Journal of Global Change Data & Discovery. 2019, 3(3): 276-283
DOI:10.3974/geodp.2019.03.08
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# Dataset of the Litterfall and Litter Composition of Three Forest Types in the Yimeng Mountain, China

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**Abstract:** To elucidate the features of carbon storage and nutrient cycling in different types of forests, it is important to study the total litterfall of each forest type and the composition dynamics of the litter. This paper presents a study on the litterfall of three forest types (*Pinus thunbergii* Parl. (black pine) plantation, *Quercus variabilis* Bl. (oriental oak) plantation, and natural secondary forest) and the dynamics of the litter compositions. The study was carried out from May 2015 to April 2017 on the state-owned Tashan Forest Farms in Feixian county, Shandong province. For the three types of forests mentioned above, 6, 5, and 6 sample plots were selected, respectively, with a forest age of more than 40 years old. A 1 m × 1 m litter frame was placed in each plot to collect the plant litter each month, which was sorted into needleleaf, broadleaf, branch, fruit, and debris litterfall. The plant litter was then dried to measure its weight and that of each component. The dataset recording the litterfall of the black pine plantation, oriental oak plantation, and natural secondary forest in the Yimeng mountainous region (201505–201704) consists of 8 data files. Data is stored in the .shp, .kmz, and .xlsx formats, with a total size of 41.6 KB (33.3 KB after compression). Datasets are useful data sources that can support forest biomass assessments, carbon sink estimations, and assessments of ecosystem service functions in the context of global change. The results of the analysis on this dataset have been published in the *Acta Ecologica Sinica*, Vol. 38, No. 18, 2018.

**Keywords:** ***Pinus thunbergii*** **Parl. Plantation;** ***Quercus variabilis*** **Bl. Plantation; natural secondary forest; litterfall; litter composition; litter dynamics; Acta Ecologica Sinica**

## 1 Introduction

Plant litter serves as a major link in the material cycle and energy flow of forest ecosys-

**Received:** 17-07-2019; **Accepted:** 02-09-2019; **Published:** 25-09-2019

**Foundations:** National Natural Science Foundation of China (41401329, 41301320, 41501253); Shandong Taishan Scholar (ts201712071)

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**Data Citation:** [1] Wang, Y., Wang, X. L., Sun, A. H., *et al*. Dataset on the litterfall and litter composition of three forest types in the Yimeng mountain, China [J]. *Journal of Global Change Data* & *Discovery*, 2019, 3(3): 276–283. DOI: 10.3974/geodp.2019.03.08.

[2] Wang, Y., Wang, X. L., Zhang, G. N., *et al*. *In situ* dataset of monthly litterfall in the forests of *Pinus thunbergii* Parl., *Quercus variabilis* Bl. and natural secondary forest in Yimeng Mountain, China (201505–201704) [DB/OL]. Global Change Research Data Publishing & Repository, 2019. DOI: 10.3974 /geodb.2019.03.12.V1.

tems[1]. It is also closely related to the maintenance of the forest's carbon sink function[2]. Forest type is a key factor that affects litterfall and the dynamics of its components[3]. It is also an important factor for explaining the differences in the carbon sink capacity[4–5]. Different forest types have different litterfall productions and compositions[3], as well as different amounts of each litter component[6–8]. There are also significant differences in the peak shapes and peak occurrence times[6–7, 9]. Different perspectives also exist concerning litterfall production, litterfall composition, peak shape, and peak occurrence time across different climatic zones and forest types. Litterfall production and its components are mainly affected by temperature, precipitation, and wind speed[6, 10–11], with variations across forest types and climatic zones, but there are differing opinions on this topic. The carbon content in litter is negatively correlated with the annual mean temperature and positively correlated with the annual precipitation[2]. A better understanding of litterfall production and composition within different forest types can provide a data source for forest biomass assessments, carbon sink estimations, and assessments of ecosystem service functions in the context of global change. This type of research is of great significance for forest restoration and climate change response[12].

## 2 Metadata of Dataset

The metadata of the "*In situ* dataset of monthly litterfall in the forests of *Pinus thunbergii* Parl., *Quercus variabilis* Bl. and natural secondary forest in Yimeng Mountain, China (201505–201704)"[13] are shown in Table 1, including names, authors, geographic regions, data year, dataset composition, service platforms of data publishing and sharing, and data sharing policies.

**Table 1** Metadata profile of the "*In situ* dataset of monthly litterfall in the forests of *Pinus thunbergii* Parl., *Quercus variabilis* Bl. and natural secondary forest in Yimeng Mountain, China (201505–201704)"

| Item | Description |
|---|---|
| Dataset full name | *In situ* dataset of monthly litterfall in the forests of *Pinus thunbergii* Parl., *Quercus variabilis* Bl. and natural secondary forest in Yimeng Mountain, China (201505–201704) |
| Dataset short name | LitterfallForestYimengMt.2015_2017 |
| Authors | Wang, Y. W-9881-2019 Shandong Provincial Key Laboratory of Water and Soil Conservation and Environmental Protection, College of Resources and Environment, Linyi University, wangyunsd@163.com<br>Wang, X. L. X-1544-201, Shandong Provincial Key Laboratory of Water and Soil Conservation and Environmental Protection, College of Resources and Environment, Linyi University, wangxinli@ lyu.edu.cn<br>Zhang, G. N. W-9900-2019, College of Agriculture and Forestry Science, Linyi University, gnzhang@lyu.edu.cn<br>Liu, B. X-7486-2019, Shandong Provincial Key Laboratory of Water and Soil Conservation and Environmental Protection, College of Resources and Environment, Linyi University, liubo0539@126.com<br>Gao, Y. W-9920-2019, Shandong Provincial Key Laboratory of Water and Soil Conservation and Environmental Protection, College of Resources and Environment, Linyi University, gaoy@lyu.edu.cn<br>Zhao, X. Y. X-1286-2019, Shandong Provincial Key Laboratory of Water and Soil Conservation and Environmental Protection, College of Resources and Environment, Linyi University, synzxy@sina.com<br>Mei, H. P. X-7730-2019, State-owned Tashan Forest Farm, Feixian county, Shandong, 597267892@qq.com |

(***To be continued on the next page***)

(***Continued***)

| Item | Description |
|---|---|
| Geographical region | State-owned Tashan Forest Farm, Feixian county, Shandong, located between 35°10′N–36°00′N and 117°35′E–118°20′E. |
| Year | 2015–2017 |
| Data format | .shp, .kmz, and .xlsx |
| Data size | 33.3 KB (after compression) |
| Data files | The dataset includes: (1) geographic location data for the sample plots; (2) monthly litterfall from May 2015 to April 2017 in three forest types: black pine plantation, oriental oak plantation, and natural secondary forest; 3) components of the monthly litterfall from May 2015 to April 2017 in the three forest types, including needleleaf, broadleaf, branch, fruit, and debris litterfall |
| Foundations | National Natural Science Foundation of China (41401329, 41301320, 41501253); Shandong Taishan Scholar Project (ts201712071); College Students Innovation and Entrepreneurship Project (201610452194) |
| Data publisher | Global Change Research Data Publishing and Repository, http://www.geodoi.ac.cn |
| Address | No. 11A, Datun Road, Chaoyang District, Beijing 100101, China |
| Data sharing policy | ***Data*** from the Global Change Research Data Publishing & Repository includes metadata, datasets (data products), and publications (in this case, in the *Journal of Global Change Data & Discovery*). ***Data*** sharing policy includes: (1) ***Data*** are openly available and can be free downloaded via the Internet; (2) End users are encouraged to use ***Data*** subject to citation; (3) Users, who are by definition also value-added service providers, are welcome to redistribute ***Data*** subject to written permission from the GCdataPR Editorial Office and the issuance of a ***Data*** redistribution license, and; (4) If ***Data*** are used to compile new datasets, the 'ten percent principal' should be followed such that ***Data*** records utilized should not surpass 10% of the new dataset contents, while sources should be clearly noted in suitable places in the new dataset[14] |
| Communication and searchable system | DOI, DCI, CSCD, WDS/ISC, GEOSS, China GEOSS |

## 3 Methods of Data Development

The data in this study was gathered through in-situ field monitoring. From May 2015 to April 2017, 17 sample plots were selected from Tashan National Forest Park (35°10′N–36°00′N, 117°35′E–118°20′E) in Feixian county, Shandong province. These plots had a similar history of land use and a forest age of about 40 years. They included 6 plots in black pine plantation, 5 in oriental oak plantation, and 6 in natural secondary forest.

### 3.1 Calculation Methods

A 1 m × 1 m sieve was placed in each plot to collect the plant litter every month. The collected litter was then brought back to the laboratory and sorted into needleleaf, broadleaf, branches, fruits, and debris. The samples were dried to a constant weight in an oven at 80 ℃. One-way analysis of variance (ANOVA) was used to analyze the differences in litterfall and composition among the different forest types. The specific data processing methods were as follows: (1) the Shapiro-Wilk test was used to test the normality of the dataset. (2) If the data was normally distributed or transformed into a normal distribution, one-way ANOVA was used to analyze the differences in the litterfall and composition among the different forest types. For the multiple range test, we used the Tukey's range test (equal variance) or the Dunnett's range test (unequal variance). (3) When the data was not normally distributed, even after transformation, a non-parametric test was performed. $P < 0.05$ indicated that the difference was significant.

### 3.2 Technical Route

The technical route is shown in Figure 1. The experiment was carried out at the Tashan National Forest Park in Feixian county, Shandong province, China (35°10′N–36°00′N, 117°35′E–118°20′E). We selected a total of 17 plots, including 6 in black pine plantation, 5 in oriental oak plantation, and 6 in natural secondary forest. A 1 m × 1 m sieve with a mesh size of 1 mm was placed in each plot, approximately 30 cm above the ground, to collect the litter. The sieves were placed from May 2015 to May 2017, and the litter was collected monthly. The litter was brought back to the laboratory, sorted into needleleaf, broadleaf, fruits, and debris, and then dried to a constant weight at 80 °C. One-way ANOVA was performed on the data using SPSS 16.0 software, to analyze the effects of the different forest types on the litter components.

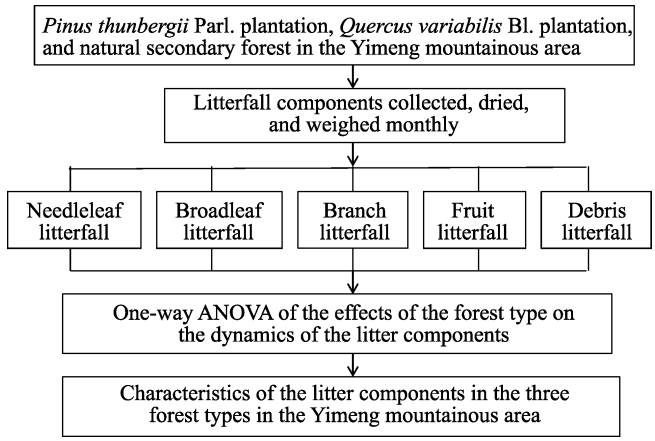


**Figure 1** Technical route of data development

## 4 Data Results and Verification

### 4.1 Dataset Composition

The dataset consists of the following components: (1) geographic location data of the sample plots; (2) monthly litterfall of the three forest types (black pine plantation, oriental oak plantation, and natural secondary forest) from May 2015 to April 2017; and 3) components of the monthly litterfall in the three forest types from May 2015 to April 2017, including needleleaf, broadleaf, branch, fruit, and debris litterfall.

### 4.2 Data Results

The time span of the data is between May 2015 and April 2017. The spatial distribution of the data is between 35°10'N−36°00'N and 117°35'E–118°20'E.

The litter dynamics of black pine plantation, oriental oak plantation, and natural secondary forest in the Yimeng mountainous region has the following characteristics. There were no significant differences concerning the total litterfall among the three forest types. The total litterfall of the three forest types in 2015 was 3,212 kg/hm$^2$, 3,256 kg/hm$^2$, and 3,368 kg/hm$^2$, respectively, and that in 2016 was 3,295 kg/hm$^2$, 3,838 kg/hm$^2$, and 4,290 kg/hm$^2$, respectively. The total litterfall of the three forest types showed a bimodal curve with the higher peak in October-November and the lower peak in April-May, whereas the minimum litterfall occurred at different times. In the black pine plantation, the minimum appeared in December, while the minimum occurred in July for the other two forest types (Figure 2[3]).

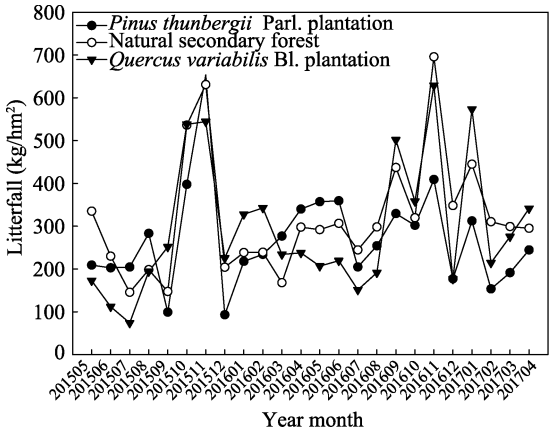


**Figure 2** Monthly dynamics of the total litterfall[3]

The litter composition of the different forest types showed the following patterns. The annual variation of the different litter components was also bimodal, but the peaks occurred at different times. The peaks for the broadleaf litterfall occurred in September–November and January–March. The peaks for the needleleaf litterfall occurred in October–November and April–May. The peaks for the branch litterfall occurred in October–November and May–June. The peak for the fruit litterfall occurred in August–October. The peaks for the debris litterfall occurred in June–July and August–September (Figure 3[3]). The quantity and proportion of needleleaf litterfall and the quantity of debris litterfall were higher in black pine plantation than those of the natural secondary forest, which in turn were higher than those of oriental oak plantation. In contrast, the quantity and proportion of broadleaf litterfall and the proportion of fruit litterfall showed the opposite trends (Figure 3). There were no significant differences concerning the quantity of the branch litterfall among the forest types (Figure 3).

### 4.3 Verification of Data Results

The data in this paper was obtained from in-situ field sampling. In November 2014, the research team conducted a survey on the vegetation of the state-owned Tashan Forest Farm in Feixian county, Shandong, and selected 17 sample plots with a similar land use history, good representativeness, and a forest age of about 40 years. GPS was used to record the latitude and longitude of the survey points and the vegetation type was also recorded. Litter frames were placed in the field to collect the litter, which was transferred to the laboratory every month. The litter was manually sorted in the laboratory and dried at 80 ℃ to a constant weight, to obtain the monthly litterfall and litter composition of the three forest types. The results have a high reliability and can accurately reflect the litterfall and litter dynamics of the three forest types in the Yimeng mountainous region.

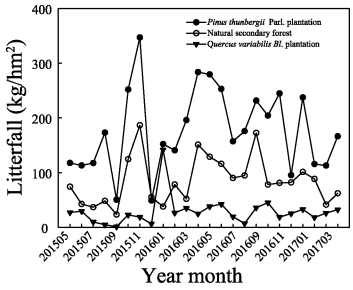


**Figure 3** Needle leaf litterfall

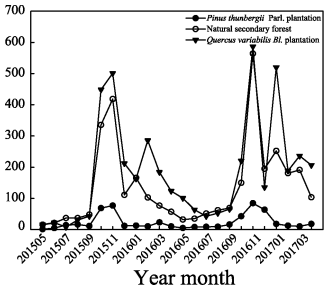


**Figure 4** Broadleaf litterfall

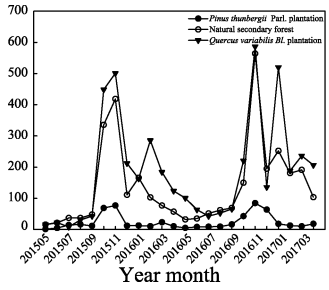


**Figure 5** Broadleaf litterfall

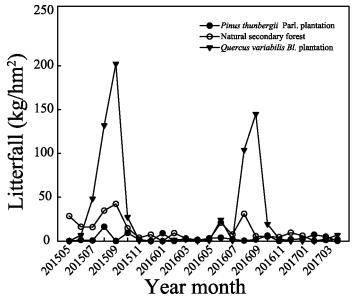


**Figure 6** Fruit litterfall

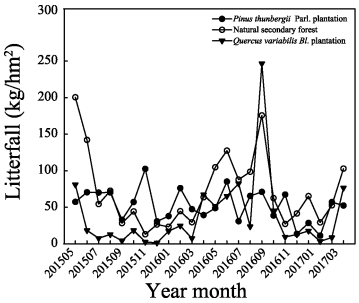


**Figure 7** Debis litterfall

## 5 Discussion and Conclusion

In this study, no significant differences were found concerning the total litterfall among the natural secondary forest, oriental oak plantation, and black pine plantation. This result is similar to the findings from most previous studies[6–8,11]. However, there are also different explanations for this[6–8,11], which are related to the composition of the plant communities, as well as their photosynthesis efficiency, niche differentiation, and productivity level[7]. The relative size of litterfall in natural secondary forests and plantation varies with climatic zones and forest types[3]. There are also different perspectives on the peak occurrence times and peak shapes of the litterfall in different forest types, which can be affected by environmental factors, such as forest type, climatic zone, elevation, and extreme climate[7,14–15]. Plant litter mainly accumulates in autumn and winter, with temperature being the main factor for the intra-annual variation of litterfall[3].

In this study, the leaf litterfall of all three forest types showed a bimodal annual variation, with peaks occurring in September-November and April-May. Previous studies adopted different perspectives regarding the peak shape, peak occurrence time, peak size, and monthly variation in the leaf litter dynamics[6–8]. Leaf litterfall is affected by temperature and maximum rainfall[3]. Most fruit litterfall is concentrated in August-September, mainly in autumn and winter. Some studies have concluded that the peaks of fruit litterfall in different forest types mainly occur in May, August, and October, and the difference is significant[6–8]. This may be related to the biological characteristics of tree species, their growth allocation strategies[16], climatic zone-induced temperature[11], rainfall[7], microclimate[17], and extreme climate[3,14].

The proportion of fruit litterfall in black pine plantation was as low as 1.2%. The fruit input

of black pine plantation was not only significantly lower than that of *Oriental oak* plantation (12.0%), but also lower than the fruit litterfall proportion in temperate pine forests[7,18]. From the perspective of the succession of plant community structure, Tashan plants showed a transition trend from needle-leaved forests to broad-leaved forests[19]. From the perspective of soil fertility, black pine plantation not only had a lower soil fertility than *Oriental oak* plantation and *Pinus densiflora* plantation, they also showed a decrease in soil fertility indicators, such as soil organic matter content, total nitrogen content, and available potassium content, along with succession[19]. Therefore, from the perspectives of reproductive organ input, plant community succession, and soil fertility succession, black pine plantation are not suitable for further introductions into the Yimeng mountainous region. The proportion of fruit litterfall in *Oriental oak* plantation was significantly higher than that in natural secondary forest (5.5%) and *P. thunbergii* plantation. The higher input of resources to reproductive organs is beneficial for producing offspring. From the perspectives of plant community succession[19] and soil fertility succession[20], oriental oak plantation is suitable to be planted in the Yimeng mountainous region. In addition, the natural secondary forest in the Yimeng mountainous region had relatively high annual litterfalls of good quality. Therefore, protecting natural secondary forest has far-reaching significance for improving the carbon storage, nutrient cycling capacity, and soil fertility maintenance capacity of forest ecosystems.

The data in this study was obtained through in-situ field surveys and sampling. It has a relatively high accuracy and good representativeness. The data can serve as a reference for forest biomass assessments, carbon sink estimations, ecosystem service function assessments, and forest restoration in the Yimeng mountainous region (and even the entire warm temperate zone in China) within the context of global change.

***Author Contributions***

Wang, Y. created the overall design for the dataset development. Wang, Y., Wang, X. L., Zhang, G. N., Gao, Y., Zhao, X. Y., and Mei, H. P. collected and processed the litterfall data. Wang, Y., Wang, X. L., Sun, A. H., and Liu, B. wrote the data paper.

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