Study on the Relationship between Plant Distribution and Local Atmospheric Environment in Guangdong Province

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Abstract. Plants can rise to purify the atmosphere, the coverage rate of plants and the species of plants are the influencing factors of the atmospheric environment within a certain area. To explore the relationship of plant distribution and local atmospheric environment association between the Shaoguan and the Zhanjiang in Guangdong Province, we can see the vegetation coverage in Shaoguan area is higher than that in Zhanjiang area, but the plant species in Zhanjiang area is more targeted. In a word, the air quality of Zhanjiang area is higher than in the Shaoguan area. So strengthening the study of phytoremediation of air pollution is beneficial to the sustainable development of ecosystem.

1. Introduction

Plants, which can exchange large amounts of gases with air through photosynthesis, are important members of the ecosystem. In addition, the surface of the plant will be deposited dry and wet by pollutants that exist in the atmosphere, while plant cells can dissolve gaseous substances and absorb soluble compounds deposited on the plant surface [1]. And different plants have different effects on their atmospheric environment [2]

The zonal forest is a typical evergreen broadleaved forest in the subtropics in the north, a subtropical monsoon evergreen broad-leaved forest in the middle, and a tropical rain forest and a monsoon rainforest in the south in the geographical distribution of Guangdong forest. The characteristics of Guangdong's geographical location are reflected in the transition of the climatic zone, which makes the forest type of Guangdong have the characteristics of the transition from tropical to subtropical. The effects of topography, soil and human activities at different geographical locations have enriched and diversified forest communities and plant species.

According to incomplete statistics, there are 6616 species of vascular plants in Guangdong (including Hainan), including about 5000 species in Guangdong. The diversity of plant species is conducive to the protection of the ecological environment. As an economic and effective treatment measures, the phytoremediation of atmospheric pollutants has made people explore the relationship between urban air pollution and phytoremediation. Therefore, this paper intends to explore the relationship between plant species and their atmospheric environment in Guangdong Province, taking Shaoguan region in northern Guangdong and Zhanjiang region in western Guangdong as examples respectively.

2. Material and Methods

2.1 Geomorphological characteristics of observation sites

Shaoguan is located in the northern part of Guangdong (23 °53’N, 112°53’E), which belongs to the middle subtropical region and is compared with the typical subtropical region. It also shows that the annual average temperature is higher and the difference of four seasons is not obvious. Shorter and warmer winter; The annual temperature difference is 19. 1 ℃, annual precipitation is above 1500mm, red soil, mountain yellow soil, lime soil and mountain meadow soil are the components of local soil.

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Observing from the climate, Shaoguan belongs to the middle subtropical monsoon climate, at the same time, the special ecological environment formed by the bedrock is limestone, which also obviously affects the distribution of local plants; the mountain area of Shaoguan The strike is mostly north-south and mountainous, but the topography is relatively broken and there are many gaps. It is easy to appear frost and low temperature in different degrees due to the southward invasion of cold air.

Zhanjiang is located in southwest Guangdong (109 °31'N, 20 °N). It has both tropics and different components of typical evergreen broadleaved forests in the middle subtropics. Zhanjiang is over covered from subtropical forest vegetation to tropical forest vegetation. Coastal platforms are widely distributed, the ground is very open, occasionally circular hills scattered among them. Because of the high altitude angle of the sun, the annual total solar radiation is more than 464 $KJ \cdot cm^{-2}$, the temperature difference is 13. 3 ℃, the annual precipitation is above 1500mm, and the wet month is up to half a year. Typhoon landfall, farmland shelterbelt net becomes the local planting demand; brick red Soil, lateritic soil, mountain yellow soil, mountain meadow soil, coastal sandy soil are the main types of local soil.

2.2 Inquiry approaches and data sources

Based on the field investigation of the main plant species and atmospheric conditions in Zhanjiang and Shaoguan regions, the atmospheric environmental quality in winter was compared between Zhanjiang and Shaoguan. The atmospheric monitoring data are mainly from the air quality reality and forecast platform of Guangdong Environmental Protection Bureau, the 2017 Guangdong Province Environmental status Bulletin, the winter air quality assessment, and the State Environmental Protection Administration Information Center of China Ecological Environment Bulletin. The survey data of plant species come from "Plant Ecology and Geography of Guangdong", "vegetation of Guangdong", "Plant Resources of Guangdong Mountain area", "Flora of Guangdong".

3. Results

3.1 Distribution of plant species in Shaoguan area

The plant species resources in Shaoguan area mainly include wood plant medicinal plant aromatic plant oil plant fiber plant and wild fruit and so on. Most of the species are widely distributed in the area. From the vertical distribution, the distribution of plant species is different due to the difference of landform, climate and vegetation type (Table 1). In addition, the most common plant species in limestone mountain areas in Shaoguan area are drought resistant species. They often form evergreen, deciduous broad-leaved mixed forests. Thickets formed on the hills or on the hills due to the total destruction of evergreen, deciduous broad-leaved mixed forests.

Table 1. Distribution of main species in Shaoguan area.

Location area	Common species
Mountain(>800m)	*Castanopsis eyrei ,Castanopsis,Tsuga longibracteata ,Lithocarpus caloptylla Chun ,Cyclobalanopsis delavayi (Franch.) Schott ,Cephalotaxus sinensis ,Lithocarpus hancei ,M. phoenicis Dunn. ,Fokienia hodginsii. ,Tsuga chinensis pritz ,Cyclobalanopsis glauca. ,Lithocarpus chrysocomus ,Pinus kwangtungensis Chun et Tsiang. ,Schima spp., Michelia foveolata ,Rhizoma Cibotii. ,Rhododendron simsii.* et.al.
Hills(<800m)	*Castanopsis eyrei ,Castanopsis hystrix ,Hicriopteris chinensis ,Castanopsis cuspidate. ,Altingia chinensis ,Lonicera japonica ,Castanopsis fabri. ,Castanopsis fissa. ,Schima spp. ,Litsea cubeba. ,Phyllostachys heterocycla. ,Machilus chinensis. ,Actinidia. ,Schefflera octophylla. ,Polygonatum sibiricum. ,Cinnamomum porrectum. ,iziphus jujuba Mill. ,Uncaria rhynchophylla. ,Selaginella doederleinii Hieron. ,Angiopteris fokiensis Hieron. ,Pinus massoniana Lamb. ,Ilex asprella. ,Camellia oleiferaAbel. ,lex pubescens. ,Cinnamomum camphora. ,Rhodomyrtus tomentosa. ,Gardenia jasminoides Ellis. ,Sageretia thea. ,Bischofia javanica. ,Vitex negundo L. ,Liquidambar formosana Hance. ,Helictercs angustifolia L. ,Ilex rotunda Thunb. ,Sapium sebiferum. ,Smilax glabra Roxb. ,Clerodendron cyrtophyllum Turcz. ,Imperatacylindrica. ,Lindera aggregate. ,Baeckea frutescens. ,Alchornea trewioides. ,Lycoris aurea. ,Spiraea salicifolia L. ,Rubus corchorifolius. ,Dendranthema indicum ,Rosa cymosa Tratt. ,Lycoris radiate. ,Bauhinia championi ,Solidago decurrens Lour. ,Clausena dunniana Levl. ,Pyracantha fortuneana ,Millettia dielsiana ,Zanthoxylum armatum DC. ,Miscanthus floridulus ,Elaeagnus pungens Thunb. ,Loropetalum chinensis. ,Artemisia japonica* et.al.
Field	*Viola philippica ,Imperata cylindrica ,Sapium sebiferum (L.) Roxb. ,Scutellaria barbata D. Don ,Ilex asprella (Hook. et Arn.) Champ. ex Benth. ,Xanthium sibiricum Patrin ,Eclipta prostrata ,Helictercs angustifolia L. ,Prunella vulgaris L ,Lobelia chinensis Lour. ,Rosa laevigata Michx. ,Hedyotis diffusa* et.al.
Limestone mountain	*Cyclobalanopsis glauca(Thunb.) Oerst. ,Alchornea trewioides ,Distylium myricoides ,Brachystegia spp ,Quercus acutissima Carruth. ,Photinia davidsoniae Rehd. ,Lindera communis Hemsl. ,Pyracantha fortuneana ,Cinnamomum wilsonii Gamble ,Acer albopurpurascens Hayata,Celtis sinensis Pers. ,Vitex negundo L. ,Osmanthus fragrans ,Mallotus philippensis ,Quercus variabilis Bl. ,Gleditsia sinensis Lam. ,Platycarya strobilacea Sieb. ,Clausena dunniana Levl. ,Ulmus parvifolia Jacq ,Pistacia chinensis Bunge ,Ziziphus jujuba Mill. var. spinosa (Bunge) Hu ex H. F. Chow ,Cladrastis platycarpa ,Loropetalum chinensis ,Swidawilsoniana ,Bauhinia championi ,Cercis glabra Pampan. ,Quercus aliena ,Zanthoxylum armatum DC ,Asparagus cochinchinensis ,Elaeagnus pungens Thunb. ,Hovenia acerba ,Zenia insignis Chun ,Sophora japonica ,Castanea mollissima ,Toona sinensis ,Trachycarpus fortunei ,Ailanthus altissima* et.al.

3.2 Distribution of Plant species in Zhanjiang area

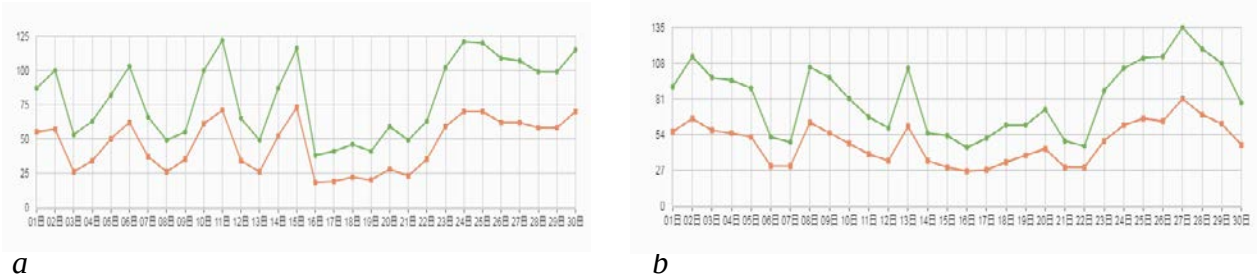
The vegetation in Zhanjiang area is dominated by evergreen broad-leaved dwarf forest or meadow on the top of the mountain. The plant composition of the forest is tropical, the subtropical family is comprehensive, and the composition of tree species is complex, mainly composed of camphor, Fagaceae, Myrrhiaceae, Moraceae, Morbiaceae, Rubiaceae, The tropical families of Hamamelidaceae, Butterfly, Sugaraceae, Tauridae, Holly and so on are mainly subtropical, and the dominant species are not obvious. There are many species of tropical shrubs in the lower layer, lianas, epiphytes are more developed, the phenomenon of plate root and stem flower still exists (Table 2).

Table 2. Distribution of main species in Zhanjiang area.

Location area	Common species
Mountain(>800m)	*Pinus massoniana Lamb. ,Rhodomyrtus tomentosa ,Dicranopteris dichotoma ,Melastoma candidum ,Psychotria rubra ,Aporosa chinensis,Breynia fruticosa.* et.al.
Hills(<800m)	*Rhodomyrtus tomentosa ,Baeckea frutescens L. ,Cratoxylon ligustrinum ,Glochidion puberum ,Raphiolepis indica ,Gleichenia linearis Clarke.,Eriachne pallescens ,Ilex asprella (Hook. et Arn.) Champ. ex Benth. ,Premna cavaleriei Levl.,Aporosa dioica ,Breynia fruticosa (Linn.) Hook. f. ,Smilax china ,Litchi chinensis Sonn. ,Dimocarpus longan Lour. ,Psidium guajava Linn. ,Clausena lansium ,Canarium album ,Canarium pimela ,Dracontomelon duperreanum Pierre ,Syzygium jambos,Annona squamosa Linn. ,Averrhoa carambola L.,Citrus reticulata Blanco,R. championii Hook. f. ,Schima superba Gardn. et Champ. ,Albizia odoratissima (Linn. f.) Benth. ,Radermachera sinica ,Lannea coromandelica ,Trema tomentosa ,Aphanamixis grandifolia Bl. ,Gironniera cuspidata ,Ficus nervosa ,Ficus virens Ait. ,Bixa orellana ,Aquilaria sinensis ,Carallia brachiata ,Ficus hirta* et.al.
Field	*Ficus altissima ,Bixa orellana ,Carallia brachiata (Lour.) Merr. ,Aquilaria sinensis (Lour.) Spreng. ,Antiaris toxicaria Lesch ,Aphanamixis grandifolia Bl. ,Schefflera octophylla (Lour.) Harms ,Endospermum chinense Benth. ,Cinnamomum Camphora (L.) Presl. ,Psychotria rubra ,Microdesmis caseariifolia Planch. ,Clausena excavata Burm.f. ,Salix myrtillacea ,Rhodomyrtus tomentosa ,Helicteres lanceolata DS. ,Rapanea neriifolia ,Waltheria indica L.* et.al.
Coastal mangrove	*Aegiceras corniculatum ,Rhizophora stylosa ,Kandelia candel ,Avicennia marina ,Bruguiera gymnorrhiza ,Eucalyptus robusta Smith ,Acacia confusa Merr. ,inus elliottii ,Pinus caribaea Morelet ,Pinus massoniana Lamb. ,Taxodiaceae Warming ,Casuarina equisetifolia Forst* et.al.

3.3 Air quality control in Shaoguan and Zhanjiang area

From the whole level, the air quality index (AQI) of the two places in the whole year is up to the first class standard of the National Environmental Air quality Standard (GB3095-2012), and the proportion of days to reach the standard of air quality in both places is between 86.3% and 99.2% (GB). According to the Chinese standard, the total AQI of Shaoguan city was 59, and PM2.5 was the primary pollutant, with a total concentration of 42 micrograms per cubic meter. And the PM10 concentration at each site was over 50 micrometers per cubic meter. Grams, and the AQI is greater than 55. 5%. The overall air quality of Zhanjiang is in the high quality level, the AQI is 38%,PM2.5 is 21 micrograms per cubic meter, there is no primary pollutant temporarily; The air quality of the whole area is in equilibrium, the concentration of PM2.5 is between 18 and 26 micrograms per cubic meter, and the concentration of PM10 is 37.5 ±7.5 micrograms per cubic meter. In the vertical contrast, the air quality in Shaoguan is relatively few days to reach the standard. Take November as an example (figure 1), Shaoguan's highest AQI is 73, the lowest AQI is 18, and the proportion of days to excellent is 50,000. The highest AQI of Zhanjiang is 81, the lowest AQI is 26, and the proportion of days of good and above is 56.67%, which indicates that the atmospheric environmental quality in Shaoguan area is obviously lower than that in Zhanjiang area.



a *b*

Fig. 1. Monthly change trend of Air quality Index in November 2017. (a)Shaoguan;(b)Zhanjiang.

In Shaoguan, the mass concentration of atmospheric particulate matter varies obviously in different regions (Fig. 2), and in forest area it is obviously lower than that in industrial area, traffic area and commercial area [3]. However, the concentration of polycyclic aromatic hydroxyl in particulate matter in Shaoguan was lower than the standard limit of GB 3095-2012 in forest area [4]. The air quality in the area with high population density was obviously different from that in the area

with high plant density. Most of Zhanjiang is a broken mountain area with a high degree of greening and relatively good air quality. PM2.5 concentration is relatively low, air resource endowment is better.

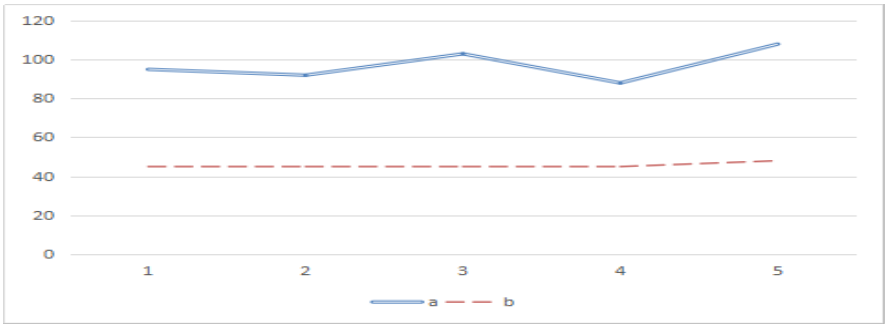


Fig. 2. Comparison of Air quality between densely populated area and High Plant density area in Shaoguan area. (a)High Plant density area;(b)populated area.

4. Discussion

Because of the irrationality of exploitation and utilization of natural resources, the plant resources in Shaoguan area have been reduced, and the timber plants have been reduced by more than half. In the development of resources in Shaoguan area, the industrialization of air pollution is serious. Liu Siyan [5] aimed at the monitoring of dry and wet deposition of total nitrogen and nitrogen nutrients in Shaoguan area, it was found that the total nitrogen deposition flux was the same as that of wet deposition, with seasonal variation and easy to be affected by rainfall. Total settlement reached 310.5 $kg \cdot km^{-2} \cdot momth^{-1}$.

The forest coverage in Shaoguan area is more than 60%, but the plant species which can effectively remediate air pollution belong to a few [2], and most of them are subtropical grassy slopes. Although the air resource endowment in Shaoguan area is abundant, the plant distribution is mostly concentrated in the mountainous area, and the central part of Shaoguan is vulnerable to local pollution. The forest type in Shaoguan area is broad-leaved forest, which is favorable to filter dust, so the atmospheric environment in the area with dense plant distribution in atmospheric monitoring is better.

Zhanjiang belongs to the western part of Guangdong province with relatively good air quality, relatively low PM2.5 concentration and good air resource endowment. However, with the urban industrialization seriously affecting the air quality, and a research results [6] show that NO_2 is the most important index of atmospheric constraints in Zhanjiang. Different industrial distribution and different distribution of pollution sources have a certain impact on the environment. The low shelf source is the main source of increasing the concentration of ambient air pollutants in Zhanjiang City. According to the change trend of AQI in Zhanjiang City, it can be seen that AQI shows positive correlation with the change of rainfall.

In view of Zhanjiang area is mostly a broken mountain area, the greening degree is high and the plant distribution is scattered. In the plant distribution of Zhanjiang, there are a large number of repairable air pollution species [2,7-8]. Among them, broad-leaved forests and mangroves account for a large proportion of the total number of plants, which can promote the abatement of air pollution [9].

5. Conclusions

The effect of green plants on purifying the atmosphere has two main aspects: one is to absorb CO_2 and release O_2, so as to maintain the balance of atmospheric environmental chemical composition; The second is to reduce the contents of sulfides, nitrides, halogens and other harmful substances in the air by absorption within the plant resistance range. Atmospheric pollutants (SO_2/NO_2/NH_3/ chloride, photochemical smog, etc.) are harmful to greening plants [10], while greening plants play a role in purifying and preventing air pollution [11]. Urban forest is an important part of urban

ecological environment, and it can absorb air pollution to a certain extent. At the same time, scientific research has proved that plants can evaporate water, absorb dust and toxic gases, secrete fungicosin and so on. Therefore, the effects of plants on atmospheric environment have special function. In general, there are some deficiencies in atmospheric monitoring, the instability of measured data and the incompleteness of plant species survey, which to some extent lead to errors between atmospheric monitoring and plant distribution. With the further research on the reduction of atmospheric pollution by plants, phytoremediation has become an important way to maintain the sustainable development of ecosystem.

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