FACTORS GOVERNING THE NATURALIZATION-TO-INVASION TRANSITION OF EXOTIC PLANTS IN SHENZHEN, CHINA

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Abstract. Understanding factors increasing the probability of exotic plants becoming invasive is crucial for designing appropriate management strategies to mitigate the detrimental effects of invasive plants on rapidly urbanizing areas. However, no study to date has attempted to determine how various factors may affect the naturalization-to-invasion transition of exotic plants in these areas. Here, we took Shenzhen, one of the largest and most rapidly urbanizing cities of the world, as a case study to explore how various factors may affect the naturalization-to-invasion transition of exotic plants in rapidly urbanizing areas, with an emphasis on exotic plant invasion in urban forests. Our results showed that 33.5% of the 349 naturalized exotic plant species in Shenzhen have become invasive. We found strong evidence that plant attributes and environmental factors have considerable effects on the naturalization-to-invasion transition of exotic plant species in Shenzhen. In contrast, there was little evidence that any socio-economic factor promotes the naturalization-to-invasion transition of exotic plants in Shenzhen. Our findings suggested that although human activities facilitated the initial establishment of exotic plant species in rapidly urbanizing areas, the naturalization-to-invasion transition of exotic plants in these areas appeared to be governed largely by biotic and environmental factors.
Keywords: *exotic plant invasion, determinants of naturalization-invasion transition, invasive plant, naturalized plant, urban forests*

Introduction

Biological invasions by exotic species are a significant component of human-caused global environmental change (Vitousek et al., 1997). More than 2,000 exotic plant species have been recorded in the USA (Vitousek et al., 1997); this figure reaches 5,700 in Europe (Vilà et al., 2010). Furthermore, biological invasions can not only cause disastrous damage to native biodiversity and ecosystem functions (Vilà et al., 2011) but also seriously affect the development of economies and societies (Perrings et al., 2002). In China, biological invasions have been estimated to cause US$ 14 billion worth of economic losses per year (Xu et al., 2006); a similar estimate for the USA reaches US$ 120 billion (Pimentel et al., 2005). Thus, there is an urgent need to understand which

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combinations of species attributes and habitat characteristics most effectively promote or prevent exotic plant invasion (Kolar and Lodge, 2001; Romanuk et al., 2009).

Urbanization, a major global trend (United Nations Population Division, 2006), is always associated with the establishment of a large number of exotic plant species in urban habitats (Pauchard and Alaback, 2004), which can ultimately decrease the ecological, social and economic sustainability of cities. Given that over 50% of the world's population now lives in cities (United Nations Population Division, 2016), a better understanding of patterns and drivers of exotic plant invasion in urban habitats is critical for the sustainability of not only cities but also the human population. Unfortunately, we have a relatively poor understanding of these aspects, largely because most previous research on exotic plant invasion has focused instead on natural or semi-natural habitats (McKinney, 2002; Pauchard et al., 2006; Spear et al., 2013).

Only a few studies have been performed to address the issue of exotic plant invasion in urban habitats (Celesti-Grapow et al., 2006; Dolan et al., 2011; Leung et al., 2009; Lososová et al., 2012; Pyšek, 1998; Ricotta et al., 2009; Ricotta et al., 2010; Wang et al., 2011). The invasiveness of exotic plant species in urban habitats was found to be related to their phylogenetic similarity to native plant species (Ricotta et al., 2010), and the species richness of exotic plants in cities was significantly affected by city size, habitat type and climate (Celesti-Grapow et al., 2006; Lososová et al., 2012; Pyšek, 1998). In addition, the number of naturalized and invasive plant species in a given district of a rapidly urbanizing city was found to be highly predicted by the economic growth of that district (Wang et al., 2011). These findings provide useful insights, but they are inadequate for developing appropriate management strategies to mitigate the detrimental effects of exotic plant invasions in cities experiencing rapid urbanization because none of the previous studies was focused on urban forest despite the fact that urban forest is a major type of habitat in cities. According to the definition proposed by Escobedo and colleagues, urban forests are the sum of all urban trees, shrubs, lawns, and pervious soils. Urban forests are generally considered as non-natural habitats, because they are located in highly altered ecosystems where humans are the main factors determining their types, amounts, and distribution (Escobedo et al., 2011). Unlike other urban habitats, such as roadsides, private gardens and parks (which can serve as important ways of exotic species introductions), urban forests are part of land use in cities (Escobedo et al., 2011; Dobbs et al., 2011). For example, urban forest currently accounts for 35.1% (Nowak et al., 2010) and 39.9% (Chen and Wang, 2013) of land use in cities in the USA and China, respectively. However, there is emerging evidence that urban forests do not escape exotic plant invasion (Singh et al., 2015).

The transition from naturalization to invasion has been considered the most important step for exotic plant species becoming serious ecological, economic and social problems (Phillips et al., 2010; Williamson and Fitter, 1996), although the exotic plant invasion process is always an introduction-naturalization-invasion continuum (Richardson et al., 2000; Richardson and Pyšek, 2006). In this sense, a promising approach to improve our understanding of exotic plant invasion in urban habitats is to explore the transition from naturalization to invasion of exotic plants in urban forests and its driving factors. However, to date, no study has attempted to directly address this issue, which constitutes a critical gap in research on exotic plant invasion in urban habitats. According to the Tens Rule proposed by Williamson and Fitter (Williamson and Fitter, 1996), approximately 10% of the exotic plant species naturalized in urban habitats will become invasive. However, we would expect the real

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invasive-to-naturalized plant species richness ratios observed in urban habitats to be greater than 10% because urban habitats are generally exposed to higher propagule pressure from exotic plants, stronger human disturbances, and larger and more frequent resource fluctuations than those more natural habitats on which the Tens Rule was based (Lososová et al., 2012).

In this study, we took Shenzhen as a case study to explore how various factors may affect the naturalization-to-invasion transition of exotic plants in cities experiencing rapid urbanization, with an emphasis on plant invasion in urban forests. To this end, we first generated a comprehensive database of all naturalized and invasive exotic plant species in Shenzhen and then used it to assess the effects of the plants' attributes on their transition from naturalization to invasion. Additionally, we conducted a series of ecological field surveys on 19 major urban forests in Shenzhen to determine the effects of environmental and socio-economic factors on the naturalization-to-invasion transition of the exotic plant species found in urban forests. We considered Shenzhen to be fairly representative of other areas experiencing rapid urbanization, as it is one of the largest cities in the world and has been experiencing rapid urbanization over the past 30 years (McKinsey Global Institute, 2012).

Materials and Methods

Study site

Located in South China, Shenzhen is a natural port city and functions as a bridge between Hong Kong and mainland China (*Fig. 1*). As China's first special economic zone, it has experienced rapid urbanization over the past 30 years, and its gross domestic product (GDP) has been growing at an average annual rate higher than 20% over that period (Liu et al., 2007). In 2013, Shenzhen's GDP reached US$ 234 billion, and its total population reached 10.5 million (Statistics Bureau of Shenzhen Municipality, 2013). Shenzhen also plays an important role in China's foreign trade, with a total import and export volume reaching US$ 537 billion in 2013 (Statistics Bureau of Shenzhen Municipality, 2013). Although this rapid urbanization has increased people's wealth and improved their quality of life, it has also had significant environmental impacts (Liu et al., 2007). For example, Shenzhen has been considered one of the areas at highest risk of biological invasions in China (Wu et al., 2006), as indicated by the fact that the number of exotic species intercepted by the Shenzhen Entry-Exit Inspection and Quarantine Bureau in 2010 was as high as 981 (SEEIQB, 2010). Indeed, the number of exotic species in Shenzhen had reached 102 approximately ten years ago (Yan et al., 2004).

Compilation of a database for naturalized and invasive plant species in Shenzhen

In this study, the term 'naturalized species' was used according to the definition of Richardson et al. (Richardson et al., 2000), whereas the term 'invasive species' was used in the sense of McNeely et al. (McNeely et al., 2001). In brief, here, invasive plant species are a subset of naturalized exotic plant species that cause damage to species, habitats, or to the economy. The published literature addressing naturalized and invasive species in Shenzhen or in China (Yan et al., 2004; Feng and Zhu, 2010; Jiang et al., 2011; Xu and Qiang, 2011; Shao et al., 2006; Wan et al., 2012; Weber et al., 2008) was reviewed to generate a comprehensive database of the naturalized and invasive exotic

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plant species in Shenzhen. The major attributes (including taxonomic group, geographic origin and life form) of the exotic plant species were documented largely according to *Flora of China* (2013) and *Flora of Shenzhen* (Li and Li, 2010).

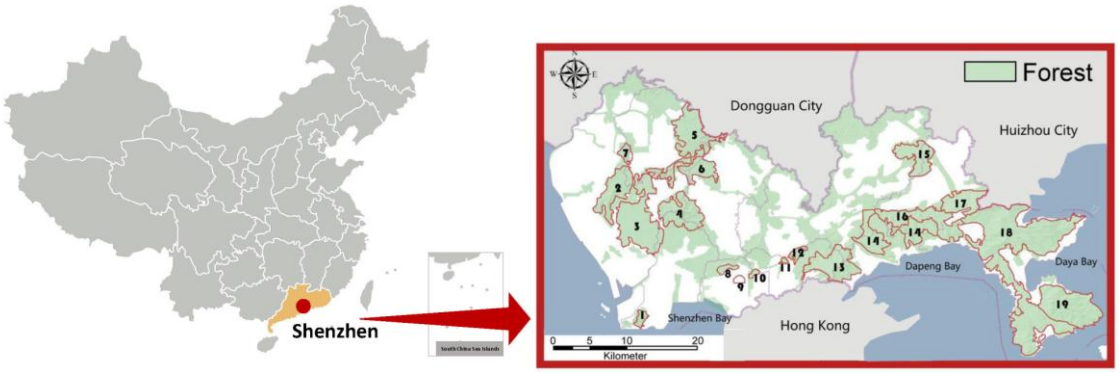

Figure 1. *Map of the study sites. The bold Arabic numbers indicate 19 major urban forests, which were investigated to explore the effects of environmental and socio-economic factors on the naturalization-to-invasion transition of exotic plants in Shenzhen. Red curves show the edges of the studied forests. See Tables S1, S2 and S3 for more details. This figure was drawn based on two maps that are open to the public: the maps of China and Shenzhen can be accessed on http://www.sbsm.gov.cn/article/ zxbs/dtfw/ and http://www.szgeoinfo.com/szgeoinfo/default.htm, respectively.*

Ecological field surveys on 19 major urban forests of Shenzhen

Forest is one of the most important types of urban land cover in Shenzhen (*Fig. 1*). Specifically, Shenzhen's urban forests cover 77,720.9 hectares, which account for 39.9% of Shenzhen Municipality's total area (Shenzhen statistics yearbook, 2013). To determine the effects of environmental and socio-economic factors on the naturalization-to-invasion transition of the exotic plants in urban forests, 19 important urban forests within Shenzhen were selected for surveying (*Fig. 1*). These forests are distributed across the city (*Fig. 1*) and their summed area accounts for 64.4% of the total forest area in the city (*Table 1*). During the ecological field surveys, data were collected from 217 plots, each having an area of 600 m^2 (30 m × 20 m). The number of plots within each urban forest ranged from 4 to 19, depending largely on their area. Replicate plots for each forest were located largely along a specific altitudinal gradient, which was set according to the altitude of individual forests. Plots were typically established on a relatively gentle slope to facilitate access. In each plot, the identity of the plants was recorded and 5 soil samples were collected. The plant species list resulting from the field surveys was used to assess the number of naturalized and invasive exotic plant species in the individual forests. The soil samples were air-dried and used to determine the following physico-chemical properties (Schinner et al., 1996): pH, density, porosity, moisture content, organic matter content, total nitrogen and available phosphorus (*Table 1* and *Table S1* in Appendix).

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Table 1. *Descriptive statistics of the environmental and socio-economic factors under consideration in this study.*

Factors*	Unit	Mean	Min	Max
Environmental factors				
Area	ha	2,634	87.3	14,457
Average altitude	m	159	57.4	326
Mean January temperature	ºC	13.6	9.8	14.4
Mean July temperature	ºC	28.4	23.9	29.5
Annual average precipitation	mm	1,617	1,311	1,901
Density of native plant species	species/ha	2.39	0.76	3.78
Soil density	g/cm^3	1.32	0.82	1.86
Soil porosity	%	48.2	40.0	58.7
Soil moisture	%	11.0	1.32	24.3
Soil pH		5.05	4.14	6.39
Soil organic matter content	g/kg	14.3	5.51	38.0
Soil total nitrogen content	g/kg	0.64	0.15	1.59
Soil available phosphorus content	g/kg	3.52	0.39	9.30
Socio-economic factors				
Population density within a 1,000-m radius	person/ha	91.7	2.23	319
Road density within a 1,000-m radius	m/ha	49.6	8.58	125
Road area ratio within a 1,000-m radius	%	5.47	0.55	17.4
Residential land area ratio within a 1,000-m radius	%	11.4	0.96	38.3
Industrial land area ratio within a 1,000-m radius	%	5.06	0.00	13.4

*The relationships between these factors and the invasive/naturalized ratios of 19 major urban forests of Shenzhen were examined (unless otherwise stated).

Information on the environmental and socio-economic factors of 19 major urban forests of Shenzhen

Beyond the soil physico-chemical properties mentioned above, information on six additional environmental factors of the 19 major urban forests were collected (*Tables 1* and *S2*): area, average altitude, mean January temperature, mean July temperature, annual average precipitation, and the density of native plant species (i.e., the number of native plant species per hectare). These factors were selected because they are generally expected to have a marked influence on the richness of exotic plants (Wu et al., 2006; Zhang et al., 2004; Cutway and Ehrenfeld, 2009; Peacock et al., 2006). The data on mean January temperature, mean July temperature, and annual average precipitation were means for the period from 2007 to 2012, which were provided by the Meteorological Bureau of Shenzhen Municipality.

Data on the following five socio-economic factors were obtained from the Development Research Center of the Urban Planning, Land and Resources Commission of Shenzhen Municipality (*Tables 1* and *S3*): population density, road density, road area ratio, residential land area ratio and industrial land area ratio. These values were calculated for a buffer zone within a radius of 1,000 m from the edge of individual urban forests under study. These factors were selected because they are suitable indicators of disturbance resulting from socio-economic development and often have strong associations with exotic plant invasions (Pauchard and Alaback, 2004; Christen and Matlack, 2006; Pyšek et al., 2010; Santos et al., 2011). GDP was not included

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because the GDPs in the different districts of Shenzhen in the past five years were highly correlated with district population ($R > 0.667$, $P < 0.01$). The distance of 1,000 m to the edge of individual forests was selected because the propagule pressure of exotic plant species tends to be strongest within a few hundred meters of the source and declines rapidly with increasing distance (Vilà and Pujadas, 2011).

Statistical analysis

Tracking and characterizing the naturalization-to-invasion transition of many exotic plant species in a given area (e.g., a city) appears to be impractical, if not impossible. Therefore, we tried to circumvent this perceived difficulty by calculating the ratio of the number of invasive exotic plant species belonging to a given subset to the number of naturalized exotic plant species belonging to the subset (hereafter referred to as 'invasive/naturalized') and using it as a surrogate measure of the probability that the naturalized exotic plant species belonging to the subset will succeed in the naturalization-invasion transition. To assess the effects of plant attributes on the transition from naturalization to invasion of the exotic plants in Shenzhen, we calculated invasive/naturalized for subsets of the exotic plant species in Shenzhen with respect to their taxonomic group, geographic origin and life form. To explore the effects of environmental and socio-economic factors on the transition, we calculated invasive/naturalized for each of the 19 major urban forests under study and tested the correlations between these ratios and the environmental and socio-economic factors of the forests and their surroundings, respectively, using linear regression analysis. Note however that Tiantou Mountain was excluded in the analysis of relationships between these ratios and environmental factors, because the soil moisture and organic matter content of the forest deviated from the normal ranges (*Table S2*). All of the statistical analyses were performed using the statistical software package SPSS (Statistical Package for the Social Sciences) for Windows Version 17.0 (SPSS Inc., Chicago, IL, USA).

Results

An overview of naturalized and invasive exotic plant species in Shenzhen

We found 349 naturalized plant species in Shenzhen, including 343 angiosperm species, 5 pteridophyte species and 1 gymnosperm species (*Table S4*). They belong to 241 genera and 75 families, accounting for approximately 12.2% of the total number of plant species in Shenzhen. A total of 117 invasive plant species were identified in Shenzhen (*Table S5*), indicating that 33.5% of the exotic plants naturalized in Shenzhen have become invasive. The invasive plants were all angiosperms, belonging to 88 genera and 33 families (*Table S5*).

The effects of plant attributes on the naturalization-to-invasion transition of exotic plant species in Shenzhen

The invasive plant species in Shenzhen were highly unevenly distributed across taxonomic groups, geographic origins and life forms. The five families that contained the most invasive plant species were Asteraceae (also called Compositae), Fabaceae (Leguminosae), Poaceae (Gramineae), Amaranthaceae and Solanaceae (*Fig. 2*). Specifically, there were 35, 13, 7, 7 and 7 invasive species in these families,

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respectively (*Fig. 2a*), which accounted for 62.5%, 32.5%, 26.9%, 43.8% and 43.8% of the total number of naturalized exotic species in the corresponding families (*Fig. 2b*). The genera having the most invasive plant species were *Amaranthus* and *Ipomoea*, followed by *Senna*, *Solanum* and *Euphorbia* (*Fig. 3*). There were 5, 5, 3, 3 and 2 invasive species in each of these genera, respectively (*Fig. 3a*), which accounted for 83.3%, 45.4%, 42.9%, 33.3% and 60.0% of the total number of naturalized species in the corresponding genera (*Fig. 3b*). As for geographical origin, the majority of the invasive plants were native to the Americas, followed by Asia, Africa, Europe, the Mediterranean and Oceania (*Fig. 4a*). These areas contributed 90, 8, 8, 6, 2 and 2 invasive species, respectively (*Fig. 4a*), which accounted for 47.4%, 12.7%, 30.8%, 26.1%, 25.0% and 40.0% of the total number of naturalized species that had originated from the corresponding areas (*Fig. 4b*). Regarding life form, the invasive plants were mainly herbs (*Fig. 5a*). Specifically, more than 96 invasive plant species were herbs, accounting for 35.0% of the total number of herbaceous naturalized plant species in Shenzhen (*Fig. 5b*).

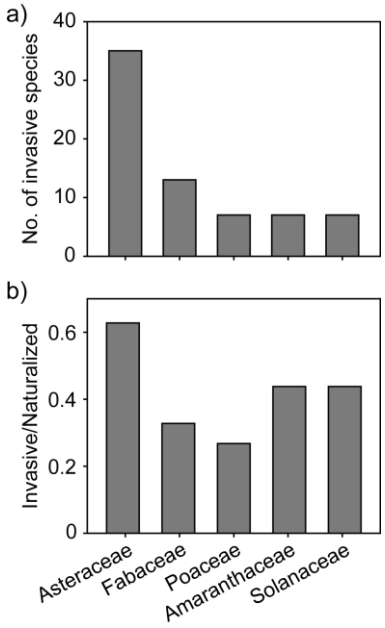

Figure 2. *The most successful families of exotic plant species in Shenzhen. The five families containing the most invasive plant species (a) and the ratios of invasive to naturalized species in these families (b).*

The effects of environmental and socio-economic factors on the naturalization-to-invasion transition of exotic plants in 19 major urban forests of Shenzhen

In the field surveys, we identified 316 naturalized plant species and 111 invasive plant species in the 19 major urban forests, which accounted for 90.5% and 94.9% of the total number of naturalized and invasive plant species in Shenzhen, respectively. The number of invasive plant species recorded in urban forests ranged from 19 to 69. In contrast, invasive/naturalized for these urban forests exhibited considerably less variation, ranging from 0.35 to 0.49. However, invasive/naturalized was significantly ($P < 0.05$) correlated with four environmental factors considered (*Fig. 6*). Specifically, the

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density of native plant species and soil density were negatively correlated with invasive/naturalized (*Figs. 6a* and *b*), whereas soil moisture and soil organic matter were positively correlated with invasive/naturalized (*Figs. 6c* and *d*). There was no significant relationship between any of the five socio-economic factors and invasive/naturalized.

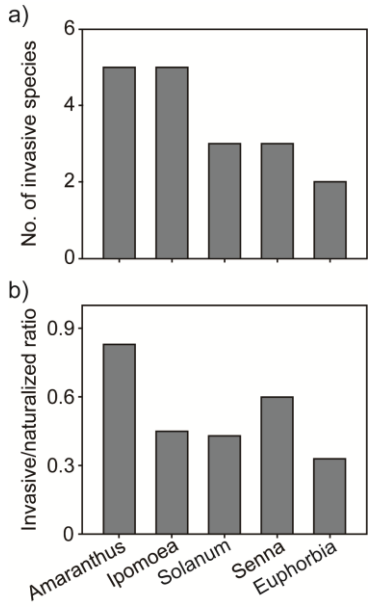

Figure 3. *The most successful genera of exotic plant species in Shenzhen. The five genera containing the most invasive plant species (a) and the ratios of invasive to naturalized species in these genera (b).*

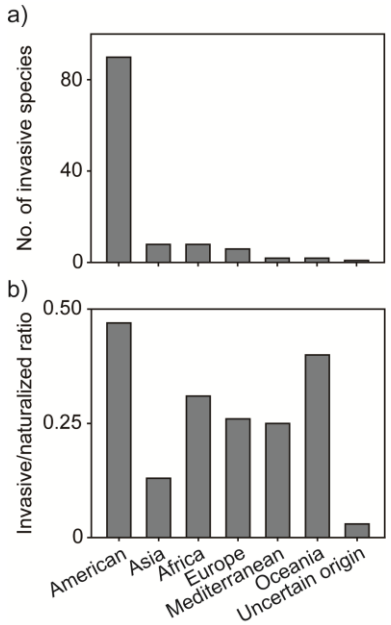

Figure 4. *Effects of geographic origin on the success of exotic plant species in Shenzhen. Effects of geographic origin on the number of invasive species (a) and the naturalization-to-invasion transition of exotic plant species (b) in Shenzhen.*

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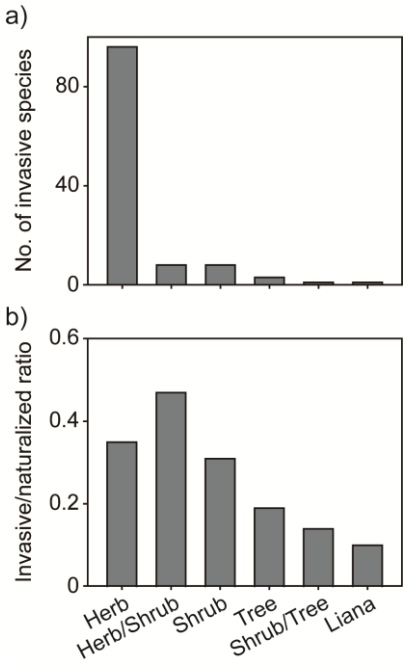

Figure 5. *Effects of life form on the success of exotic plant species in Shenzhen. Effects of life form on the number of invasive species (a) and the naturalization-to-invasion transition of exotic plant species in Shenzhen (b).*

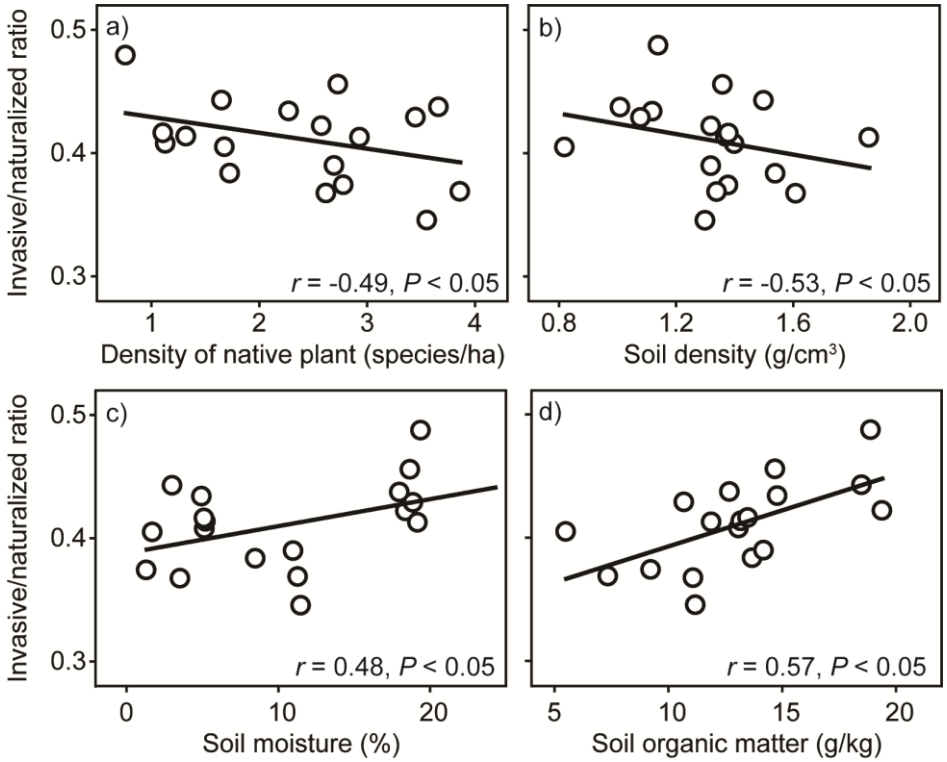

Figure 6. *Effects of environmental factors on the success of exotic plant species in Shenzhen. Effects of density of native plants (a), soil density (b), soil moisture (c) and soil organic matter (d) on the naturalization-to-invasion transition of exotic plant species in 18 major urban forests in Shenzhen. Each data point represents one forest.*

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Discussion

In this study, 349 naturalized plant species were found in Shenzhen, representing 40.5% of all 861 naturalized plant species in China (Jiang et al., 2011). Moreover, the number of naturalized plant species in Shenzhen was considerably higher than that (112) in Beijing, another rapidly urbanizing city in China (Wang et al., 2011). The presence of this high number of naturalized plant species in Shenzhen made it a suitable city for studying the naturalization-to-invasion transition of exotic plant species in rapidly urbanizing areas. Indeed, 43.3% of all 270 invasive plant species in China (Weber et al., 2008) were present in Shenzhen.

As expected, the invasive/naturalized ratios recorded in this study far exceeded 0.1. This finding cannot be considered novel, given that Williamson and Fitter (Williamson and Fitter, 1996) had long noted that approximately 20% of exotic crop plant species naturalized in Canada became invasive. However, the naturalization-to-invasion transition of exotic plants in urban forests of rapidly urbanizing cities deserves more explicit attention. The invasive/naturalized ratios for urban forests (ranging from 0.35 to 0.49) observed in this study were comparable to those (with an average of 0.43) obtained in urban roadsides, parks and gardens in Beijing (Wang et al., 2011), possibly indicating that urban forests are not necessarily more resistant to exotic plant invasion than other urban habitats. Here, we have attempted to elucidate the reasons for these extreme invasive/naturalized values by investigating the effects of plant attributes and environmental and socio-economic factors on the naturalization-to-invasion transition of exotic plants in Shenzhen, although further studies are needed to test whether our finding is applicable to other rapidly urbanizing cities around the world.

The effects of plant attributes on the naturalization-to-invasion transition of exotic plant species in Shenzhen were mirrored not only by the highly uneven distribution of invasive species across taxonomic groups, geographic origins and life forms but also by the associated invasive/naturalized ratios. First, the Asteraceae family contained the highest number of invasive plant species (34), which accounted for 29.1% of all invasive plant species in Shenzhen and 12.6% of all invasive plant species in China (Weber et al., 2008). Moreover, invasive/naturalized in this family was 0.61, possibly suggesting that the naturalized members of this family are highly successful in the naturalization-to-invasion transition. Similarly, the Asteraceae family accounted for 31.3% of the total number of invasive plant species in Beijing, associated with an invasive/naturalized value of 0.75 (Wang et al., 2011). This performance may be partially attributed to the plant traits that contribute to the strong dispersal and establishment abilities of this family, such as a large number of small and light seeds, rapid germination and a high germination rate (Pyšek, 1997). At the genus level, *Amaranthus* was found to contain the highest number of invasive species (5) and show a high invasive/naturalized value of 0.83, which corresponds with the fact that many species in this genus have been reported as invasive species in other parts of the world and tend to germinate quickly, grow rapidly and produce more leaf area (Horak and Loughin, 2000; Steckel, 2007; Steckel et al., 2004). Second, 76.9% of the invasive species found in Shenzhen originated from the Americas, a higher percentage than that (70.8%) of Beijing (Wang et al., 2011). However, the percentages for these two Chinese cities were greater than that (68%) reported for China as a whole (Liu et al., 2006). Moreover, the invasive/naturalized ratio (0.47) for American plants was higher than those for other geographic origins. In fact, Wang et al. reported similar patterns in Beijing (Wang et al., 2011). Similar environmental conditions and the high volume of

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commerce between the invaded and native ranges were considered as possible explanations for the numerical predominance of American invasive plants and their high invasive/naturalized ratios, following the suggestions of previous work (Liu et al., 2006). Our subsequent analyses showed that the former was more likely to be a major reason (see the next paragraph for more details). Third, herbaceous species accounted for 82.1% of the total invasive species in Shenzhen, which exhibited an invasive/naturalized value (0.35) greater than expected from the Tens Rule (Williamson and Fitter, 1996). A similar pattern was observed in Beijing (Wang et al., 2011). Additionally, approximately 88% of all of the invasive plant species in China were herbaceous (Liu et al., 2006). These findings may be partially explained by the fact that many herbaceous invasive species are characterized by their rapid growth and reproduction (Sakai et al., 2001), which may facilitate the rapid evolutionary adaptation of these invasive plants to novel environments (Prentis et al., 2008).

We assessed the effects of environmental and socio-economic factors on the naturalization-to-invasion transition of exotic plants in urban forests of Shenzhen by identifying significant relationships between the selected factors and the invasive/naturalized ratios (Weber et al., 2008; Liu et al., 2006). The negative relationship between the density of native plant species and the invasive/naturalized ratio may indicate that native biodiversity represses the transition, which would be consistent with the widely accepted notion that biodiversity is a barrier to ecological invasion (Kennedy et al., 2002). Although there is currently no report addressing the effects of soil density on plant invasion, the negative relationship between soil density and invasive/naturalized may be attributed to the inhibitory effects of elevated soil density on the germination, growth and reproduction of plants (Ehrenfeld et al., 2005). In contrast, soil moisture and organic matter content were positively correlated with the invasive/naturalized ratio, likely indicating that wetter and richer soils tended to be beneficial to the transition. In agreement with these results, previous studies have shown that wetter and richer soils were associated with higher germination and survival rate of invasive plants, as well as a greater number of invader seeds (Ehrenfeld et al., 2001; Warren et al., 2013). The lack of significant associations between the socio-economic factors and the invasive/naturalized ratio was initially surprising. This unexpected finding, in combination with other results of the present study, instead suggests that although human activities facilitate the initial establishment of exotic plants, biotic and environmental factors are more likely to be the major drivers of their further spread and impacts (Stohlgren et al., 2005). However, the effects of human activities on plant invasion may vary greatly at different spatial scales. Indeed, there is evidence that socio-economic factors could promote plant invasion at a provincial scale in China (Lin et al., 2007; Liu et al., 2005).

There are a few potential caveats with this study. First, the invasive/naturalized ratio may be a good measure to assess the overall success of the naturalization-invasion transition of exotic plants in a given area, but it does not represent the long-term ecological processes associated with the transition. Second, as noted by Vilà and Pujadas (Vilà and Pujadas, 2011), correlations between variables do not necessarily imply causation. Third, some variables not under consideration in this study could have an effect on the transition (Phillips et al., 2010; Milbau and Stout, 2008). However, despite these caveats, this study provided new insights into the factors driving the naturalization-to-invasion transition of exotic plants in a rapidly urbanizing area, particularly for urban forests. Nonetheless,

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if the findings of this study prove to be applicable to other rapidly urbanizing areas, they will be useful in developing a more objective and accurate approach for managing and predicting plant invasions in these areas.

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APPENDIX

Table S1. *Environmental factors of 19 major urban forests of Shenzhen**

Code	Forest ecosystem	Area (ha)	Average altitude (m)	Mean January temperature (ºC)	Mean July temperature (ºC)	Annual average precipitation (mm)	Density of native plant species (species/ha)
1	Nanshan	351	143	14.2	28.3	1311	1.70
2	Fenghuang Mountain	243	126	13.6	28.7	1799	2.57
3	Tiegang	5401	68.0	13.7	28.6	1705	1.62
4	Yangtai Mountain	2843	219	13.8	28.1	1574	2.23
5	Guangming	2063	129	13.7	29.1	1565	1.12
6	Guanlan	2211	120	14.1	29.5	1606	1.30
7	Wuzhipa	485	112	14.4	29.5	1485	1.65
8	Meilin	118	82.0	13.9	28.7	1572	2.72
9	Lianhua Mountain	180	57.4	14.4	28.5	1901	3.78
10	Bijia Mountain	142	86.0	14.4	28.6	1653	3.48
11	Weiling	87.2	107	13.8	28.7	1807	2.52
12	Buxin Mountain	348	119	14.0	28.9	1772	0.76
13	Wutong Mountain	2890	294	9.80	23.9	1548	3.58
14	Sanzhoutian	3483	326	12.3	26.3	1387	2.67
15	Songzikeng	1804	83.0	13.5	29.0	1583	1.09
16	Maluan Mountain	3172	218	13.5	28.8	1509	2.64
17	Tiantou Mountain	3003	229	13.2	29.2	1360	3.66
18	Dapeng Peninsula	14500	208	14.2	28.8	1882	3.37
19	Qiniang Mountain	4642	297	14.3	28.2	1705	2.87

* Excluding soil physico-chemical properties.

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***Table S2**. Soil physico-chemical properties of 19 major urban forests of Shenzhen. Data are presented as means (n = 20-95).*

Code	Forest ecosystem	Density (g/cm^3)	Porosity (%)	Moisture (%)	pH	OM* (g/kg)	TN* (g/kg)	AP* (mg/kg)
1	Nanshan	1.54	47.3	8.51	4.95	13.7	0.57	3.11
2	Fenghuang Mountain	1.61	40.0	3.55	6.39	11.1	0.72	1.53
3	Tiegang	1.50	44.6	3.03	4.55	18.5	0.71	2.51
4	Yangtai Mountain	1.12	45.0	4.96	5.20	14.8	0.20	2.40
5	Guangming	1.40	48.6	5.15	5.10	13.1	0.78	9.30
6	Guanlan	1.37	47.9	5.23	5.51	13.2	0.90	4.60
7	Wuzhipa	0.82	46.6	1.72	4.14	5.51	0.47	0.39
8	Meilin	1.38	48.0	1.32	5.25	9.24	0.27	6.83
9	Lianhua Mountain	1.34	51.4	11.3	5.56	7.36	0.15	4.48
10	Bijia Mountain	1.30	45.4	11.5	5.40	11.2	1.01	2.32
11	Weiling	1.32	55.4	18.4	5.02	19.4	0.54	0.92
12	Buxin Mountain	1.14	52.4	19.4	5.27	18.9	0.44	0.80
13	Wutong Mountain	1.01	55.3	18.0	5.15	12.7	0.30	7.80
14	Sanzhoutian	1.36	50.6	18.7	4.56	14.7	0.72	1.41
15	Songzikeng	1.38	47.2	5.13	5.03	13.5	0.55	1.07
16	Maluan Mountain	1.32	58.7	11.0	4.77	14.2	0.52	2.24
17	Tiantou Mountain	1.20	54.6	24.3	4.23	38.0	1.59	4.81
18	Dapeng Peninsula	1.08	34.2	18.9	4.64	10.7	0.67	3.95
19	Qiniang Mountain	1.86	42.5	19.2	5.30	11.9	1.11	6.33

*: OM, organic matter content; TN, total nitrogen content; AP, available phosphorus content.

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***Table S3**. Socio-economic factors of 19 major urban forests of Shenzhen.*

Code	Forest ecosystem	Population density within a 1,000-m radius (person/ha)	Road density within a 1,000-m radius (m/ha)	Road area ratio within a 1,000-m radius area (%)	Residential land area ratio within a 1,000-m radius (%)	Industrial land area ratio within a 1,000-m radius (%)
1	Nanshan	74.9	72.3	0.91	23.0	5.39
2	Fenghuang Mountain	73.5	57.1	8.46	8.23	6.99
3	Tiegang	107	44.8	6.43	5.53	6.57
4	Yangtai Mountain	80.0	51.5	6.14	6.17	4.91
5	Guangming	68.9	27.4	3.13	5.46	12.8
6	Guanlan	28.2	20.8	2.22	2.85	4.92
7	Wuzhipa	32.6	51.4	7.97	2.06	13.4
8	Meilin	144	59.0	5.31	16.7	0.47
9	Lianhua Mountain	221	125	17.4	32.6	6.29
10	Bijia Mountain	272	101	12.0	25.4	6.53
11	Weiling	319	79.5	7.40	38.3	3.53
12	Buxin Mountain	154	52.7	5.03	21.4	3.77
13	Wutong Mountain	59.2	43.5	5.43	7.42	1.09
14	Sanzhoutian	17.3	25.6	2.61	2.99	2.25
15	Songzikeng	30.3	59.2	7.00	8.06	8.40
16	Maluan Mountain	15.3	23.8	2.16	3.65	2.93
17	Tiantou Mountain	32.9	20.5	2.08	1.56	5.17
18	Dapeng Peninsula	9.37	19.0	1.75	3.43	0.88
19	Qiniang Mountain	2.23	8.58	0.55	0.96	0.00

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***Table S4**. Checklist of naturalized plant species in Shenzhen.*

Code	Species	Family	Genus	Geographic origin	Life form
		Acanthaceae			
1	*Adhatoda vasica*	Acanthaceae	Adhatoda	America	Shrub
2	*Andrographis paniculata*	Acanthaceae	Andrographis	South Asia, India, Australia	Herb
3	*Barleria cristata*	Acanthaceae	Barleria	Asia	Shrub
4	*Ruellia brittonina*	Acanthaceae	Ruellia	Mexico	Herb
5	*Thunbergia grandiflora*	Acanthaceae	Thunbergia	Asia	Liana
		Adiantaceae			
6	*Adiantum capillus-veneris*	Adiantaceae	Adiantum	pantropical	Herb
		Agavaceae			
7	*Agave americana*	Agavaceae	Agave	America	Herb
8	*Agave sisalana*	Agavaceae	Agave	North America	Herb
		Aizoaceae			
9	*Tetragonia tetragonioides*	Aizoaceae	Tetragonia	Australia, Asia, South America	Herb
10	*Trianthema portulacastrum*	Aizoaceae	Trianthema	Tropical Africa and Asia	Herb
		Amaranthaceae			
11	*Achyranthes aspera*	Amaranthaceae	Achyranthes	India, Vietnam, Philippines	Herb
12	*Alternanthera bettzickiana*	Amaranthaceae	Alternanthera	America	Herb
13	*Alternanthera paronychioides*	Amaranthaceae	Alternanthera	South America	Herb
14	*Alternanthera philoxeroides*	Amaranthaceae	Alternanthera	South America	Herb
15	*Alternanthera sessilis*	Amaranthaceae	Alternanthera	Vietnam, Malaysia, Philippines	Herb
16	*Amaranthus hybridus*	Amaranthaceae	Amaranthus	America	Herb
17	*Amaranthus lividus*	Amaranthaceae	Amaranthus	America	Herb

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18	*Amaranthus paniculatus*	Amaranthaceae	Amaranthus	America	Herb
19	*Amaranthus spinosus*	Amaranthaceae	Amaranthus	America	Herb
20	*Amaranthus tricolor*	Amaranthaceae	Amaranthus	Asia	Herb
21	*Amaranthus viridis*	Amaranthaceae	Amaranthus	Africa	Herb
22	*Celosia argentea*	Amaranthaceae	Celosia	America	Herb
23	*Celosia cristata*	Amaranthaceae	Celosia	Asia	Herb
24	*Gomphrena celosioides*	Amaranthaceae	Gomphrena	America	Herb
25	*Gomphrena globosa*	Amaranthaceae	Gomphrena	America	Herb
26	*Iresine herbstii*	Amaranthaceae	Iresine	Brazil	Herb
		Amaryllidaceae			
27	*Hippeastrum rutilum*	Amaryllidaceae	Hippeastrum	South America	Herb
28	*Hippeastrum vittatum*	Amaryllidaceae	Hippeastrum	South America	Herb
29	*Narcissus tazetta*	Amaryllidaceae	Narcissus	Middle Europe, Mediterranean, West Asia	Herb
30	*Zephyranthes candida*	Amaryllidaceae	Zephyranthes	North America	Herb
31	*Zephyranthes grandiflora*	Amaryllidaceae	Zephyranthes	North America	Herb
		Anacardiaceae			
32	*Mangifera indica*	Anacardiaceae	Mangifera	India	Tree
		Annonaceae			
33	*Annona glabra*	Annonaceae	Annona	Tropical America	Tree
34	*Annona squamosa*	Annonaceae	Annona	Tropical America	Shrub, Tree
		Apiaceae			
35	*Coriandrum sativum*	Apiaceae	Coriandrum	Mediterranean	Herb
36	*Daucus carota*	Apiaceae	Daucus	Asia	Herb
37	*Daucus carota var. sativa*	Apiaceae	Daucus	Europe, North Africa, Asia	Herb
38	*Eryngium foetidum*	Apiaceae	Eryngium	America	Herb

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39	*Foeniculum vulgare*	Apiaceae	Foeniculum	Mediterranean	Herb
		Apocynaceae			
40	*Catharanthus roseus*	Apocynaceae	Catharanthus	Africa	Herb
41	*Plumeria rubra*	Apocynaceae	Plumeria	South America	Tree
42	*Rauvolfia tetraphylla*	Apocynaceae	Rauvolfia	Tropical America, Tropical Africa	Shrub
43	*Thevetia peruviana*	Apocynaceae	Thevetia	Tropical America	Tree
		Araceae			
44	*Caladium bicolor*	Araceae	Caladium	South America	Herb
45	*Dieffenbachia picta*	Araceae	Dieffenbachia	South America	Herb
46	*Pistia stratiotes*	Araceae	Pistia	Brazil	Herb
		Asclepiadaceae			
47	*Asclepias curassavica*	Asclepiadaceae	Asclepias	Latin America	Herb
		Asteraceae			
48	*Ageratum conyzoides*	Asteraceae	Ageratum	Central and South America	Herb
49	*Ageratum houstonianum*	Asteraceae	Ageratum	North America	Herb
50	*Ambrosia artemisiifolia*	Asteraceae	Ambrosia	North America	Herb
51	*Artemisia annua*	Asteraceae	Artemisia	America	Herb
52	*Artemisia verlotiorum*	Asteraceae	Artemisia	NorthernEurasia	Herb
53	*Aster subulatus*	Asteraceae	Aster	North America	Herb
54	*Bidens bipinnata*	Asteraceae	Bidens	East Asia	Herb
55	*Bidens pilosa*	Asteraceae	Bidens	America	Herb
56	*Bidens pilosa var. radiata*	Asteraceae	Bidens	North America	Herb
57	*Centipeda minima*	Asteraceae	Centipeda	Pantropical	Herb
58	*Chrysanthemum coronarium*	Asteraceae	Chrysanthemum	Mediterranean	Herb
59	*Conyza bonariensis*	Asteraceae	Conyza	America	Herb

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60	*Conyza canadensis*	Asteraceae	Conyza	North America	Herb
61	*Conyza sumatrensis*	Asteraceae	Conyza	South America	Herb
62	*Coreopsis lanceolata*	Asteraceae	Coreopsis	North America	Herb
63	*Coreopsis tinctoria*	Asteraceae	Coreopsis	North America	Herb
64	*Cosmos bipinnata*	Asteraceae	Cosmos	North America	Herb
65	*Cosmos sulphureus*	Asteraceae	Cosmos	North America	Herb
66	*Crassocephalum crepidioides*	Asteraceae	Crassocephalum	Africa	Herb
67	*Crossostephium Chinensis*	Asteraceae	Crossostephium	America	Herb, Shrub
68	*Dahlia pinnata*	Asteraceae	Dahlia	Mexico	Herb
69	*Elephantopus scaber*	Asteraceae	Elephantopus	America	Herb
70	*Elephantopus tomentosus*	Asteraceae	Elephantopus	America	Herb
71	*Emilia sonchifolia*	Asteraceae	Emilia	Pantropical	Herb
72	*Erechthites hieracifolia*	Asteraceae	Erechthites	North America	Herb
73	*Erechthites valerianaefolia*	Asteraceae	Erechthites	South America	Herb
74	*Erigeron annuus*	Asteraceae	Erigeron	North America	Herb
75	*Erigeron karvinskianus*	Asteraceae	Erigeron	Mexico, Panama	Herb
76	*Eupatorium odoratum*	Asteraceae	Eupatorium	Tropical America	Herb
77	*Eupatorium catarium*	Asteraceae	Eupatorium	South America	Herb
78	*Galinsoga parviflora*	Asteraceae	Galinsoga	South America	Herb
79	*Gnaphalium pensylvanicum*	Asteraceae	Gnaphalium	Warm America	Herb
80	*Gnaphalium polycaulon*	Asteraceae	Gnaphalium	Pantropical	Herb
81	*Helianthus annuus*	Asteraceae	Helianthus	America	Herb
82	*Helianthus tuberosus*	Asteraceae	Helianthus	North America	Herb
83	*Lactuca sativa*	Asteraceae	Lactuca	Mediterranean	Herb
84	*Leucanthemum vulgare*	Asteraceae	Leucanthemum	Europe	Herb
85	*Mikania cordata*	Asteraceae	Mikania	Indonesia, LALaos, Vietnam	Herb/Vine
86	*Mikania micrantha*	Asteraceae	Mikania	Central and South America	Herb/Vine
87	*Parthenium hysterophorus*	Asteraceae	Parthenium	America	Herb
88	*Silybum marianum*	Asteraceae	Silybum	Europe, Asia, Africa	Herb

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89	*Solidago canadensis*	Asteraceae	Solidago	North America	Herb
90	*Soliva anthemifolia*	Asteraceae	Soliva	Oceania	Herb
91	*Sonchus arvensis*	Asteraceae	Sonchus	Europe	Herb
92	*Sonchus asper*	Asteraceae	Sonchus	Europe	Herb
93	*Sonchus oleraceus*	Asteraceae	Sonchus	Europe	Herb
94	*Spilanthes paniculata*	Asteraceae	Spilanthes	Pantropical	Herb
95	*Synedrella nodiflora*	Asteraceae	Synedrella	America	Herb
96	*Tagetes erecta*	Asteraceae	Tagetes	North America（Mexico）	Herb
97	*Tagetes patula*	Asteraceae	Tagetes	Mexico	Herb
98	*Tithonia diversifolia*	Asteraceae	Tithonia	Central and North America	Herb
99	*Tridax procumbens*	Asteraceae	Tridax	America	Herb
100	*Vernonia cinerea*	Asteraceae	Vernonia	Pantropical	Herb
101	*Wedelia trilobata*	Asteraceae	Wedelia	America	Herb
102	*Xanthium strumarium*	Asteraceae	Xanthium	Eurasia	Herb
103	*Zinnia elegans*	Asteraceae	Zinnia	Mexico	Herb
		Balsaminaceae			
104	*Impatiens balsamina*	Balsaminaceae	Impatiens	Asia	Herb
105	*Impatiens walleriana*	Balsaminaceae	Impatiens	Africa	Herb
		Basellaceae			
106	*Basella alba*	Basellaceae	Basella	Tropical Asia	Herb
		Begoniaceae			
107	*Begonia cucullata*	Begoniaceae	Begonia	South America	Herb
108	*Begonia semperflorens*	Begoniaceae	Begonia	Brazil	Herb
		Bignoniaceae			
109	*Macfadyena unguis-cati*	Bignoniaceae	Macfadyena	America	Liana
110	*Pyrostegia venusta*	Bignoniaceae	Pyrostegia	America	Liana

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		Bixaceae			
111	*Bixa orellana*	Bixaceae	Bixa	tropical America	Tree
		Boraginaceae			
112	*Heliotropium indicum*	Boraginaceae	Heliotropium	Thailand, Southeast Asia	Herb
		Brassicaceae			
113	*Brassica juncea*	Brassicaceae	Brassica	Asia	Herb
114	*Brassica oleracea var. botrytis*	Brassicaceae	Brassica	Europe	Herb
115	*Brassica oleracea var. capitata*	Brassicaceae	Brassica	Europe	Herb
116	*Brassica rapa var. oleifera*	Brassicaceae	Brassica	Europe	Herb
117	*Capsella bursa-pastoris*	Brassicaceae	Capsella	Europe	Herb
118	*Cardamine flexuosa*	Brassicaceae	Cardamine	Northern Eurasia	Herb
119	*Lepidium virginicum*	Brassicaceae	Lepidium	North America	Herb
120	*Lobularia maritima*	Brassicaceae	Lobularia	Mediterranean	Herb
121	*Nasturtium officinale*	Brassicaceae	Nasturtium	Europe	Herb
122	*Raphanus sativus*	Brassicaceae	Raphanus	Mediterranean	Herb
123	*Rorippa heterophylla*	Brassicaceae	Rorippa	Asia	Herb
124	*Sisymbrium altissimum*	Brassicaceae	Sisymbrium	Europe	Herb
		Cactaceae			
125	*Epiphyllum oxypetalum*	Cactaceae	Epiphyllum	Mexico	Shrub
126	*Hylocereus undatus*	Cactaceae	Hylocereus	America	Liana
127	*Opuntia dillenii*	Cactaceae	Opuntia	Tropical America	Herb
128	*Pereskia aculeata*	Cactaceae	Pereskia	America	Liana
		Cannaceae			
129	*Canna indica*	Cannaceae	Canna	tropical America	Herb

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		Capparidaceae			
130	*Cleome rutidosoerma*	Capparidaceae	Cleome	Africa	Herb
		Caricaceae			
131	*Carica papaya*	Caricaceae	Carica	Tropical America	Tree
		Caryophyllaceae			
132	*Arenaria serpyllifolia*	Caryophyllaceae	Arenaria	Europe	Herb
133	*Stellaria media*	Caryophyllaceae	Stellaria	Cosmopolitan	Herb
134	*Stellaria uliginosa*	Caryophyllaceae	Stellaria	Northern Eurasia	Herb
		Casuarinaceae			
135	*Casuarina equisetifolia*	Casuarinaceae	Casuarina	Australia	Tree
		Chenopodiaceae			
136	*Chenopodium album*	Chenopodiaceae	Chenopodium	Northern Eurasia	Herb
137	*Chenopodium ambrosioides*	Chenopodiaceae	Chenopodium	America	Herb
		Combretaceae			
138	*Quisqualis indica*	Combretaceae	Quisqualis	Europe, Asia	Shrub
		Commelinaceae			
139	*Zebrina pendula*	Commelinaceae	Zebrina	Mexico	Herb
		Convolvulaceae			
140	*Argyreia acuta*	Convolvulaceae	Argyreia	Asia	Liana
141	*Argyreia nervosa*	Convolvulaceae	Argyreia	India	Liana
142	*Cuscuta japonica*	Convolvulaceae	Cuscuta	Asia	Herb/Vine
143	*Ipomoea alba*	Convolvulaceae	Ipomoea	America	Herb/Vine
144	*Ipomoea aquatica*	Convolvulaceae	Ipomoea	America	Herb/Vine

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145	*Ipomoea batatas*	Convolvulaceae	Ipomoea	America	Herb
146	*Ipomoea cairica*	Convolvulaceae	Ipomoea	Europe	Herb/Vine
147	*Ipomoea carnea scbsp. fistulosa*	Convolvulaceae	Ipomoea	Tropical America	Shrub
148	*Ipomoea indica*	Convolvulaceae	Ipomoea	South America	Herb/Vine
149	*Ipomoea mauritiana*	Convolvulaceae	Ipomoea	America	Herb/Vine
150	*Ipomoea nil*	Convolvulaceae	Ipomoea	America	Herb/Vine
151	*Ipomoea purpurea*	Convolvulaceae	Ipomoea	Tropical America	Herb/Vine
152	*Ipomoea quamoclit*	Convolvulaceae	Ipomoea	Tropical America	Herb/Vine
153	*Ipomoea triloba*	Convolvulaceae	Ipomoea	Tropical America	Herb/Vine
	Crassulaceae				
154	*Bryophyllum pinnatum*	Crassulaceae	Bryophyllum	Africa	Herb
155	*Kalanchoe tubiflora*	Crassulaceae	Kalanchoe	Africa	Herb
156	*Kalanchoe verticillata*	Crassulaceae	Kalanchoe	Africa	Herb
157	*Sedum mexicanum*	Crassulaceae	Sedum	Mexico, America	Herb
	Cucurbitaceae				
158	*Momordica charantia*	Cucurbitaceae	Momordica	Palaeotropics	Herb/Vine
159	*Sechium edule*	Cucurbitaceae	Sechium	America	Herb/Vine
	Cyatheaceae				
160	*Sphaeropteris lepifera*	Cyatheaceae	Sphaeropteris	Southeast Asia	Tree
	Cyperaceae				
161	*Cyperus alternifolius subsp. flabelliformis*	Cyperaceae	Cyperus	Africa	Herb
162	*Cyperus rotundus*	Cyperaceae	Cyperus	Asia	Herb
163	*Schoenoplectus mucronatus*	Cyperaceae	Schoenoplectus	cosmopolitan	Herb
	Elatinaceae				

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164	*Elatine americana*	Elatinaceae	Elatine	America	Herb
		Equisetaceae			
165	*Equisetum arvense*	Equisetaceae	Equisetum	North temperate Zone	Herb
166	*Equisetum ramosissimum*	Equisetaceae	Equisetum	Asia	Herb
		Euphorbiaceae			
167	*Codiaeum variegatum*	Euphorbiaceae	Codiaeum	Malay Peninsula To Oceania	Shrub, Tree
168	*Euphorbia cyathophora*	Euphorbiaceae	Euphorbia	Central America, South America	Herb
169	*Euphorbia graminea*	Euphorbiaceae	Euphorbia	South Mexico, Central and South America	Herb
170	*Euphorbia hirta*	Euphorbiaceae	Euphorbia	Tropical	Herb
171	*Euphorbia marginata*	Euphorbiaceae	Euphorbia	North America	Herb
172	*Euphorbia milii*	Euphorbiaceae	Euphorbia	Africa	Liana
173	*Euphorbia prostrata*	Euphorbiaceae	Euphorbia	Tropical America	Herb
174	*Excoecaria tirucalli*	Euphorbiaceae	Excoecaria	Africa	Herb
175	*Jatropha curcas*	Euphorbiaceae	Jatropha	America	Shrub, Tree
176	*Manihot esculenta*	Euphorbiaceae	Manihot	South America	Shrub
177	*Pedilanthu tithymaloides*	Euphorbiaceae	Pedilanthu	Tropical America	Herb, Shrub
178	*Phyllanthus niruri*	Euphorbiaceae	Phyllanthus	America	Herb
179	*Phyllanthus tenellus*	Euphorbiaceae	Phyllanthus	America	Herb
180	*Ricinus communis*	Euphorbiaceae	Ricinus	Africa	Herb
		Fabaceae			
181	*Acacia farnesiana*	Fabaceae	Acacia	America	Shrub
182	*Aeschynomene indica*	Fabaceae	Aeschynomene	Aisa	Herb
183	*Arachis duranensis*	Fabaceae	Arachis	America	Herb
184	*Arachis hypogaea*	Fabaceae	Arachis	South America	Herb
185	*Caesalpinia pulcherrima*	Fabaceae	Caesalpinia	America	Shrub, Tree
186	*Cajanus cajan*	Fabaceae	Cajanus	Asia	Shrub
187	*Canavalia gladiata*	Fabaceae	Canavalia	America	Herb/Vine

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188	*Cassia bicapsularis*	Fabaceae	Cassia	America	Shrub
189	*Cassia surattensis*	Fabaceae	Cassia	America	Shrub
190	*Centrosema pubescens*	Fabaceae	Centrosema	America	Herb/Vine
191	*Chamaecrista nictitans subsp. patellaria var. glabrata*	Fabaceae	Chamaecrista	Tropical America	Herb
192	*Chamaecrista mimosoides*	Fabaceae	Chamaecrista	America	Herb, Shrub
193	*Clitoria ternatea*	Fabaceae	Clitoria	India	Herb
194	*Crotalaria pallida*	Fabaceae	Crotalaria	Ethiopia	Herb
195	*Crotalaria zanzibarica*	Fabaceae	Crotalaria	South America	Herb, Shrub
196	*Derris elliptica*	Fabaceae	Derris	Tropical Asia, India	Liana
197	*Desmodium tortuosum*	Fabaceae	Desmodium	America	Herb
198	*Dolichos lablab*	Fabaceae	Dolichos	Asia	Herb/Vine
199	*Erythrina corallodendron*	Fabaceae	Erythrina	South America	Shrub
200	*Indigofera suffruticosa*	Fabaceae	Indigofera	America	Herb, Shrub
201	*Leucaena leucocephala*	Fabaceae	Leucaena	America	Shrub
202	*Lotus corniculatus*	Fabaceae	Lotus	Europe, Asia, Africa	Herb
203	*Medicago sativa*	Fabaceae	Medicago	Asia	Herb
204	*Mimosa bimucronata*	Fabaceae	Mimosa	America	Shrub
205	*Mimosa invisa*	Fabaceae	Mimosa	America	Herb
206	*Mimosa pudica*	Fabaceae	Mimosa	America	Herb, Shrub
207	*Pachyrhizus erosus*	Fabaceae	Pachyrhizus	America	Herb/Vine
208	*Pithecellobium dulce*	Fabaceae	Pithecellobium	Central America	Tree
209	*Pueraria phaseoloides*	Fabaceae	Pueraria	Indonesia,Malaysia	Herb/Vine
210	*Senna alata*	Fabaceae	Senna	America	Shrub
211	*Senna occidentalis*	Fabaceae	Senna	America	Herb, Shrub
212	*Senna siamea*	Fabaceae	Senna	Burma to Malaysia	Tree
213	*Senna occidentalis var. sophera*	Fabaceae	Senna	Aisa	Shrub
214	*Senna tora*	Fabaceae	Senna	Asia（India）	Herb
215	*Sesbania cannabina*	Fabaceae	Sesbania	Asia（India）	Herb
216	*Stylosanthes guianensis*	Fabaceae	Stylosanthes	South America	Herb, Shrub

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217	*Tamarindus indica*	Fabaceae	Tamarindus	Africa	Tree
218	*Tephrosia candida*	Fabaceae	Tephrosia	Asia	Herb, Shrub
219	*Trifolium repens*	Fabaceae	Trifolium	Europe, North Africa	Herb
220	*Zornia gibbosa*	Fabaceae	Zornia	America	Herb
		Geraniaceae			
221	*Geranium carolinianum*	Geraniaceae	Geranium	America	Herb
		Hemionitidaceae			
222	*Pityrogramma calomelanos*	Hemionitidaceae	Pityrogramma	America	Herb
		Lamiaceae			
223	*Hyptis brevipes*	Lamiaceae	Hyptis	America	Herb
224	*Hyptis rhomboidea*	Lamiaceae	Hyptis	America	Herb
225	*Hyptis suaveolens*	Lamiaceae	Hyptis	America	Herb
226	*Mentha haplocalyx*	Lamiaceae	Mentha	Asia	Herb
227	*Mentha spicata*	Lamiaceae	Mentha	Europe	Herb
228	*Ocimum basilicum*	Lamiaceae	Ocimum	Africa, Asia	Herb
229	*Perilla frutescens*	Lamiaceae	Perilla	Asia	Herb
230	*Salvia coccinea*	Lamiaceae	Salvia	America	Herb
		Liliaceae			
231	*Aloe vera var.chinese*	Liliaceae	Aloe	Southern Africa	Herb, Shrub
232	*Asparagus densiflorus cv. densiflorus*	Liliaceae	Asparagus	South Africa	Herb/Vine
233	*Asparagus setaceus*	Liliaceae	Asparagus	Africa	Shrub
234	*Cordyline fruticosa*	Liliaceae	Cordyline	uncertain	Herb
		Iridaceae			
235	*Gladiolus gandavensis*	Iridaceae	Gladiolus	Mediteeranean, Tropical Africa,	Herb

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				Southwest and Central Asia	
		Lythraceae			
236	*Cuphea balsamona*	Lythraceae	Cuphea	America	Herb
237	*Lythrum salicaria*	Lythraceae	Lythrum	Europe	Herb
		Malvaceae			
238	*Abelmoschus moschatus*	Malvaceae	Abelmoschus	South Asia	Herb
239	*Bombax malabarica*	Malvaceae	Bombax	South Africa	Tree
240	*Corchorus capsularis*	Malvaceae	Corchorus	Subtropics	Herb
241	*Malva verticillata*	Malvaceae	Malva	Asia	Herb
242	*Malvastrum coromandelianum*	Malvaceae	Malvastrum	America	Herb, Shrub
243	*Sida acuta*	Malvaceae	Sida	Asia	Herb
244	*Sida cordata*	Malvaceae	Sida	Pantropic	Herb, Shrub
245	*Sida rhombifolia*	Malvaceae	Sida	Pantropic	Herb
246	*Urena lobata*	Malvaceae	Urena	Pantropic	Herb, Shrub
247	*Urena procumbens*	Malvaceae	Urena	Pantropic	Herb, Shrub
248	*Waltheria indica*	Malvaceae	Waltheria	America	Herb, Shrub
		Molluginaceae			
249	*Mollugo verticillata*	Molluginaceae	Mollugo	Tropical America	Herb
		Musaceae			
250	*Musa basjoo*	Musaceae	Musa	Ryukyu Islands	Herb
		Myrtaceae			
251	*Eucalyptus robusta*	Myrtaceae	Eucalyptus	Australia	Tree
252	*Psidium guajava*	Myrtaceae	Psidium	America	Shrub, Tree
253	*Syzygium jambos*	Myrtaceae	Syzygium	Southest Asia	Tree

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		Nyctaginaceae			
254	*Bougainvillea glabra*	Nyctaginaceae	Bougainvillea	Brazil	Shrub
255	*Bougainvillea spectabilis*	Nyctaginaceae	Bougainvillea	Brazil	Shrub
256	*Mirabilis jalapa*	Nyctaginaceae	Mirabilis	South America	Herb
		Nymphaeaceae			
257	*Nymphaea alba*	Nymphaeaceae	Nymphaea	North Afica, Eurasia	Herb
		Oleaceae			
258	*Jasminum sambac*	Oleaceae	Jasminum	India	Herb
		Onagraceae			
259	*Ludwigia hyssopifolia*	Onagraceae	Ludwigia	America	Herb
260	*Oenothera drummondii*	Onagraceae	Oenothera	America	Herb
		Oxalidaceae			
261	*Oxalis corniculata*	Oxalidaceae	Oxalis	South America, Afica	Herb
262	*Oxalis corymbosa*	Oxalidaceae	Oxalis	America	Herb
		Palmaceae			
263	*Elaeis guineensis*	Palmaceae	Elaeis	Tropical Africa	Shrub
		Passifloraceae			
264	*Passiflora caerulea*	Passifloraceae	Passiflora	South America	Herb/Vine
265	*Passiflora edulis*	Passifloraceae	Passiflora	Brazil and Netherlands antilles	Herb/Vine
266	*Passiflora foetida*	Passifloraceae	Passiflora	Latin America	Herb/Vine
		Phytolaccaceae			
267	*Phytolacca americana*	Phytolaccaceae	Phytolacca	North America	Herb

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		Piperaceae			
268	*Peperomia pellucida*	Piperaceae	Peperomia	America	Herb
269	*Piper betle*	Piperaceae	Piper	Tropical Asia, Africa	Herb/Vine
		Pittosporaceae			
270	*Pittosporum tobira*	Pittosporaceae	Pittosporum	America	Shrub, Tree
		Plantaginaceae			
271	*Plantago major*	Plantaginaceae	Plantago	Cosmopolitan	Herb
		Poaceae			
272	*Alopecurus aequalis*	Poaceae	Alopecurus	North America	Herb
273	*Alopecurus japonicus*	Poaceae	Alopecurus	Asia	Herb
274	*Arundo donax*	Poaceae	Arundo	Mediterranean	Herb
275	*Axonopus compressus*	Poaceae	Axonopus	America	Herb
276	*Brachiaria eruciformis*	Poaceae	Brachiaria	Pantropics	Herb
277	*Cenchrus echinatus*	Poaceae	Cenchrus	America	Herb
278	*Chloris barbata*	Poaceae	Chloris	Tropical America	Herb
279	*Coix lacryma-jobi*	Poaceae	Coix	Tropical Asia	Herb
280	*Digitaria ciliaris*	Poaceae	Digitaria	Tropics, Subtropics	Herb
281	*Digitaria sanguinalis*	Poaceae	Digitaria	Europe	Herb
282	*Echinochloa crusgalli*	Poaceae	Echinochloa	Europe，Asia	Herb
283	*Eleusine indica*	Poaceae	Eleusine	Asia	Herb
284	*Eragrostis cillaris*	Poaceae	Eragrostis	Paleotropics	Herb
285	*Eragrostis perennans*	Poaceae	Eragrostis	Cosmopolitan	Herb
286	*Melinis repens*	Poaceae	Melinis	Africa	Herb
287	*Panicum maximum*	Poaceae	Panicum	Africa	Herb
288	*Panicum repens*	Poaceae	Panicum	Brazil	Herb

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289	*Paspalum conjugatum*	Poaceae	Paspalum	America	Herb
290	*Paspalum distichum*	Poaceae	Paspalum	Tropical America	Herb
291	*Paspalum urvillei*	Poaceae	Paspalum	Tropical America	Herb
292	*Pennisetum purpureum*	Poaceae	Pennisetum	Africa	Herb
293	*Poa annua*	Poaceae	Poa	Europe	Herb
294	*Setaria geniculata*	Poaceae	Setaria	Asia, Europe	Herb
295	*Setaria glauca*	Poaceae	Setaria	Eurasia, America, Australia	Herb
296	*Setaria pallidifusca*	Poaceae	Setaria	Southern Asia, Australia	Herb
297	*Setaria palmifolia*	Poaceae	Setaria	Africa	Herb
298	*Setaria viridis*	Poaceae	Setaria	Eurasia	Herb
		Polygonaceae			
299	*Antigonon leptopus*	Polygonaceae	Antigonon	Central America	Liana
300	*Homalocladium platycladum*	Polygonaceae	Homalocladium	Oceania	Shrub
301	*Polygonum aviculare*	Polygonaceae	Polygonum	Asia	Herb
302	*Rumex acetosella*	Polygonaceae	Rumex	Eurasia	Herb
303	*Rumex crispus*	Polygonaceae	Rumex	Eurasia	Herb
		Pontederiaceae			
304	*Eichhornia crassipes*	Pontederiaceae	Eichhornia	America	Herb
		Portulacaceae			
305	*Portulaca grandiflora*	Portulacaceae	Portulaca	America	Herb
306	*Portulaca oleracea*	Portulacaceae	Portulaca	Cosmopolitan	Herb
307	*Portulaca pilosa*	Portulacaceae	Portulaca	Tropical America	Herb
308	*Talinum paniculatum*	Portulacaceae	Talinum	America	Herb
		Punicaceae			
309	*Punica granatum*	Punicaceae	Punica	Asia	Shrub, Tree

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		Ranunculaceae			
310	*Ranunculus japonicus*	Ranunculaceae	Ranunculus	Aisa	Herb
		Rubiaceae			
311	*Borreria articularis*	Rubiaceae	Borreria	India	Herb/Vine
312	*Borreria latifolia*	Rubiaceae	Borreria	South America	Herb
313	*Galium aparine*	Rubiaceae	Galium	Northern Eurasia	Herb
		Rutaceae			
314	*Citrus aurantifolia*	Rutaceae	Citrus	Uncertain	Tree
		Sapindaceae			
315	*Cardiospermum halicacabum*	Sapindaceae	Cardiospermum	America	Herb/Vine
		Scrophulariaceae			
316	*Scoparia dulcis*	Scrophulariaceae	Scoparia	America	Herb
317	*Striga asiatica*	Scrophulariaceae	Striga	Asia	Herb
318	*Torenia fournieri*	Scrophulariaceae	Torenia	Vietnam	Herb
319	*Veronica peregrina*	Scrophulariaceae	Veronica	North America	Herb
320	*Veronica persica*	Scrophulariaceae	Veronica	West Asia, Europe	Herb
321	*Veronica polita*	Scrophulariaceae	Veronica	Asia	Herb
		Solanaceae			
322	*Capsicum annuum*	Solanaceae	Capsicum	Mexico, South America	Herb
323	*Capsicum annuum var. conoides*	Solanaceae	Capsicum	Mexico to Columbia	Herb
324	*Datura metel*	Solanaceae	Datura	America	Herb
325	*Datura stramonium*	Solanaceae	Datura	North America	Herb
326	*Lycopersicon esculentum*	Solanaceae	Lycopersicon	South America	Herb
327	*Nicandra physaloides*	Solanaceae	Nicandra	South America	Herb
328	*Petunia hybrida*	Solanaceae	Petunia	Argentina	Herb

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329	*Physalis angulata*	Solanaceae	Physalis	America	Herb
330	*Physalis minima*	Solanaceae	Physalis	Tropical Asia	Herb
331	*Solanum americanum*	Solanaceae	Solanum	South America	Herb
332	*Solanum capsicoides*	Solanaceae	Solanum	Brazil	Herb, Shrub
333	*Solanum erianthum*	Solanaceae	Solanum	America	Tree
334	*Solanum melongena*	Solanaceae	Solanum	South America	Herb
335	*Solanum pseudocapsicum*	Solanaceae	Solanum	Brazil	Herb
336	*Solanum surattense*	Solanaceae	Solanum	Brazil	Herb, Shrub
337	*Solanum torvum*	Solanaceae	Solanum	America	Shrub
		Tropaeolaceae			
338	*Tropaeolum majus*	Tropaeolaceae	Tropaeolum	South America	Herb
		Urticaceae			
339	*Pilea microphylla*	Urticaceae	Pilea	South America	Herb
		Verbenaceae			
340	*Clerodendrum philippinum*	Verbenaceae	Clerodendrum	Asia	Shrub
341	*Duranta erecta*	Verbenaceae	Duranta	Latin America	Shrub
342	*Lantana camara*	Verbenaceae	Lantana	America	Shrub
343	*Lantana montevidensis*	Verbenaceae	Lantana	Latin America	Shrub
344	*Phyla nodiflora*	Verbenaceae	Phyla	America	Herb
345	*Stachytarpheta jamaicensis*	Verbenaceae	Stachytarpheta	Central and South America	Herb
		Zingiberaceae			
346	*Alpinia officinarum*	Zingiberaceae	Alpinia	South Asia	Tree
347	*Curcuma domestica*	Zingiberaceae	Curcuma	India	Herb
348	*Hedychium coronarium*	Zingiberaceae	Hedychium	Himalaya	Herb
349	*Zingiber officinale*	Zingiberaceae	Zingiber	Tropical Asia	Herb

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***Table S5**. Checklist of invasive plant species in Shenzhen.*

Code	Species	Family	Genus	Geographic origin	Life form
		Amaranthaceae			
1	*Alternanthera philoxeroides*	Amaranthaceae	Alternanthera	South America	Herb
2	*Amaranthus hybridus*	Amaranthaceae	Amaranthus	America	Herb
3	*Amaranthus paniculatus*	Amaranthaceae	Amaranthus	America	Herb
4	*Amaranthus spinosus*	Amaranthaceae	Amaranthus	America	Herb
5	*Amaranthus tricolor*	Amaranthaceae	Amaranthus	Asia	Herb
6	*Amaranthus viridis*	Amaranthaceae	Amaranthus	Africa	Herb
7	*Gomphrena celosioides*	Amaranthaceae	Gomphrena	America	Herb
		Apiaceae			
8	*Coriandrum sativum*	Apiaceae	Coriandrum	Mediterranean	Herb
9	*Daucus carota*	Apiaceae	Daucus	Asia	Herb
10	*Eryngium foetidum*	Apiaceae	Eryngium	America	Herb
		Apocynaceae			
11	*Catharanthus roseus*	Apocynaceae	Catharanthus	Africa	Herb
		Araceae			
12	*Pistia stratiotes*	Araceae	Pistia	Brazil	Herb
		Asclepiadaceae			
13	*Asclepias curassavica*	Asclepiadaceae	Asclepias	Latin America	Herb
		Asteraceae			
14	*Ageratum conyzoides*	Asteraceae	Ageratum	Central and South America	
15	*Ageratum houstonianum*	Asteraceae	Ageratum	North America	Liana
16	*Ambrosia artemisiifolia*	Asteraceae	Ambrosia	North America	
17	*Aster subulatus*	Asteraceae	Aster	North America	

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18	*Bidens bipinnata*	Asteraceae	Bidens	East Asia	Herb
19	*Chrysanthemum coronarium*	Asteraceae	Chrysanthemum	Mediterranean	
20	*Conyza bonariensis*	Asteraceae	Conyza	America	
21	*Conyza canadensis*	Asteraceae	Conyza	North America	Herb
22	*Conyza sumatrensis*	Asteraceae	Conyza	South America	
23	*Coreopsis lanceolata*	Asteraceae	Coreopsis	North America	
24	*Coreopsis tinctoria*	Asteraceae	Coreopsis	North America	Herb
25	*Cosmos bipinnata*	Asteraceae	Cosmos	North America	Herb
26	*Crassocephalum crepidioides*	Asteraceae	Crassocephalum	Africa	Herb
27	*Crossostephium Chinensis*	Asteraceae	Crossostephium	America	Herb
28	*Erechthites hieracifolia*	Asteraceae	Erechthites	North America	Herb
29	*Erechthites valerianaefolia*	Asteraceae	Erechthites	South America	Herb
30	*Erigeron annuus*	Asteraceae	Erigeron	North America	Herb
31	*Eupatorium odoratum*	Asteraceae	Eupatorium	Tropical America	Herb
32	*Galinsoga parviflora*	Asteraceae	Galinsoga	South America	Herb
33	*Gnaphalium pensylvanicum*	Asteraceae	Gnaphalium	Warm America	Herb
34	*Helianthus tuberosus*	Asteraceae	Helianthus	Europe	Herb
35	*Leucanthemum vulgare*	Asteraceae	Leucanthemum	North America	Herb
36	*Mikania micrantha*	Asteraceae	Mikania	America	Herb
37	*Parthenium hysterophorus*	Asteraceae	Parthenium	Central and South America	Herb, Shrub
38	*Silybum marianum*	Asteraceae	Silybum	Europe, Asia, Africa	Herb
39	*Solidago canadensis*	Asteraceae	Solidago	North America	Herb
40	*Soliva anthemifolia*	Asteraceae	Soliva	Oceania	Herb
41	*Sonchus asper*	Asteraceae	Sonchus	Europe	Herb
42	*Sonchus oleraceus*	Asteraceae	Sonchus	Europe	Herb
43	*Synedrella nodiflora*	Asteraceae	Synedrella	America	Herb
44	*Tagetes erecta*	Asteraceae	Tagetes	North America（Mexico）	Herb
45	*Tagetes patula*	Asteraceae	Tagetes	Mexico	Herb/Vine
46	*Tithonia diversifolia*	Asteraceae	Tithonia	Central and North America	Herb
47	*Tridax procumbens*	Asteraceae	Tridax	America	Herb

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48	*Wedelia trilobata*	Asteraceae	Wedelia	America	Herb
					Herb
		Bignoniaceae			
49	*Macfadyena unguis-cati*	Bignoniaceae	Macfadyena	America	Liana
		Brassicaceae			
50	*Lepidium virginicum*	Brassicaceae	Lepidium	North America	Herb
		Cactaceae			
51	*Opuntia dillenii*	Cactaceae	Opuntia	Tropical America	Herb
		Chenopodiaceae			
52	*Chenopodium ambrosioides*	Chenopodiaceae	Chenopodium	America	Herb
		Convolvulaceae			
53	*Ipomoea cairica*	Convolvulaceae	Ipomoea	Europe	Herb/Vine
54	*Ipomoea indica*	Convolvulaceae	Ipomoea	South America	Herb/Vine
55	*Ipomoea nil*	Convolvulaceae	Ipomoea	America	Herb/Vine
56	*Ipomoea purpurea*	Convolvulaceae	Ipomoea	Tropical America	Herb/Vine
57	*Ipomoea triloba*	Convolvulaceae	Ipomoea	Tropical America	Herb/Vine
		Crassulaceae			
58	*Bryophyllum pinnatum*	Crassulaceae	Bryophyllum	Africa	Herb
		Euphorbiaceae			
59	*Euphorbia hirta*	Euphorbiaceae	Euphorbia	Central America, South America	Herb
60	*Euphorbia marginata*	Euphorbiaceae	Euphorbia	North America	Herb
61	*Jatropha curcas*	Euphorbiaceae	Jatropha	America	Shrub, Tree
62	*Ricinus communis*	Euphorbiaceae	Ricinus	Africa	Herb
		Fabaceae			
63	*Acacia farnesiana*	Fabaceae	Acacia	America	Shrub
64	*Chamaecrista mimosoides*	Fabaceae	Chamaecrista	America	Herb, Shrub

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65	*Crotalaria zanzibarica*	Fabaceae	Crotalaria	South America	Herb, Shrub
66	*Indigofera suffruticosa*	Fabaceae	Indigofera	America	Herb, Shrub
67	*Leucaena leucocephala*	Fabaceae	Leucaena	America	Shrub
68	*Medicago sativa*	Fabaceae	Medicago	Asia	Herb
69	*Mimosa bimucronata*	Fabaceae	Mimosa	America	Shrub
70	*Mimosa invisa*	Fabaceae	Mimosa	America	Herb
71	*Mimosa pudica*	Fabaceae	Mimosa	America	Herb, Shrub
72	*Senna alata*	Fabaceae	Senna	America	Shrub
73	*Senna occidentalis*	Fabaceae	Senna	America	Herb, Shrub
74	*Senna tora*	Fabaceae	Senna	Burma to Malaysia	Tree
75	*Trifolium repens*	Fabaceae	Trifolium	Europe, North Africa	Herb
		Geraniaceae			
76	*Geranium carolinianum*	Geraniaceae	Geranium	America	Herb
		Labitae			
77	*Hyptis brevipes*	Lamiaceae	Hyptis	America	Herb
78	*Hyptis rhomboidea*	Lamiaceae	Hyptis	America	Herb
79	*Hyptis suaveolens*	Lamiaceae	Hyptis	America	Herb
		Lythraceae			
80	*Cuphea balsamona*	Lythraceae	Cuphea	America	Herb
		Malvaceae			
81	*Malvastrum coromandelianum*	Malvaceae	Malvastrum	America	Herb, Shrub
82	*Waltheria indica*	Malvaceae	Waltheria	America	Herb, Shrub
		Myrtaceae			
83	*Eucalyptus robusta*	Myrtaceae	Eucalyptus	Australia	Tree
84	*Syzygium jambos*	Myrtaceae	Syzygium	Southest Asia	Tree

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		Nyctaginaceae			
85	*Mirabilis jalapa*	Nyctaginaceae	Mirabilis	South America	Herb
		Onagraceae			
86	*Oenothera drummondii*	Onagraceae	Oenothera	America	Herb
		Oxalidaceae			
87	*Oxalis corymbosa*	Oxalidaceae	Oxalis	America	Herb
		Passifloraceae			
88	*Passiflora foetida*	Passifloraceae	Passiflora	Latin America	Herb/Vine
		Phytolaccaceae			
89	*Phytolacca americana*	Phytolaccaceae	Phytolacca	North America	Herb
		Piperaceae			
90	*Peperomia pellucida*	Piperaceae	Peperomia	America	Herb
		Poaceae			
91	*Axonopus compressus*	Poaceae	Axonopus	America	Herb
92	*Cenchrus echinatus*	Poaceae	Cenchrus	America	Herb
93	*Melinis repens*	Poaceae	Melinis	Africa	Herb
94	*Panicum maximum*	Poaceae	Panicum	Africa	Herb
95	*Panicum repens*	Poaceae	Panicum	Brazil	Herb
96	*Paspalum conjugatum*	Poaceae	Paspalum	America	Herb
97	*Pennisetum purpureum*	Poaceae	Pennisetum	Africa	Herb
		Pontederiaceae			
98	*Eichhornia crassipes*	Pontederiaceae	Eichhornia	America	Herb

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		Portulacaceae			
99	*Portulaca pilosa*	Portulacaceae	Portulaca	Tropical America	Herb
100	*Talinum paniculatum*	Portulacaceae	Talinum	America	Herb
		Rubiaceae			
101	*Borreria latifolia*	Rubiaceae	Borreria	South America	Herb
		Scrophulariaceae		North America	Herb
102	*Scoparia dulcis*	Scrophulariaceae	Scoparia	America	Herb
103	*Veronica peregrina*	Scrophulariaceae	Veronica	Asia	Herb
104	*Veronica persica*	Scrophulariaceae	Veronica	West Asia, Europe	Herb
105	*Veronica polita*	Scrophulariaceae	Veronica	America	Herb
		Solanaceae			
106	*Datura metel*	Solanaceae	Datura	America	Herb
107	*Datura stramonium*	Solanaceae	Datura	North America	Herb
108	*Nicandra physaloides*	Solanaceae	Nicandra	South America	Herb
109	*Physalis angulata*	Solanaceae	Physalis	America	Herb, Shrub
110	*Solanum erianthum*	Solanaceae	Solanum	America	Tree
111	*Solanum surattense*	Solanaceae	Solanum	Brazil	Herb, Shrub
112	*Solanum torvum*	Solanaceae	Solanum	America	Shrub
		Urticaceae			
113	*Pilea microphylla*	Urticaceae	Pilea	South America	Herb
		Verbenaceae			
114	*Duranta erecta*	Verbenaceae	Duranta	Latin America	Shrub
115	*Lantana camara*	Verbenaceae	Lantana	America	Shrub
116	*Lantana montevidensis*	Verbenaceae	Lantana	Latin America	Shrub
117	*Stachytarpheta jamaicensis*	Verbenaceae	Stachytarpheta	Central and South America	Herb

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