Journal of Global Change Data & Discovery. 2021, 5(2): 156-161
www.geodoi.ac.cn

Global Change Research Data Publishing & Repository

Dataset of Foliar Element Concentrations of Plants from Natural Forests with Different Substrates in Southern China

Cui, P. X.[1] Cao, K. F.[1*] Tian, S. Q.[1] Fu, P. L.[2] Bai, K. D.[3] Jiang, Y. J.[2]

1. State Key Laboratory for Conservation and Utilization of Agrobioresources, College of Forestry, Guangxi University, Nanning 530004, China;
2. Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences, Mengla 666303, China;
3. Institute of Botany of Guangxi Zhuang Autonomous Region and Chinese Academy of Sciences, Guilin 541006, China

Abstract: The foliar concentrations of nutrient elements play an important role in plant growth and reproduction, which can reflect the absorption or accumulation of elements by plants growing with different substrates. From August to September 2006, leaves of 23 species were collected from a tropical karst forest in Xishuangbanna, Yunnan. In July 2013, leaves of 40 species were collected in another tropical karst forest in Nonggang, Guangxi. From August to September 2015, leaves of 12 mangrove species were collected in Hainan. The foliar concentrations of N, P, K, Ca, Mg, Fe, Mn, Zn, Na, etc. were determined by chemical analysis. The dataset includes: (1) species names, Latin names and leaf element concentrations of 23 plant species in Xishuangbanna karst forest; (2) species names, Latin names and leaf element concentrations of 40 plant species in the karst forest of Nonggang National Nature Reserve; (3) species names, Latin names and leaf element concentrations of 12 plant species in the Qinglangang Mangrove Nature Reserve. The dataset is composed of three data tables in .xlsx data format in 24 KB.

Keywords: tropical karst forest; mangroves; foliar element concentrations

DOI: https://doi.org/10.3974/geodp.2021.02.07

CSTR: https://cstr.escience.org.cn/CSTR:20146.14.2021.02.07

Dataset Availability Statement:

The dataset supporting this paper was published and is accessible through the *Digital Journal of Global Change Data Repository* at: https://doi.org/10.3974/geodb.2021.01.17.V1 or https://cstr.escience.org.cn/CSTR:20146.11.2021.01.17.V1.

1 Introduction

The nutrient elements play an important role in the growth and reproduction of plants. The concentrations of these elements can reflect the abundance and deficiency of elements in the

Received: 01-02-2021; **Accepted:** 29-05-2021; **Published:** 25-06-2021

Foundations: National Natural Science Foundation of China (31670406); Key R & D projects of Guangxi (Guike AB16380254); Guangxi Bagui scholar talent project (C33600992001)

***Corresponding Author:** Cao, K. F., College of Forestry, Guangxi University, kunfangcao@gxu.edu.cn

Data Citation: [1] Cui, P. X., Cao, K. F., Tian, S. Q., *et al*. Dataset of foliar element concentrations of plants from natural forests with different substrates in southern China [J]. *Journal of Global Change Data & Discovery*, 2021, 5(2): 156−161. https://doi.org/10.3974/geodp.2021.02.07. https://cstr.escience.org.cn/CSTR:20146.14.2021.02.07.

[2] Cui, P. X., Cao, K. F., Tian, S. Q., *et al*. Dataset of foliar element concentrations of plants from natural forests with different substrates in Southern China [J/DB/OL]. *Digital Journal of Global Change Data Repository*, 2021. https://doi.org/10.3974/geodb.2021.01.17.V1. https://cstr.escience.org.cn/CSTR:20146.11.2021.01.17.V1.

soil environment[1–4]. There are differences in the process of soil formation in different habitats, which makes the accumulation of elements in the environment different.

The soil parent material of karst is soluble carbonate rock, and its limestone and dolomite are rich in Ca and Mg elements. Its soil pH value is around 7, and the soil layer is shallow and discontinuous. The bare rock rate is high, the water holding capacity is low, the nutrient is poor, and the habitat is easy to be degraded by human interferences. Mangroves grow in the coastal intertidal zone, and some also grow in the upper edge of the intertidal zone. Affected by the sea water, the sandy soil is salinized and contains acid sulfate in a reduced state[5].

This study used the data with an evergreen broad-leaved forest leaf element concentration data from the literature for comparison[7]. The nutrient concentration of leaves in three habitats with different substrate conditions was analyzed and the following questions were addressed: (1) which elements are enriched or lacked in leaf in different habitats? (2) differences in leaf nutrient concentrations and ratios between different habitats?

2 Metadata of the Dataset

The metadata of the Dataset of foliar element concentrations of plants from natural forests with different substrates in southern China[8] is summarized in Table 1, including dataset name, authors, year, data format, data size, data files, data publisher, and data sharing policy, etc.

Table 1 Metadata summary of the Dataset of foliar element concentrations of plants from natural forests with different substrates in southern China

Items	Description
Dataset full name	Dataset of foliar element concentrations of plants from natural forests with different substrates in southern China
Dataset short name	FoliarElementSouthernChina
Authors	Cui, P. X., College of Forestry, Guangxi University, 870925644@qq.com Cao, K. F., College of Forestry, Guangxi University, kunfangcao@gxu.edu.cn Tian, S. Q., College of Forestry, Guangxi University, 869899632@qq.com Fu, P. L., Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences, fpl@xtbg.org.cn Bai, K. D., Institute of Botancy of Guangxi Zhuang Autonomous Region and Chinese Academy of Sciences, bkd008@126.com Jiang, Y. J., Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences, jyj@xtbg.org.cn
Geographical region	Green Stone Forest Park in Xishuangbanna, Yunnan, 101°16′53.54″E, 21°54′43.39″N; Nonggang National Nature Reserve, Guangxi, 106°42′28″E–107°04′54″E, 22°13′56″E–22°39′09″N; Qinglangang Mangrove Nature Reserve, Hainan, 110°30′E–110°02′E, 19°15′N–20°09′N
Year of sampling	2006, 2013, 2015
Data format	.xlsx
Data size	24 KB (20.7 KB after compression)
Data files	The dataset consists of 1 compressed data file package, including 3 Excel data: leaf element concentrations of 23 plant species in a tropical karst forest, Xishuangbanna leaf element concentrations of 40 plant species in a tropical karst forest of Nonggang National Nature Reserve leaf element concentrations of 12 plant species in Qinglangang Mangrove Nature Reserve
Foundations	National Natural Science Foundation of China (31670406); Key R & D projects of Guangxi (Guike AB16380254); Guangxi Bagui scholar talent project (C33600992001)
Data publisher	Global Change Research Data Publishing & 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 (in the *Digital Journal of Global Change Data Repository*), and publications (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 per cent 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[9]
Communication and searchable system	DOI, CSTR, Crossref, DCI, CSCD, CNKI, SciEngine, WDS/ISC, GEOSS

3 Methods

3.1 Collection and Determination

In this study, 23 species of 18 families in a tropical karst forest in the greenstone Forest Park, Xishuangbanna Tropical Botanical Garden, Yunnan province, 40 species of 17 families in a tropical karst forest in the Nonggang Nature Reserve, and 12 mangrove species of 8 families in Qinglangang Mangrove Nature Reserve in Hainan province were selected.

The fresh leaves were washed and dried in the air, and then dried to constant weight at 100 ºC by oven. The leaves were ground and crushed by automatic ball mill, and then passed through 60 mesh sieve for storage. The sample powder was digested with HNO_3-$HClO_4$, acidolysis with hydrochloric acid and filtered. The concentrations of P, K, Ca, Mg, S, Fe, Mn, B, Zn and Na were determined by inductively coupled plasma emission spectrometer (ICP AES-iCAP6300, Thermo Fisher Scientific, MA, USA). Si was determined by mass method, after acidolysis and filtration, the filter paper and the residue are put into the crucible for drying at 105 ºC, and then transferred to the high temperature furnace for burning at 800 ºC, cooling and weighing.

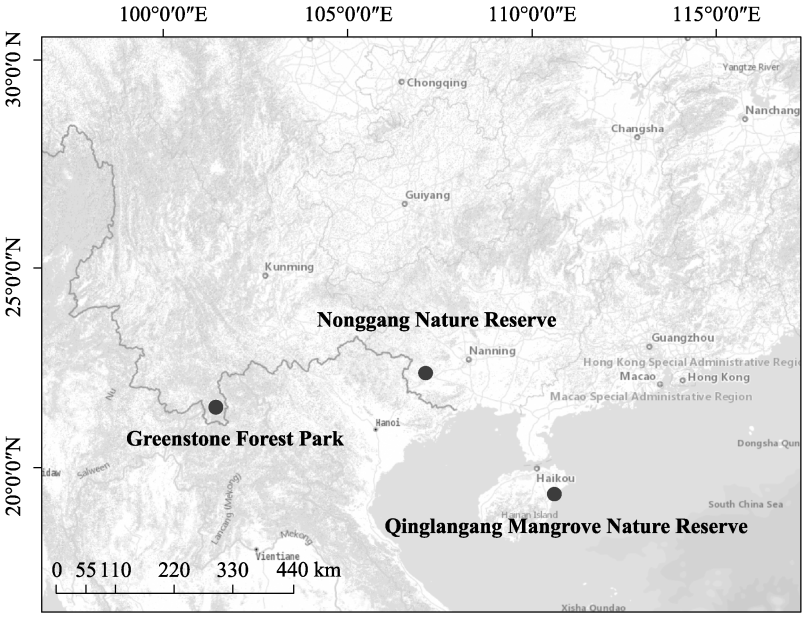

Figure 1 The location map of the study sites

3.2 Statistical Analysis

IBM SPSS statistics 20 software was used to analyze the data. One sample t test was used to analyze whether there was significant difference between the ratio of elements to N in plant leaves and the national level[10]. The data of ratio of C, Zn, B, Cu and N were measured by the data of demand concentration of terrestrial higher plants[11]. In order to improve the normality, logarithmic transformation was used in the correlation analysis.

3.3 Technical Route

The development process of Dataset of foliar element concentrations of plants from natural forests with different substrates in southern China was shown in Figure 2.

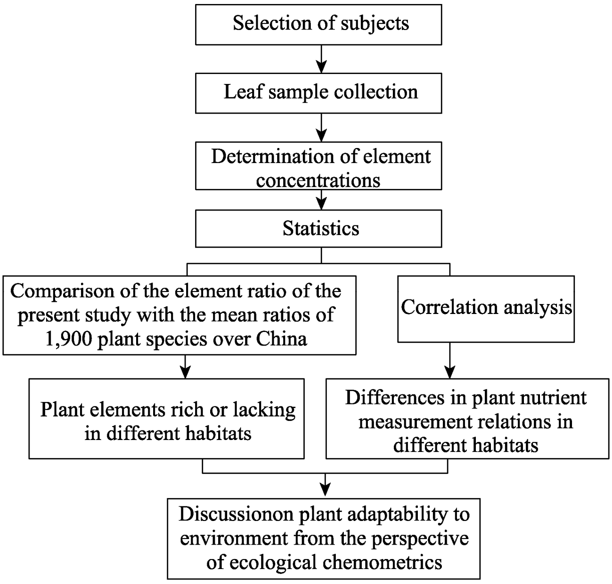

Figure 2 The technical route of the analysis of foliar element concentrations of plants from natural forests with different substrates in southern China

4 Data Results and Validation

4.1 Data Products

The dataset consists of one compressed data file package, including three Excel data files:

(1) Xishuangbanna Green Stone Forest Park plant leaf element concentration data table, including C, N, P, K, Ca, Mg, Fe, Mn, Na, Zn, B elements, the format was .xlsx and the data size was 13 KB.

(2) Nonggang National Nature Reserve plant leaf element concentration data table, including N, P, K, Ca, Mg, Fe, S, Cu and Zn elements. The format was .xlsx and the data size was 14 KB.

(3) Qinglangang Mangrove Nature Reserve plant leaf element concentration data table, including C, N, P, K, Ca, Mg, Fe, Mn, Na, Zn, S and Si. The data format is .xlsx and the data size is 11 KB.

4.2 Data Results

The results of this study were compared with the data of leaf element concentration of evergreen broad-leaved forest plants from literature[7]. The table of leaf element concentration and N ratio of plants in different habitats was shown in literature [12]. The results were as follows:

The leaves of karst forest plants in Xishuangbanna and Nonggang were generally rich in Ca and Mg. Due to the difference of lithology, the plants in Nonggang area with certain dolomite in substrate were rich in Mg, K, Fe, Na and Zn were deficient in Karst Forest in Xishuangbanna; Due to the particularity of dolomite mineral composition and slower weathering rate, the concentrations of K, Zn and S in leaves of karst plants in Nonggang were higher. Mangrove plants were rich in P, Ca, Mg, Na and S elements. A large number of ions in the seawater environment enter into the soil and were absorbed and utilized by plants, which improves the nutrient concentration of mangroves. In the high salt environment, Na was enriched in leaves. Mangrove plants were deficient in Fe, Si and Zn. The plants in subtropical evergreen broad-leaved forest were greatly affected by acid soil, with a large enriched amount of Mn deficient of P and Na. Compared with other habitats, the concentrations of N, P, Ca and Mg in the subtropical evergreen broad-leaved forest were lower. The N/P ratios of karst forest plants in Xishuangbanna and Nonggang were 14.27 and 18.26, respectively, indicating that the former was limited by both N and P, while the latter was mainly limited by P. The N/P ratio of mangrove was 13.12, which was limited by N. The plants in the evergreen broad-leaved forest were seriously deficient of P, and the N/P ratio was 26.27.

According to Table 2, there was a significant positive correlation between N and P in leaves of plants on different substrates. This stable synergistic relationship was a general rule for plants to adapt to the environment. There was a positive correlation between Ca and Mg in Karst forests and evergreen broad-leaved forest, but there was no correlation between them in the mangrove forest. The analysis showed that Na salt stress increased the absorption of Mg and changed the balance of Ca and Mg. There was a synergetic relationship between N and K in mangrove and evergreen broad-leaved forest, but the synergetic relationship between N and K was changed due to the synergetic effect of Ca and Mg on K absorption in the karst environment. P and Zn showed a synergistic relationship in karst forest and mangrove forest, which was related to the two elements involved in enzyme synthesis in plant metabolism. Mangrove plants showed antagonistic relationship between K and Mn, but there was no correlation between these two elements in karst forest and evergreen broad-leaved forest. There was a positive correlation between S and P in Nonggang karst forest, which could help karst plants alleviate the symptoms of P deficiency, but there was no correlation between them in the mangrove plants with high P content.

Table 2 The correlation between leaf element concentrations in different habitats

Correlation Element	Habitat	Fitting Equation	R^2
N-P	Xishuangbanna Karst Forest	$y = 0.7157x - 0.7573$	0.450,6
	Nonggang Karst Forest	$y = 1.1043x - 1.3841$	0.638,9
	Mangrove	$y = 0.8973x - 0.978$	0.598,6
	Broad-leaved Evergreen Forests	$y = 1.3318x - 1.8027$	0.594,1
Ca-Mg	Xishuangbanna Karst Forest	$y = 0.4229x - 0.1494$	0.482,4
	Nonggang Karst Forest	$y = 1.5674x - 1.3649$	0.506,7
	Mangrove	$y = -0.0258x + 0.6868$	0.002,0
	Broad-leaved Evergreen Forests	$y = 0.5073x - 0.2817$	0.356,3
N-K	Xishuangbanna Karst Forest	$y = 0.3133x + 0.4049$	0.048,9
	Nonggang Karst Forest	$y = 0.4282x + 0.4813$	0.062,0
	Mangrove	$y = 1.0472x - 0.2739$	0.355,2
	Broad-leaved Evergreen Forests	$y = 1.0712x - 0.3315$	0.348,6
P-Zn	Xishuangbanna Karst Forest	$y = 0.5609x - 1.7635$	0.176,3
	Nonggang Karst Forest	$y = 0.9394x - 1.2202$	0.356,4
	Mangrove	$y = 0.9342x - 1.9231$	0.469,8
K-Mn	Xishuangbanna Karst Forest	$y = -0.4259x - 0.8155$	0.027,2
	Mangrove	$y = -1.3747x + 0.249$	0.473,3
	Broad-leaved Evergreen Forests	$y = 0.3125x - 0.5022$	0.020,0
P-S	Nonggang Karst Forest	$y = 0.7561x + 0.3312$	0.622,2
	Mangrove	$y = -0.0743x + 0.5284$	0.005,6

5 Discussion and Conclusion

In this study, the element data of plant leaves in three habitats were compared with the data of 1,900 plant elements in China. It was found that the abundance and deficiency characteristics of plant elements in different habitats were different. The reasons for the differences include: parent material of soil formation in karst forest[13], lithology difference[14], slow soil formation rate[15]; The high salt stress and the input of elements in seawater in the intertidal environment of mangroves; Acid soil with low pH value in evergreen broad-leaved forest. Through the correlation analysis of elements, it was found that the quantitative relationship of elements in plant leaves in different habitats changed, which was related to the nutrient supply in different soil substrates and the physiological characteristics of plants.

Author Contributions

Cao, K. F. designed the algorithms of dataset; Tian, S. Q., Fu, P. L., Bai, K. D., Jiang, Y. J. collected samples and measured data; Cui, P. X. contributed to the data analysis and wrote the data paper.

Conflicts of Interest

The authors declare no conflicts of interest.

References

[1] He, J. S., Han, X. G. Ecological stoichiometry: searching for unifying principles from individuals to ecosystems [J]. *Chinese Journal of Plant Ecology*, 2010, 34(1): 2–6.

[2] Sterner, R. W., Elser, J. J. Ecological Stoichiometry: the Biology of Elements from Molecules to the Biosphere [M]. *New Jersey*: *Princeton University Press*, 2002: 1183.

[3] Güsewell, S. N:P ratios in terrestrial plants: variation and functional significance [J]. *New Phytologist*, 2004, 164(2): 243–266.

[4] Agren, G. I. The C:N:P stoichiometry of autotrophs-theory and observations [J]. *Ecology Letters*, 2010, 7(3): 185–191.

[5] Chen, H., Qiu, M. H. Research on the growing adaptability of species of mangrove in different substrate. *Tropical Forestry*, 2015, 43(2): 4–6.

[6] Hui, C. Y., Shi, S., Feng, J. C., *et al*. Analysis on the content and stoichiometry of 15 nutrient elements of zonal *Stipa* plants in Inner Mongolia [J]. *Journal of Yunnan University*: *Natural Sciences Edition*, 2019, 41(2): 380–389.

[7] Xu, Y. M., Kuang, Y. W., Gong, Y. N., *et al*. Chemical element contents in leaves of 16 dominant species from evergreen broad-leaved forest at Nanling Nature Reserve [J]. *Forest Research*, 2013, 26(6): 759–765.

[8] Cui, P. X., Tian, S. Q., Cao, K. F., *et al*. Dataset of foliar element concentrations of plants from natural forests with different substrates in southern China [J/DB/OL]. *Digital Journal of Global Change Data Repository*, 2021. https://doi.org/10.3974/geodb.2021.01.17.V1. https://cstr.escience.org.cn/CSTR: 20146.11.2021.01.17.V1.

[9] GCdataPR Editorial Office. GCdataPR data sharing policy [OL]. https://doi.org/10.3974/dp.policy.2014.05 (Updated 2017).

[10] Han, W. X., Fang, J. Y., Reich, P. B., *et al*. Biogeography and variability of eleven mineral elements in plant leaves across gradients of climate, soil and plant functional type in China [J]. *Ecology Letters*, 2011, 14(8): 788–796.

[11] Taiz, L., Zeiger, E. Plant Physiology 4th Edition [M]. Beijing: Science Press, 2009: 60–127.

[12] Cui, P. X., Shen, Z. H., Cao, K. F., *et al*. Comparison of foliar element concentrations of plants from natural forests with different substrates in southern China [J]. *Acta Ecologica Sinica*, 2020, 40(24): 9148–9163.

[13] Liu, L. B., Zhong, Q. L., Ni, J. Ecosystem C: N: P stoichiometry and storages of a secondary plateau-surface karst forest in Guizhou Province, southwestern China [J]. *Acta Ecologica Sinica*, 2019, 39(22): 8606–8614.

[14] Zhang, C., Xie, Y. Q., Lyv, Y., *et al*. Soil organic matter and the contents of available micronutrients in soils from karst mountain in Nongla, Guangxi [J]. *Carsologica Sinica*, 2006(1): 63–66.

[15] Shen, Y. X., Yu, Y., Lucas-Borja, M. E., *et al*. Change of soil K, N and P following forest restoration in rock outcrop rich karst area [J]. *CATENA*, 2020, 186: 104395.

[16] Lin, H. X., Zhang, H. L., Hou, X. Y. Chemical constituents of indicator plants in acid soil, calcareous soil and saline soil [J]. *Chinese Science Bulletin*, 1957, (19): 591–592.