Species and spatial differences of vegetation rainfall interception capacity - a synthesis and meta-analysis in China

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October 10, 2020

Abstract

China has carried out many ecological restoration projects in the past. At present, there are large spatial differences in the hydrological effects of forest ecosystems in different regions of the country under heterogeneous conditions, which is not conducive to the macro guidance of ecological restoration projects. Canopy interception is an important link in the water cycle of the ecosystem. This paper attempts to use this index as a bridge to connect the research literature of existing ecological sites, so as to evaluate the differences in water resources distribution in different regions and vegetation ecosystems and analyze the main reasons for the differences. We combined canopy interception rate (I0) and canopy water storage ability (I) to interpret canopy interception, and collected site related geographic, meteorological and ecosystem structure information simultaneously in the literature to build up an original dataset. Analysis on the database showed that the comprehensive interception capacity of vegetation in the south was generally higher than that in the north, which was dominated by shrubs, and that the tree species had interception advantages. Mixed forest showed the best comprehensive interception capacity, while pure tree forest had better interception potential than shrubbery due to its biomass advantage. The actual interception capacity of shrubbery was better than pure tree forest due to the advantages of stand density and the dry climate. Results from the evaluation of canopy interception ability using different indexes were not consistent, meaning that evaluating canopy interception with multiple indexes may be more objective. The study also highlights that the current structural characteristics of shrubby forests in northern China may be counterproductive to mitigating drought, reducing the structural density of a given stand will increase the opportunity for precipitation to reach the surface, thereby increasing the amount of water available to ecosystems in arid areas. Maintaining the healthy growth of mixed forests is still the right choice for humid areas in the south.

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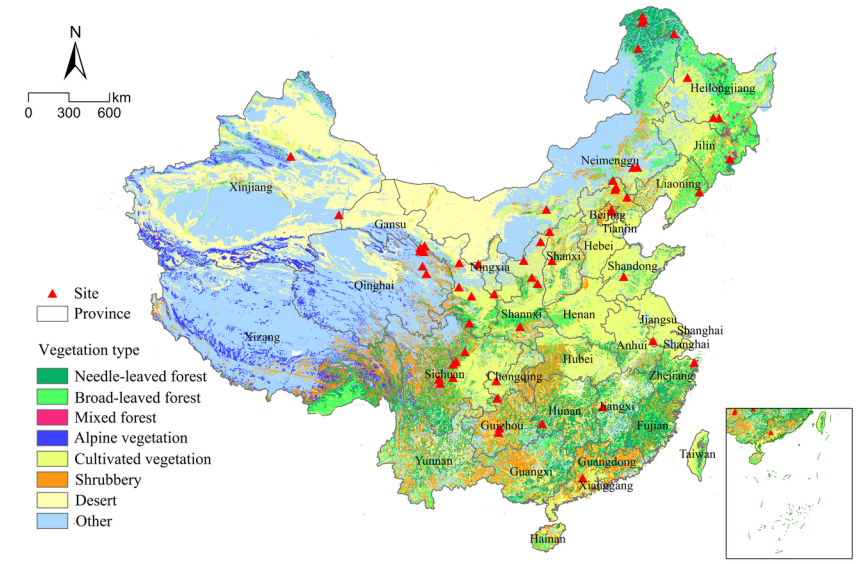

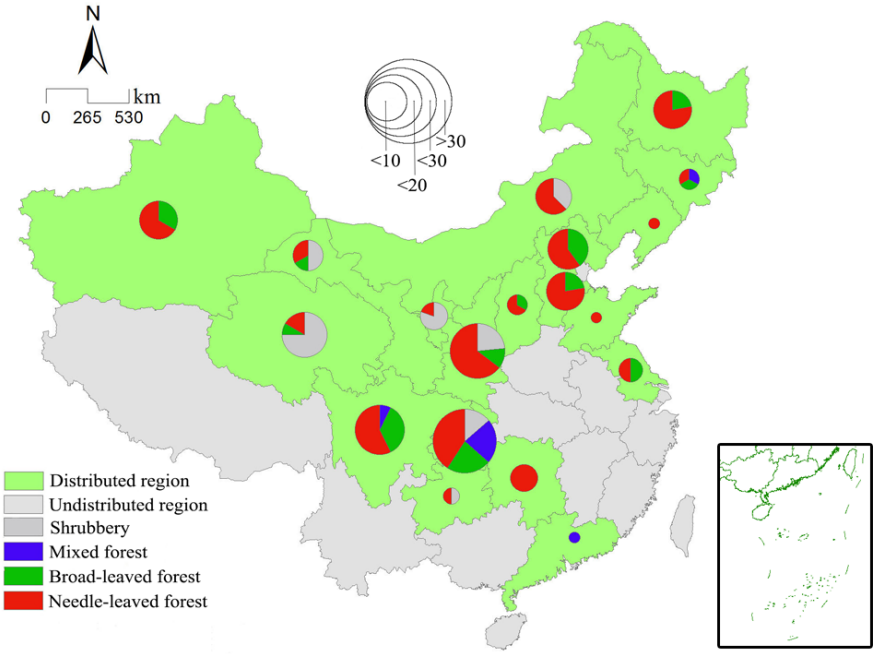

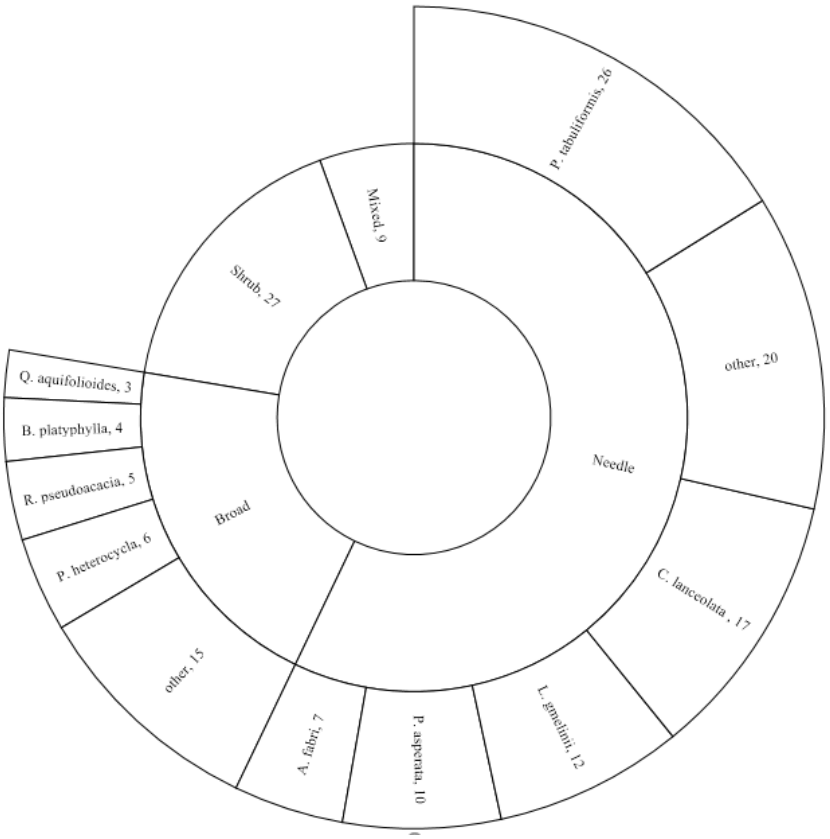

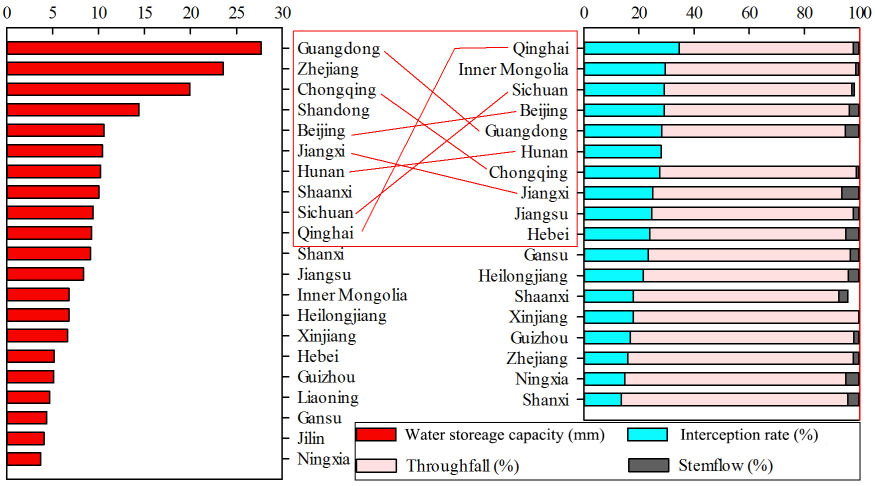

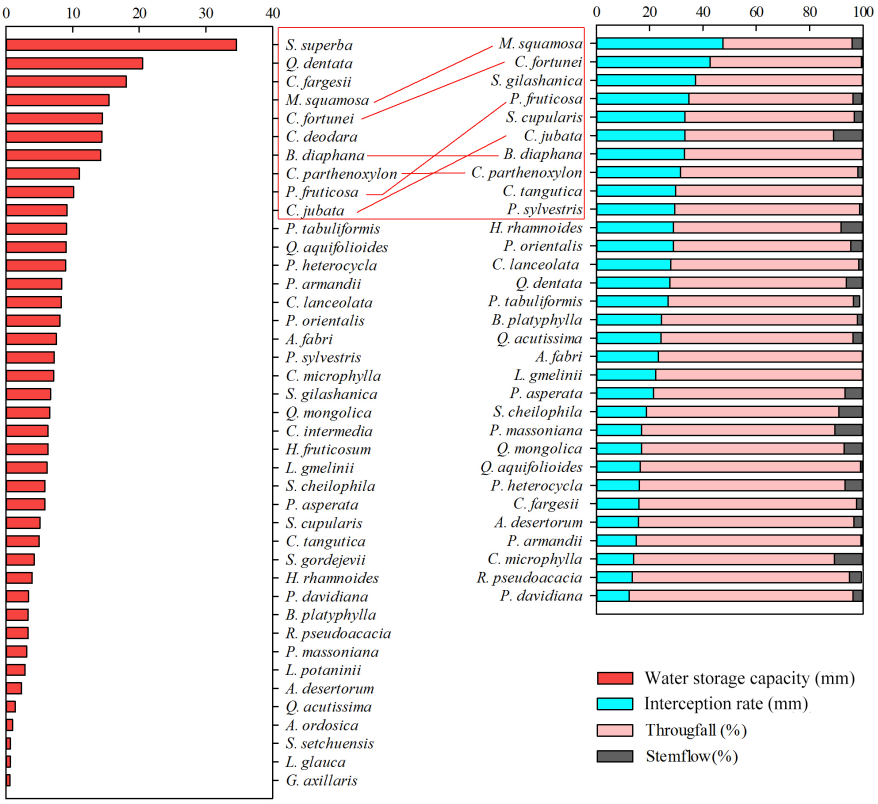

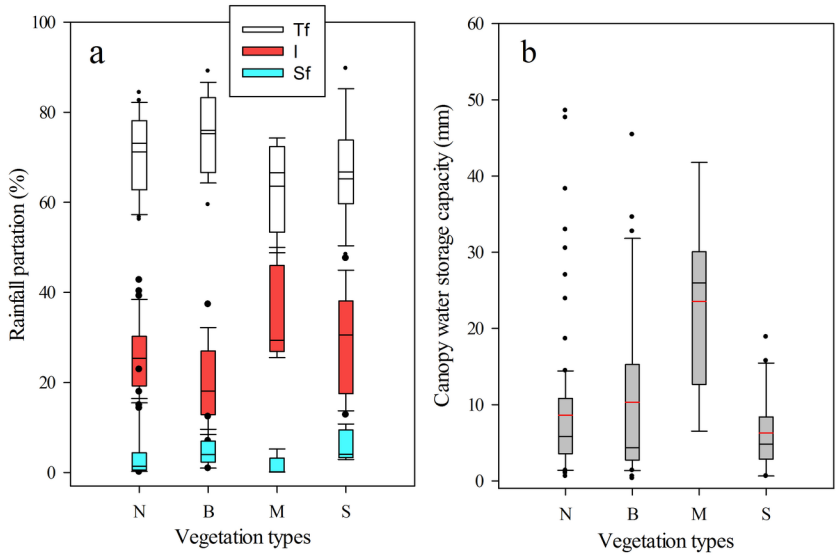

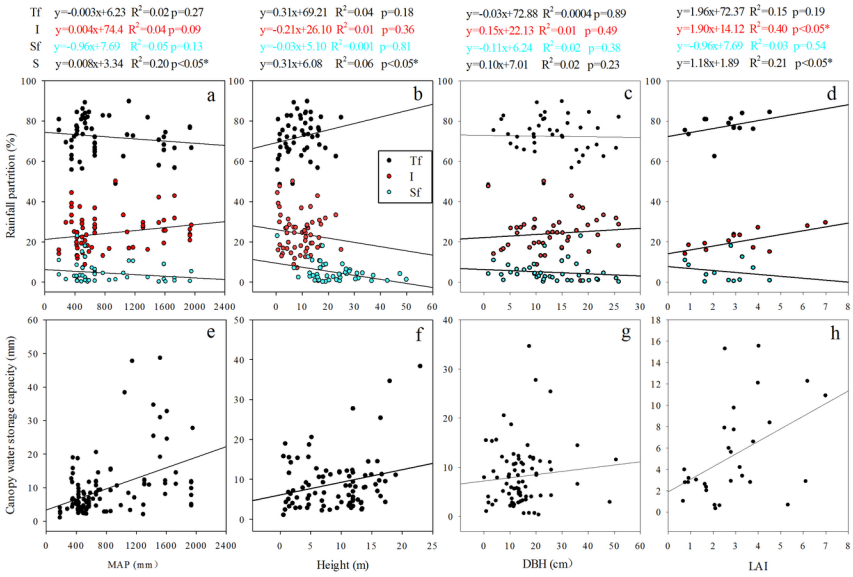

Table 1. Major afforestation programs in China.

Six key afforestation projects	Region	Project dates	Project goals	Planted area (million ha)
Three Norths Shelter Forest SystemProject (Phase IV)	Northern and western provinces	2001–2010	Desertification control	27.5
Natural Forest Conservation Program	Northern and central China; 17 provinces	2000–2010	Soil and water conservation	4.4
Sand Control Program	Northern China; 5 provinces	2001–2010	Desertification control	5.2
Grain for Green Project	All of China except the southeastern provinces	2001–2010	Soil and water conservation	32
Forest Industrial Base Development Program	Areas of eastern China where precipitation is more than 400 mm; 17 provinces	2001–2015	Wood production	13.3
Wildlife Conservation and Nature Reserves Development Program	All of China	2001–2010	Wildlife conservation and the development of nature reserves	—

Sourece: Wang et al., 2007;Cao et al., 2011.

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`Table 2.pdf` available at https://authorea.com/users/366162/articles/485961-species-and-spatial-differences-of-vegetation-rainfall-interception-capacity-a-synthesis-and-meta-analysis-in-china

Table 3. Stand characteristics

Variables	Number of studies	Percentage of studies	Range	
			Minimum	Maximum
Density (trees ha^{-1})	62	38.75	209 (Diao et al, 2016; Song et al., 2016)	17900 (He et al., 2008)
Age (years)	59	36.88	10 (Pei and Zheng, 1996)	170 (Diao et al, 2016)
Height (m)	93	58.13	0.6 (Liu et al., 2012; Ma et al., 2017)	39.49 (Hao, 2007)
DBH (cm)	81	50.63	0.19 (Peng et al., 2014)	50.78 (Diao et al, 2016)
Canopy density	120	75.00	0.2 (Hao et al., 2009)	0.95 (Song, 2015; Wang, 2008)
LAI (m^2 m^{-2})	31	19.38	0.67 (Liu et al., 2012)	7 (Sun et al., 2011b)

Variables included: density, age, height, DBH (diameter at breast height and LAI (leaf area index), the number and percentage of studies, minima and maxima of these variables for all the studies reviewed.