III > II > IV > V. In community I, i.e. the community dominated by Polyporaceae, the richness index reached the maximum of 1.3954, indicating that the dominant species of macrofungi have certain adaptability to this plant community, and the vegetation type is broad-leaved forest with ground cover, and the conditions such as forest depression and air humidity are suitable for the growth of most macrofungi. The species richness of macrofungi is lowest in type V, mainly due to the high altitude, wide range of light and temperature variation, and air humidity.

The variation of the diversity indices D and H' was I>II>III>IV>V, which shows that the trend is consistent under the two diversity measures. The highest performance in Type I and high values in Types II and III are due to the rich variety of understorey shrubs and herbaceous plants in Types I, II and III and the rapid natural regenustion, which provide rich nutrients for the growth of macrofungi. Type VI, on the other hand, is a coniferous forest with poorer forest composition species, mainly some species of fir, spruce, pine and larch, with relatively homogeneous nutrient composition, and with strong and long light exposure, the chance of macrofungi occurrence is relatively reduced.

From the evenness index E, the distribution of fungi in each vegetation type was relatively uneven, with the highest evenness index of 1.0230 for Type I, mainly because it is a broad-leaved forest with a high diversity of shrubs and herbs in the understory, a thicker humus layer on the ground, and rich in nutrients.

By comparing different vegetation types in the middle and upper reaches of the Bailong River forest area, it was found that coniferous mixed forests were the richest in macrofungi species [42]; comparing different vegetation types in the Fanjing Mountains, it was found that deciduous broad-leaved forests were the richest in macrofungi species [34]. In genusl, Zhanjiang area has the most distribution of macrofungi in broad-leaved forests, mainly *Polyporus*, *Ganoderma*, *Marasmius*, *Hexagonia and Cantharellus,* etc.; followed by mixed coniferous forests, mainly distributed by *Mycena*., *Marasmius, Amanita and Perenniporia;* in scrub there are *Psathyrella, Agaricus and Bolbitius*. Thus, in communities with high species diversity, the number of macrofungi orders is also higher, and attention should be paid to the conservation of macrofungi diversity.

Table 3: Macrofungal diversity indices of different forest types in the Zhanjiang area

Forest type	Species (S)	(N)	Richness index (R)	Diversity index		Evenness index (E)
				(D)	(H')	
Broad-leaved forest(I)	25	321	1.3954	0.7978	3.2077	1.0230
Coniferous and broad-leaved mixed forest(II)	7	230	0.4616	0.5383	1.3011	0.6686
Shrub grass(III)	3	26	0.5883	0.3698	0.9294	0.8459
Coniferous forest(IV)	2	31	0.3592	0.0624	0.2056	0.2966
Bamboo forest(V)	1	35	0.1690	0	0	0

4. Summary and Discussion

The study of the resource status and species diversity of macrofungi in the Zhanjiang area provides insights into the composition and abundance of macrofungi, dominant families, geographical composition, ecology and community diversity in the Zhanjiang area. The macrofungi collected from six parks and nearby mountain forests in the Zhanjiang area identified 45 species of fungi, belonging to 1 phylum, 8 orders, 19 families and 31 genus, of which the dominant family is Polyporaceae and the dominant genus is Polyporus, indicating that the macrofungi of the Zhanjiang area are very rich in Polyporus resources.

The biota component is one of the important components of biodiversity. In terms of the geographical zonation of species, the macrofungi found in Zhanjiang region are mainly genus widely distributed in the world, accounting for 67.74%, while the subtropical-tropical distribution genus account for 16.13%, the temperate distribution genus account for 9.68%, and both the East-Asian distribution genus and the Chinese endemic genus account for 3.23%, indicating that the macrofungi in the region This indicates that the macrofungal species in this region not only have the characteristics of the subtropical-tropical zone, but also have the characteristics of transition from

the subtropical-tropical zone to the north temperate zone, so they have a certain proportion of north temperate components. The macrofungi system of Zhanjiang has a high degree of similarity with those of Yunyang County, Yunnan Province and Shenzhen City, with 43.6% and 18.6% similarity respectively, indicating that there is a certain connection between the macrofungi system of Zhanjiang and the above two places; while the degree of similarity with Dinghushan and Fanjingshan in Guangdong is lower, with only 5.9% and 4.3% similarity. This is mainly due to the significant differences in altitude, climatic conditions and vegetation types between the Zhanjiang area and the two places. This is because the growth of macrofungi is closely related to vegetation types and environmental factors, and similar ecological conditions have nurtured macrofungi species resources with similar zonal composition. This also provides some theoretical support for further research on the growth environment of macrofungi, and contributes to the exploitation of macrofungi resources in the region.

Many groups of macrofungi in the region have important economic value, and some of them are edible and medicinal fungi that are closely related to human production and life and have significant socio-economic value. *Psathyrella candolleana (Fr.) A. H. Smith* can be collected and processed, developed and applied; wood-rotting fungi such as *Perenniporia ochroleuca* and *Coriolopsis glabro-rigens* are closely related to the natural protection of forest resources, disease control and development of forestry in the region; Poisonous mushrooms should also be taken seriously. Every year in China there are incidents of poisoning caused by the consumption of wild mushrooms, so it is important to find out the types of poisonous mushrooms and the types of poisoning for prevention and treatment.

By analysing the community diversity of macrofungi under different vegetation communities, it was found that the diversity index D, H' and evenness index E of broad-leaved forests within the Zhanjiang region were greater than those of mixed coniferous forests, shrublands, coniferous forests and bamboo forests, and the differences between mixed coniferous forests and scrublands were not significant, indicating that the species richness of broad-leaved forests in this region was more diverse and richer than the other four, all of which to some extent reflect the species distribution within each plant community and may be related to environmental factors such as canopy depression, temperature and humidity, and human disturbance of different vegetation types.

This research is only a preliminary survey of some areas in Zhanjiang. During the survey, it was found that artificial intervention and environmental damage in the park were too severe and the findings were incomplete, pending more extensive and in-depth field surveys. This has given us some food for thought, as the key to conserving macrofungi resources, and indeed the biological resources of the whole region, is to protect the habitat and prevent the deterioration of their living conditions. The question of the origin and evolution of macrofungi in Zhanjiang can be addressed to some extent by the results of this zonation study, but there is still a need for in-depth and systematic research on macrofungi in China to resolve this scientific question, but as many researchers continue to develop and deepen their research on the diversity of fungal zones, it will be increasingly important to explore aspects of the origin and evolution of macrofungi.

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