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Global new species of vascular plants published in 2020

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ABSTRACT

Aims: Research and publication of the planet's remaining plant species as yet unknown to science is essential if we are to address the United Nations Sustainable Development Goal (SDG) 15 "Life on Land" which includes the protection of terrestrial ecosystems and halting of biodiversity loss. If species are not known to science, they cannot be assessed on the International Union for Conservation of Nature (IUCN) Red List of Threatened Species, and thus reducing the possibility to protect them from extinction. Scientific discovery, including naming new taxa, is important because without a scientific name, a species is invisible to science and the possibilities of researching its ecology, applications, and threats, and conserving it, are greatly reduced. This study analyzes the new species of vascular plants in the world published in 2020, aims to enrich the basic information about the new species of vascular plants in the world, discuss the current threats to biodiversity, and summarize the direction of future research.

Methods: The data were derived from the International Plant Name Index (IPNI; https://www.ipni.org/). Statistics of new species of vascular plants published in 2020 were available as of February 1, 2021 excluding new combinations, new statuses or new names and bryophyte data. In order to facilitate the comparison of new species of vascular plants discovered and published in major regions and countries in 2020, the data in this article were only from IPNI, although IPNI had not documented all new species published in 2020 by February 1, 2021, and those species published in some local journals (such as university journals) and local monographs were not available in IPNI.

Results: In 2020, 1,747 new species of vascular plants were described worldwide in 103 journals and 5 books by 1,544 botanists (264 Chinese botanists, 1,280 non-Chinese botanists), as documented in IPNI. Among the 1,747 new species, 1,689 belonged to angiosperms, 52 to pteridophytes, and only 6 to gymnosperms. A large number of new species were from the largest families, such as Asteraceae, Orchidaceae, and Piperaceae. Southern America and tropical Asia were the most important regions of new discoveries with more than 828 new species described in 2020. By country, China, Brazil, and Madagascar were the top three with the most new species discovered in 2020, with 247, 223, and 99, respectively. *Phytotaxa* and *PhytoKeys* were the top two journals in terms of the numbers of new species of vascular plants published in 2020 and published 644 and 168 species, respectively. Among various new names there were five invalid names and two illegitimate names.

Conclusions: Despite the increased attention given to biodiversity in recent years, the evidence indicates that a number of species in the world have yet to be discovered. Further investigations of the world vascular plants are still needed, especially in biodiversity hotspots and islands. We recommend an urgent increase in investment in scientific discovery of plant species, while they still survive. Priorities include more investment in training taxonomists, in building and equipping collections-based research centers, especially in species-rich, income-poor regions where the bulk of species are yet unknown to science.

Key words: authors of new species; biodiversity hotspots; conservation; new species; vascular plants; venues of publications

The world's biodiversity is facing unprecedented threats. Human-mediated environmental changes disrupt population and community dynamics, resulting in population genetic diversity loss, species extinctions, changes in ecosystem functioning, and loss of ecosystem services (Dirzo & Raven, 2003). Recent research suggests that plants contribute about 80% of all the biomass on earth (Bar-On et al, 2018). Most of the biomass is formed by vascular plants (tracheophytes), which can survive for centuries and grow into large sizes. Vascular plants are defined by the presence of vascular tissues with characteristic secondary cell-wall thickenings, which ensure both structural support and transport over longer distances (De Rybel et al, 2016; Ohtani et al, 2017; Fukuda & Ohashi-Ito, 2019). In contrast, non-vascular plants mostly rely on

cell-to-cell symplastic transport, limiting movement of water and solutes to just a few cells (Lucas et al, 2013). The acquisition of conducting tissues can be regarded as a major evolutionary innovation. Vascular plants contribute to most of the food and feed production on earth and deliver heating and construction materials in the form of wood (Lu et al, 2020). An accurate, authoritative, and timely plant list is essential for the management, decision-making, and research of biodiversity resources in any countries or regions.

For most organisms, the number of described species considerably underestimates how many exist. Considering the current high rate of species extinction, this is a problem in itself and may lead to secondary complications; that is, the remaining undescribed plants and their habitats may disappear before they are discovered (Joppa et al, 2011). The currently known, described, and accepted number of plant species is ca. 374,000, of which approximately 308,312 are vascular plants (Christenhusz & Byng, 2016). Biodiversity is the material basis for human survival and development. As an important part of the biological system, plants have direct and/or potential values. Plant diversity is an indispensable part of biological diversity and has a major influence on maintaining ecosystems. However, lack of knowledge on species descriptions, species geographic distributions, species abundance and population dynamics, evolutional history, functional traits, interactions between species and the abiotic environment, and biotic interactions has led to an unprecedented reduction in plant diversity (Dirzo & Raven, 2003; Kuussaari et al, 2009).

In order to reduce the loss of plant diversity and effectively conserve and use plant diversity, tremendous efforts are needed. High-quality biodiversity data are the scientific basis for understanding the origin and maintenance of biodiversity and dealing with its extinction risk. With the rapid development of science and technology, the acquisition of massive molecular data has become easier, providing great technical support for the discovery and classification of plants. For example, the emergence of GBIF (https://www.gbif.org/), iDigBio (https://www.idigbio.org/), IPNI (https://www.ipni.org/), The Plant List (http://www.theplantlist.org/), Tropicos (https://www.tropicos.org/), and the World Flora Online (http://www.worldfloraonline.org/) databases has greatly improved our ability to catalog plant species. The advent of the current era of big data offers a potential solution to the ever-decreasing plant diversity. However, how to utilize and effectively analyze the ever-growing quantity of biodiversity data is a huge challenge. Currently the numbers of new land plant species published per decade (excluding new combinations) has stabilized around 20,000 per decade (Lindon et al, 2015). An average of ca 2,000 new vascular plants have been described in the past 15 years (Christenhusz & Byng, 2016; Cheek et al, 2020), although in the last year there seems to be a slight decline (1,747 new species of vascular plants were registered on the IPNI by 1 February 2021), and we can only hope that this is not a continuing (Fig. 1).

The 1,747 new species are authored by 1,544 scholars. Appendix I accounts for the name of each newly described species and its place of publication and involves type specimens, collection locations, and herbaria of most new species.

The following is a summary of the new species of vascular plants in 2020.

1 Methods and Material

The data were derived from the International Plant Name Index (IPNI; https://www.ipni.org/). Statistics of new species of vascular plants published in 2020 were available as of February 1, 2021 excluding new combinations, new statuses or new names and bryophyte data. In order to facilitate the comparison of new species of vascular plants discovered and published in major regions and countries in 2020, the data in this article were only from IPNI, although IPNI had not documented all new species published in 2020 by February 1, 2021, and those species published in some local journals (such as university journals) and local monographs were not available in IPNI. Therefore, the number of new species in a certain region or country in this paper is smaller than the actual number. For example, our statistics showed that 247 new species of vascular plants were described from China in 2020. This number was smaller than the 312 counted by Du et al (2021).

2 Results

2.1 New species of vascular plants published in 2020

In 2020, 1,747 new species of vascular plants were described worldwide in 103 journals and five books by 1,544 botanists (264 Chinese botanists, 1,280 non-Chinese botanists), as documented in IPNI. Among the 1,747 new species, 1,689 belonged to angiosperms, 52 to pteridophytes, and only 6 to gymnosperms. A large number of new species were from the largest families, such as Asteraceae, Orchidaceae, and Piperaceae. Southern America and tropical Asia were the most important regions of new discoveries with more than 828 new species described in 2020. By country, China, Brazil, and Madagascar were the top

three with the most new species discovered in 2020, with 247, 223, and 99, respectively. *Phytotaxa* and *PhytoKeys* were the top two journals in terms of the numbers of new species of vascular plants published in 2020 and published 644 and 168 species, respectively. Among various new names there were five invalid names and two illegitimate names.

In 2020, a total of 1,747 new species of vascular plants have been described worldwide, of which 46 are hybrids (Appendix I). The number of new vascular plants described worldwide has been stable at around 2000 per year for each year since 2004 (Fig. 1). The data show that despite increased attention paid to plant diversity, a large number of undescribed species in the world await discovery. Further investigations are certainly necessary.

New species published in 2020 are in 168 families and 676 genera, covering about 35% of the families and 5% of the genera recognized in the world (Christenhusz et al, 2011, Angiosperm Phylogeny Group, 2016, Pteridophyte Phylogeny Group, 2016). Among the 1,747 new species, 1,689 (ca. 96.7%) belong to angiosperms, 52 (ca. 3%) to pteridophytes, and only 6 (0.3%) to gymnosperms. Statistics on the number of newly described plants indicate that a large number of them are published in the largest families, such as Orchidaceae (85 gen., 178 sp.), Piperaceae (2 gen., 131 sp.), and Asteraceae (44 gen., 119 sp.). South Asia and Southeast Asia, as biodiversity hotspots, harbor numerous endemics and have been the source of many new discoveries of vascular plants in 2020, especially in such families as Araceae (13 gen., 74 sp.), Berberidaceae (1 gen., 64 sp.), and Rubiaceae (21 gen., 58 sp.). The 24 families and genera with the most new species of vascular plants described in 2020 are shown in Table 1.

In 2020, 178 new species of Orchidaceae are published by 187 scholars, but only 10 scholars published more than five species. In fact, these 10 scholars published 72 new species of orchids, accounting for more than 40% of all new orchids in 2020. One hundred and thirty-one new species of Piperaceae are published by nine scholars, but only two scholars published more than five species. These two scholars published 125 new species of Piperaceae, accounting for more than 95% of the total new Piperaceae in 2020. One hundred and nineteen new species of Asteraceae are published by 97 scholars, but only four scholars published more than five species. These four scholars published 64 new species of Asteraceae, accounting for more than 53% of the total new Asteraceae. This analysis demonstrates that the majority of the new species in 2020 are described by a few botanists in a few families.

Among these newly described species, *Piper*, *Berberis*, and *Taraxacum* are the top three genera of new species of vascular plants, with 93, 64, and 51 new species in 2020, respectively.

As a member of Piperaceae, the genus *Piper* contains more than 2,000 species distributed almost all over the world but mainly in tropical and subtropical regions (Ghosh et al, 2014). *Piper* is mostly known for its commercial, economic, and medicinal importance, and provides humans with daily necessities such as food, spices, and medicines. For example, *Piper nigrum* L., known as the “King of Spices”, is one of the most important spice crops in the world, and it is also widely used in the medical industry and food

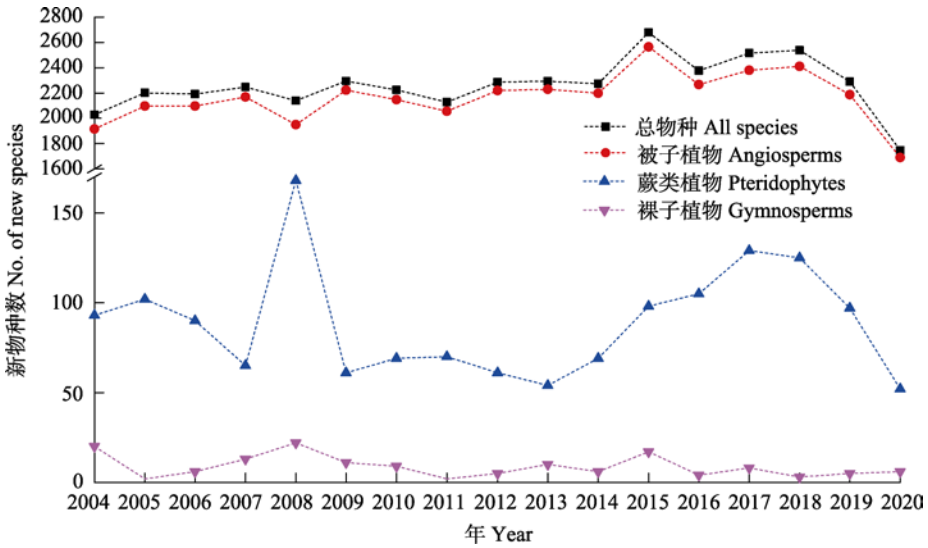

Fig. 1 Number of new vascular plant species described worldwide from 2004 to 2020. Statistics of this study were available as of February 1, 2021, note that the name of new species published in 2020 is still reaching the International Plant Names Index compilers and being indexed, so this number will rise.

industry (Zhang et al, 2021). Among the 93 new *Piper* species, 88 are from the Americas, and the remaining five are from East Asia or Southeast Asia. Due to the richness of species and immense application value, *Piper* has become a typical genus for biodiversity research.

Berberis is the largest genus in Berberidaceae, including about 500 species, mainly distributed in the northern temperate zone (Landrum, 1999) and the only genus in the Berberidaceae that is distributed in tropical African mountains and South America. There are about 300 species in China (Harber, pers. comm. to L.-B.Z.), mainly in the West and Southwest (Harber, 2020). Among the 64 new species of *Berberis*, one is from Vietnam, and the remaining 63 are discovered in China. *Berberis* plants are rich in resources and have a long history of medicinal use, which can be used to treat a variety of diseases. The main components of *Berberis* are alkaloids and flavonoids, and the most studied agent is berberine. Berberine has pharmacological effects such as hypoglycemic, anti-inflammatory, antibacterial, which can be used to treat diabetes and its complications (Liao et al, 2019).

As one of the most speciose genera in the Asteraceae, *Taraxacum* includes ca. 60 sections and 2,800 species predominantly distributed in the temperate to subtropical regions of the Northern Hemisphere, with a few in tropical regions of South America (Kirschner et al, 2014; Rewicz et al, 2020). Most species of *Taraxacum* have medicinal values. They contain multiple components with various biological activities, which can exert direct or indirect therapeutic effects when used alone or in combination with other traditional medicines. Actually, *Taraxacum* plants are not only medicinal plants, but also one of the important sources of green vegetables, with high medicinal and nutritional value (Wang et al, 2017). All 51 newly described species in *Taraxacum* are discovered in the Indian Subcontinent (tropical Asia).

In addition to *Piper*, *Berberis*, and *Taraxacum*, a number of other newly discovered species also have potentially important economic and application value. Forty-seven new species of *Begonia*, a genus that is known for bright and gorgeous flowers with different shapes and long flowering period, and easy to cultivate, are described from tropical Asia, temperate Asia, and southern America. Species of *Begonia* have been used as ornamental plants for a long time (Tian et al,

Table 1 Top 24 families and genera in which new species of world vascular plants are described in 2020

科 Family	属数 Number of genera	种数 Number of species	属 Genus	科 Family	种数 Number of species
兰科 Orchidaceae	85	178	胡椒属 *Piper*	胡椒科 Piperaceae	93
胡椒科 Piperaceae	2	131	小檗属 *Berberis*	小檗科 Berberidaceae	64
菊科 Asteraceae	44	119	蒲公英属 *Taraxacum*	菊科 Asteraceae	51
天南星科 Araceae	13	74	花烛属 *Anthurium*	天南星科 Araceae	47
小檗科 Berberidaceae	1	64	秋海棠属 *Begonia*	秋海棠科 Begoniaceae	47
茜草科 Rubiaceae	21	58	省藤属 *Calamus*	棕榈科 Arecaceae	41
凤梨科 Bromeliaceae	17	48	草胡椒属 *Peperomia*	胡椒科 Piperaceae	38
秋海棠科 Begoniaceae	1	47	舌蕨属 *Elaphoglossum*	藤蕨科 Lomariopsidaceae	20
棕榈科 Arecaceae	6	46	石豆兰属 *Bulbophyllum*	兰科 Orchidaceae	18
苦苣苔科 Gesneriaceae	18	43	石斛属 *Dendrobium*	兰科 Orchidaceae	14
野牡丹科 Melastomataceae	12	41	龙丹属 *Microlicia*	野牡丹科 Melastomataceae	14
禾本科 Poaceae	25	39	长蛛檀属 *Faramea*	茜草科 Rubiaceae	13
大戟科 Euphorbiaceae	13	34	凤仙花属 *Impatiens*	凤仙花科 Balsaminaceae	12
姜科 Zingiberaceae	9	30	甜樟属 *Ocotea*	樟科 Lauraceae	12
萝藦科 Asclepiadaceae	14	29	天料木属 *Homalium*	大风子科 Flacourtiaceae	11
豆科 Leguminosae	20	28	多香木属 *Polyosma*	南鼠刺科 Escalloniaceae	11
桃金娘科 Myrtaceae	10	26	舞花姜属 *Globba*	姜科 Zingiberaceae	10
樟科 Lauraceae	6	22	喜光芥属 *Heliophila*	十字花科 Brassicaceae	10
爵床科 Acanthaceae	12	21	谷木属 *Memecylon*	野牡丹科 Melastomataceae	10
藤蕨科 Lomariopsidaceae	1	20	九节属 *Psychotria*	茜草科 Rubiaceae	10
唇形科 Lamiaceae	14	19	茄属 *Solanum*	茄科 Solanaceae	10
茄科 Solanaceae	5	18	矾木属 *Myrcia*	桃金娘科 Myrtaceae	9
铃兰科 Convallariaceae	6	16	马铃苣苔属 *Oreocharis*	苦苣苔科 Gesneriaceae	9
莎草科 Cyperaceae	7	16	叶苞凤梨属 *Orthophytum*	凤梨科 Bromeliaceae	9

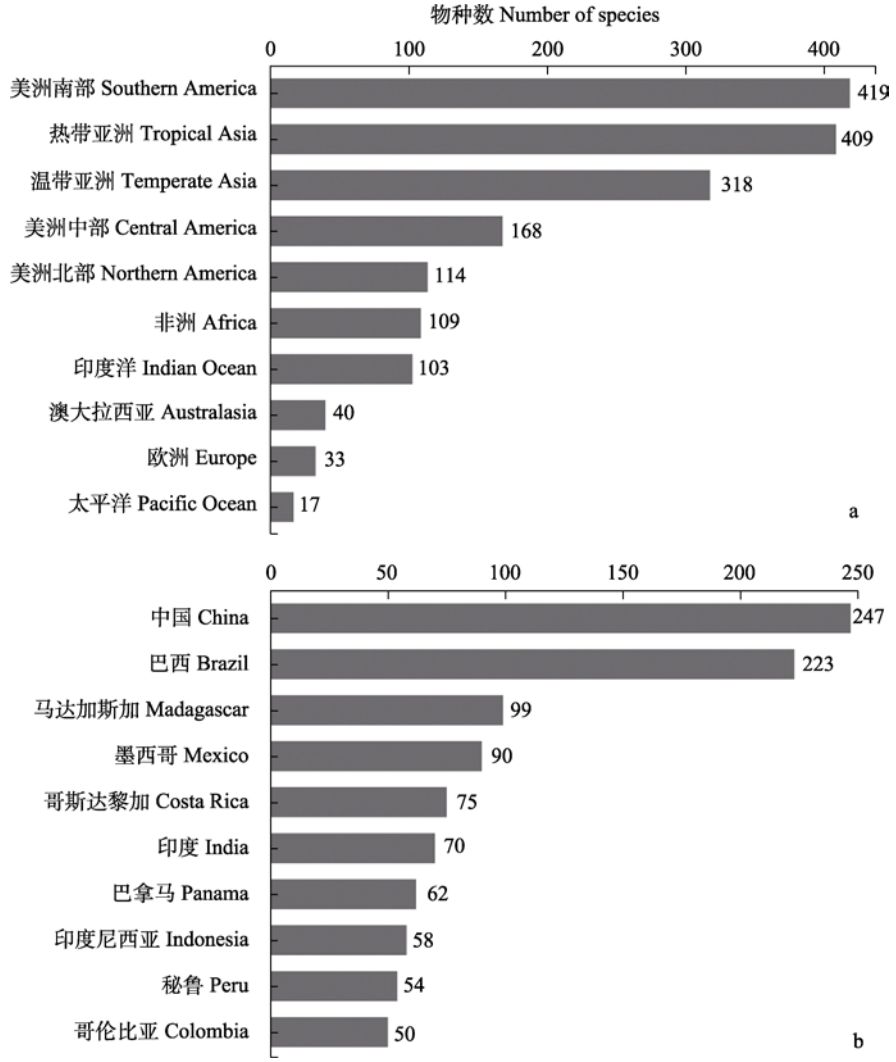

Fig. 2 Number of vascular plant species described in the world in 2020. (a) Distribution of new plant species in the world divided by continents and oceans. (b) Top 10 countries from which new species of vascular plants are described in 2020 (excluding invalid, illegitimate names and those names of unknown origins).

2017). Forty-one new species of *Calamus*, a palm genus key in providing rattan still wild-harvested for cane furniture (Chowdhury et al, 2019), are described from tropical Asia. Eight species of *Ipomoea* are discovered from the Americas, seven of *Allium* from temperate Asia and Europe, and four of *Camellia* from tropical Asia and temperate Asia provide us with potential food, spices, and drinks, respectively (Cheek et al, 2020). In short, plant species play a vital role in nature, the environment, and human lives.

2.2 Regions and countries of new species

Of the 1,747 new species, 419 and 409 new species are discovered from southern America and tropical Asia, respectively. The new species from these two regions represent about half of the total new species described in 2020 and are far more than those from any other regions in the world. The greatest numbers of new species from tropical Asia and southern America are probably attributed to the common factors: both are extremely large and biodiverse regions, long-term attention has been paid to these two areas, and a large number of well-resourced, well-trained professional taxonomists have engaged in active floristic (botanical inventory) projects in these two regions. Temperate Asia, Central America, and North America are also important regions of the new discoveries, with 600 new species from these three regions together (temperate Asia: 318; Central America: 168; North America: 114). By country, China and Brazil, two countries in temperate(/tropical) Asia and southern America, respectively, have the highest numbers of newly described species in 2020. Madagascar and Mexico have the third and fourth highest numbers of newly described species in 2020 (Fig. 2). Though they do not occupy vast areas, Madagascar and Mexico harbor extraordinary levels of species

diversity and endemism (Callmander et al, 2011; Ulloa et al, 2017).

New species of vascular plants from China and Brazil account for more than a quarter of the total new species described in 2020, with 247 and 223, respectively. Brazil has generally led in new species discoveries since 2008, offering 200 or more new species annually (about 10% of total global plant discoveries; Cheek et al, 2020). Most parts of Brazil are in the tropics, with a tropical rainforest climate in the north, a savanna climate in the middle, and a humid subtropical monsoon climate in parts of the south. The topography of Brazil is complex, with interspersed rivers, wetlands, mountains, and plateaus. Due to its diverse climates and habitats, Brazil is one of the countries that has the greatest plant richness in the world, with an estimated 34,459 species of vascular plants (Araújo et al, 2021). According to a report by Kew, between 2006 and 2015, China was among the top three countries in the discovery and naming of new species of vascular plants (Willis & Bachman, 2016). The topography of China encompasses the highest and one of the lowest places on Earth, and its topography varies from nearly impenetrable mountainous terrains to vast coastal lowlands. Its climate ranges from extremely dry, desert-like conditions in the northwest to tropical monsoon in the southeast. The diversity of both China's topography and its climates has resulted in one of the world's widest arrays of ecological niches, and these niches have been filled by a vast number of plant and animal species, with more than 32,500 species of vascular plants documented from throughout its vast territory (Du et al, 2020). Indeed, practically all types of Northern Hemisphere plants, except those of the polar tundra, are found in China (Wang et al, 2015). Our analysis reinforces that China and Brazil still have a large number of undescribed species awaiting discovery.

Europe and Pacific region saw relatively few new vascular plants species published in 2020, with 33 and 17, respectively. The Europe flora has generally been well surveyed for many years, and is much less diverse than tropical floras. The exploration and collection of plants in the Pacific region is considerably scanty. Therefore, few new plant species are described from these two regions.

2.3 Authors and institutions of new species

The 1,747 new species of vascular plants in the world in 2020 are authored by 264 (17.1%) Chinese botanists and 1,280 (82.9%) non-Chinese botanists. Among those, 1,534 new species, or about 87.8% of all new species, are published solely by non-Chinese authors; 176 new species, or about 10%, are published solely by Chinese authors; 37 new species, or only about 0.02%, are published jointly by Chinese and non-Chinese authors. Remarkably, among all those authors, Callejas published 120 new species of Piperaceae, accounting for more than 91% of new Piperaceae; Kirschner and Štěpánek published 51 new species, accounting for more than 42% of new Asteraceae.

The top 15 Chinese and non-Chinese botanists of new species authors in 2020 (with the standard abbreviations of their names and full names) are in Table 2. Ten of the top 15 Chinese authors are affiliated to the Chinese Academy of Sciences, and the number of new species from these 10 authors accounts for two thirds of the total new species described by the top 15 Chinese authors in 2020. Five of the top 15 non-Chinese authors are from the Missouri Botanical Garden (MO), and the number of new species from these five MO authors accounts for 30% of the total new species described by the top 15 non-Chinese authors in 2020. MO botanists have consistently described about 10% of the world's new species of vascular plants annually in the past decades. In 2020, about 200 new species are described by MO botanists (Hamdan, 2021). Not only in discovering and describing new species, MO also leads the preparation of some major flora books and descriptive works such as the *Flora of China* (http://www.efloras.org/flora_page.aspx?flora_id=2), *Flora of North America* (http://www.efloras.org/flora_page.aspx?flora_id=1), *Flora Mesoamericana* (http://legacy.tropicos.org/Project/FM), and so on (Hamdan, 2021), playing a hugely important role in plant conservation.

2.4 Venues of publication of new species

The 1,747 new species in 2020 are published in 103 journals and five books. Among the 1,747 new species, 1,609 (92.1%) are published in articles in 103 journals. Among the new species of vascular plants in 2020, 127 are published in floras, 64 in monographs, and one in a proceedings. Articles with non-Chinese authors as the lead authors account for the majority, and most of the articles are published in English. Although there are 103 journals publishing articles on new species of vascular plants in 2020, 75.8% of the articles are published in 20 journals/monographs only, such as *Phytotaxa*, *PhytoKeys*, *Systematic Botany*, *Monographs in systematic botany from the Missouri Botanical Garden*, *Novon*, and *Candollea* (Fig. 3). Most of the articles are published in journals monitored by the Scientific Citation Index (SCI; Anonymous, 2021). Generally, the articles with strict international peer reviews are significantly better in quality than those not with. Articles in English are more convenient for an international audience. Among the journals, *Phytotaxa* continues to play a major role in accelerating the

Table 2 Top 15 Chinese and top 15 non-Chinese authors of new species of vascular plants in 2020 (The abbreviations of the authors' herbaria are in parentheses, except for MCFR, which refers to the Monitoring Center for Forest Resources in Zhejiang)

标准形式 Standard form	全称 Full name	新物种数 No of new species	标准形式 Standard form	全称 Full name	新物种数 No. of new species
Y. H. Tan (HITBC)	谭运洪 Tan, Yun Hong	14	Callejas (HUA)	Callejas Posada, Ricardo	120
W. H. Chen (KUN)	陈文红 Chen, Wen Hong	13	Harber (MO)	Harber, Julian	64
Y. M. Shui (KUN)	税玉民 Shui, Yu Min	13	Štěpánek (PRA)	Štěpánek, Jan	51
Yan Liu (IBK)	刘演 Liu, Yan	13	Kirschner (PRA)	Kirschner, Jan	51
F. Wen (IBK)	温放 Wen, Fang	10	Croat (MO)	Croat, Thomas Bernard	46
H. B. Ding (HITBC)	丁洪波 Ding, Hong Bo	9	A. J. Hend. (NY)	Henderson, Andrew James	39
G. W. Hu (HIB)	胡光万 Hu, Guang Wan	7	O. Ortiz (PMA)	Orlando, Oriel Ortiz	24
Lei Cai (KUN)	蔡磊 Cai, Lei	7	C. M. Taylor (MO)	Taylor, Charlotte Morley	23
C.I Peng (HAST)	彭镜毅 Peng, Ching I†	6	Rouhan (P)	Rouhan, Germinal	20
Q. F. Wang (HIB)	王青锋 Wang, Qing Feng	6	Leme (HB)	Leme, Elton Martinez Carvalho	19
X. F. Jin (HTC)	金孝锋 Jin, Xiao Feng	6	Szlach. (UGDA)	Szlachetko, Dariusz Lucjan	14
D. G. Zhang (JIU)	张代贵 Zhang, Dai Gui	5	Appleq. (MO)	Applequist, Wendy Linn	13
Z. H. Chen (MCFR)	陈征海 Chen, Zheng Hai	5	Kolan. (LOD)	Kolanowska, Marta	13
Huan C. Wang (YUKU)	王焕冲 Wang, Huan Chong	4	Gideon F. Sm. (PEU)	Smith, Gideon Francois	12
N. H. Xia (IBSC)	夏念和 Xia, Nian He	4	Van der Werff (MO)	Van der Werff, Henk	12

† Ching I Peng (1950–2018) is a well-known plant taxonomist in Taiwan of China. The taxa published by C. I Peng were completed with other collaborators in 2020.

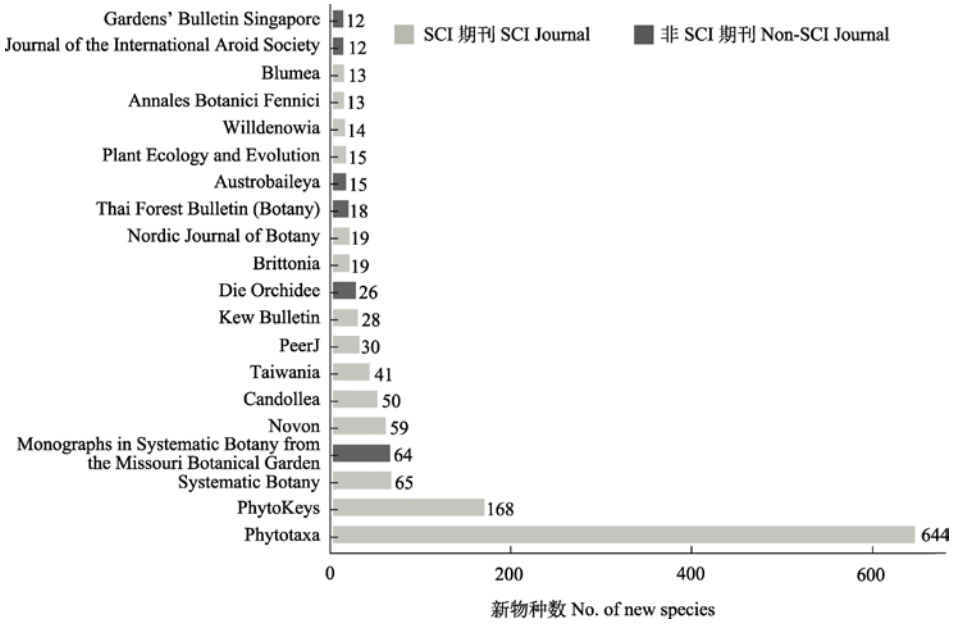

Fig. 3 Top 20 journals/monographs in which new species of vascular plants are published in 2020

publication of new discoveries, with 644 new species of vascular plants published in 2020. *Phytotaxa* has published more than a quarter of the approximately 2000 species described each year worldwide and has become a major player in the disseminating of knowledge on newly described plants (Christenhusz & Byng, 2016). *Phytokeys* ranks the second in the number (168) of new species published in 2020. The two venues together from *the Missouri Botanical Garden*, Novon and *Monographs in systematic botany from the Missouri Botanical Garden*, rank the third in the number (123) of new species published in 2020.

2.5 Invalid and illegitimate names

We examined the original literature for newly described vascular plants in the world and discovered 5 names are not validly published. Failure to designate a type specimen is the reason for all of the five invalid names. Two names are illegitimate because they are later homonyms. The names of the seven invalid or illegitimate names and reasons for their rejection are

given in Appendix II.

3 Discussion

Despite the increased attention given to biodiversity in recent years, the evidence indicates that a number of species in the world have yet to be discovered. Further investigations of the world vascular plants are still needed, especially in biodiversity hotspots and islands. We recommend an urgent increase in investment in scientific discovery of plant species, while they still survive. Priorities include more investment in training taxonomists, in building and equipping collections-based research centers, especially in species-rich, income-poor regions where the bulk of species are yet unknown to science.

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