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IS THE OVERSPREADING OF *PAEDERIA SCANDENS* IN HIGHLY DISTURBED AREAS JUST OCCASIONAL?

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Abstract

Paederia scandens, a native weedy vine, is a common species in China, however in recent years, it has spread extensively. Though research focused on this vine has increased, still ecological information concerning it is rare. We hypothesized that the overspreading of this weedy vine in highly disturbed area was not an occasional case. In order to test this hypothesis, field observations were carried out in Shenzhen, China. Records showed that *P. scandens* was distributed sporadically before in most of the ecosystems in Shenzhen, but it was densely distributed in 8 areas now where the ecosystems were disturbed and quite vulnerable**.** The current coverage area is about 24-5000 times that of the past and the total coverage area has reached 8.8 hm^2. More than 29 plant families, 39 genera and 45 species have been impacted by this weedy vine. The average growth rate was 1.3cm/d in the rapid growing period, and the maximum growth rate was 1.9cm/d. The simple community of *P. scandens* had a lower number of species and abundance than the control. Results suggested that the distribution pattern of *P. scandens* had changed from sporadic to dense in the highly disturbed areas. *P. scandens* had the potential to overspread in highly disturbed areas and the community with simple configuration offered more opportunities for it to overspread. Integrating the present investigations and studies, we conclude that the overspreading of *P. scandens* in highly disturbed areas is not just an occasional case.

Introduction

Paederia scandens, one of the common native weedy vines in China, belonging to *Paederia*, Rubiaceae, is widely distributed in most of East and South-East Asia, according to the Flora of China (Anon., 1977). It is a perennial, twining, malodorous, deciduous climbing species and mainly grows on wasteland, cultivated land, forest edge, hillsides and thickets.

In recent years, this weedy vine has spread extensively, with a high coverage rate, and has become a weedy pest in the Baiyunshan Mountain Forest Park of Guangzhou and the Xiqiaoshan Mountain Forest Park of Foshan, southern China (Peng *et al.*, 2009; Yu *et al.*, 2009). In America, this weedy vine, which is an exotic invasive species, invades citrus groves, pasturelands, urban landscapes, field plantings, forests, wetlands, and so forth, causing immense losses for livestock, natural ecosystems, and human beings (Possley & Brazis, 1998 Langeland & Burks, 1998; Walker *et al.*, 2001), therefore, it has been declared a category I Florida exotic pest plant (Langeland & Burks, 1998), a listing that groups the plant with the most invasive weed species in Florida (Pemberton & Pratt, 2002).

Due to the increase of this vine, there have been an increasing number of studies on it, mainly related to its chemical composition and pharmacology, configuration flora, management and control, as well as the evaluations (Gann & Gordon, 1998; Langeland & Burks, 1998; Diamond, 1999; Pratt & Pemberton, 2000; Ye *et al.*, 2011). Although much attention has been paid to this species in America, little is known about the changes in its ecological traits due to the lack of related research, and thus related studies have been proposed for future research (Pemberton & Pratt, 2002). In China, research focused on invasive species (Huang *et al.*, 2011), while related ecological studies on this vine were rare except for some primary investigations (Peng *et al.*, 2009).

P. scandens is a common weedy vine that has been around for a long time in the native distribution areas (Anon., 1977), however, it has the potential to become an invasive species when introduced to new areas (Gann & Gordon, 1998). The overspreading of this weedy vine has been found in highly urbanized areas where the ecological disturbance was intense, thus we ask: was this just an occasional case in highly urbanized areas? We hypothesized that the overspreading of this weedy vine in highly disturbed area was not an occasional case. In order to test this hypothesis, we need to know if the distribution pattern of this vine has changed, if this species has the potential to overspread, and what kind of habitat helps this vine to overspread. Due to the fact that ecological information on this species is rare, the answers to these questions are not clear.

The present study aimed to test if the overspreading of *P. scandens* in highly disturbed areas is just an occasional case. Because related research is rare, the study on the overspreading of this vine is quite important for controlling this weed. The study on the overspreading of this vine was beneficial to the warning management of the native distributional countries. It will help other countries into which the plant has been introduced to manage it. Results from the present study will also be helpful for introducing new plant species during the process of urbanization for their growth potential and adaptability to intense disturbance and global change.

Materials and Methods

Study area: Shenzhen (113°45′44″ 114°37′21″E, 22°26′59″ 22°51′49″N), one of the Special Economic Zones in China, lies in the eastern part of the Pearl River delta area and is to the north of Hong Kong (Fig. 1). It is a door and test field of the reform and opening-up in China, with a total area of 1957.32 km^2, a population of more than 14 million and a total GDP of 951.1 billion Chinese

Yuan in 2010. Nearly half of the land in Shenzhen belongs to the construction area. It has a typical subtropical oceanic monsoon climate with an average annual temperature of 22.5°C and an annual average precipitation of 1966 mm.

Data collection and analysis: In order to test if the overspreading of this weedy vine is occasional in highly urbanized areas, field investigations were carried out in Shenzhen, where almost half of the land belongs to the building area, while the rest of the land belongs to the "Shenzhen Basic Ecological Control Line", which has an area of 974km^2 and is protected by law (Fig. 2). The "Shenzhen Basic Ecological Control Line" was chosen as the investigation area due to its ecological importance and its fragility. Furthermore, the coastal line was also investigated in present study. Thus, the area investigated in the present study comprised more than half the land of Shenzhen.

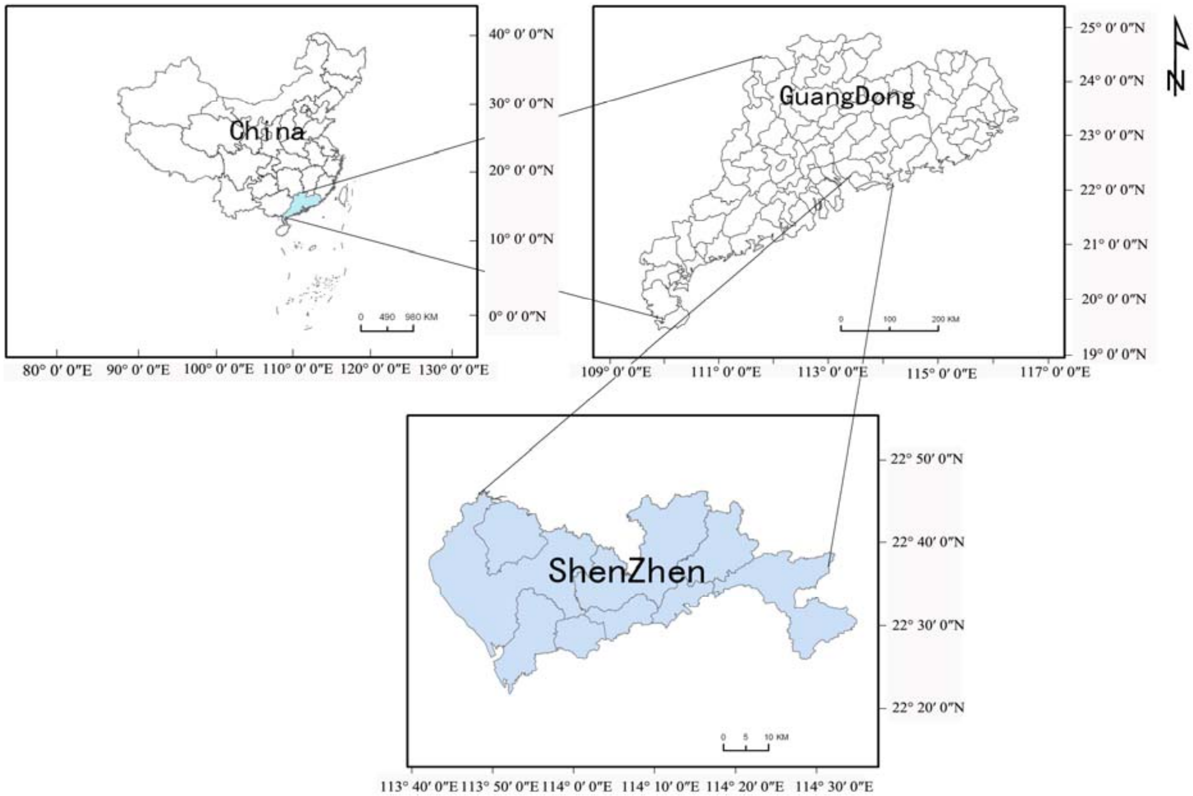

Fig. 1. Location of research site.

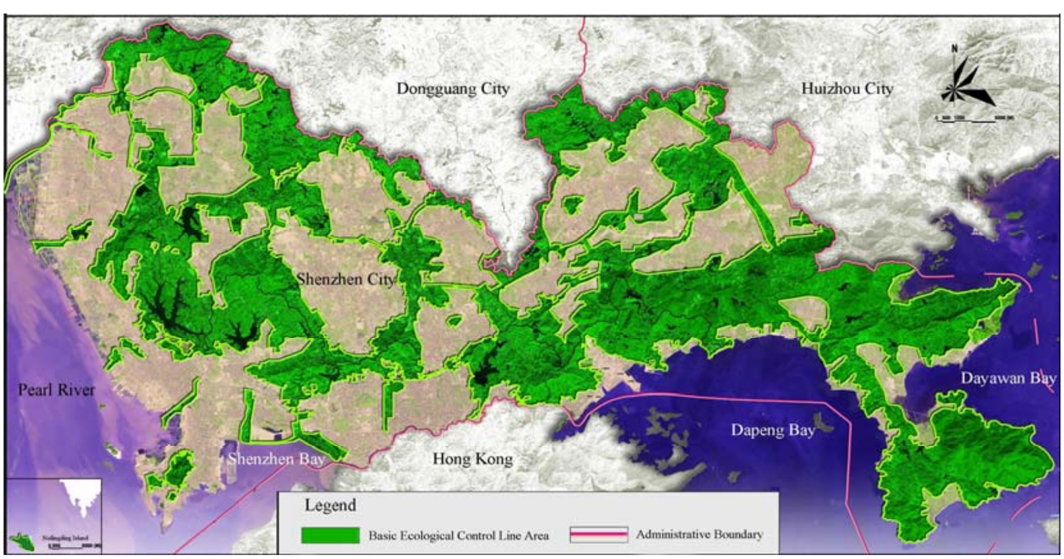

Fig. 2. Most of the investigated area in present study-Shenzhen basic ecological control line.

The investigation on the overspreading of this weed was dependent on the use of trucks during the whole process. We stood on trucks that were driven along the roads and highways or we walked along the byways to evaluate the growth situation of the weed. When a mass of weed was found, we stopped to see if it was *P. scandens.* Detailed observation was carried out once the locations of this vine were confirmed. The area, landform and slope direction, buildings and structures, pollution, management situation, space from the disturbance were recorded based on Wang *et al.,* (1996) (Table 1), and quadrats were set to investigate the diversity. Massed vines were found with our naked eye and a telescope, and the area of the investigation sites and the space from the disturbance were evaluated based on a telemeter (LS206, ± 0.5m).

In fact, not all of the area could be observed during the investigation, thus other studies and interviews were carried out as supplements in the present study. We studied the materials and data on these areas including species list, published references, internal documentation, personal communications, botanic atlas and flora, and examined the related specimens. We also interviewed the managers of 20 main parks or beauty spots (Meilin Park, Wutongshan Forest Park, Linzhi Park, Nanshan Park, Xinan Park, Lizhi Park, Lianhuashan Park, Bijiashan Park, Meilinshan Park, Futian mangrove reserve, Weilin Park, Haishangtianyuan, Baguan managrogve wetland, Shanzhoutian Forest Park, Maluanshan Forest Park, Qiniangshan, Longcheng Park, Haibin Park, Yuanboyuan, Donghug Park), obtained view from some senior experts of southern China, as well as the local residents. The plot of the distribution pattern was marked using ArcGIS10.0 based on the longitude and latitude of each investigated site.

In the present study, we could not obtain the historical data on this weedy vine through direct observation due to the absence of previous research. Fortunately, many valid methods were proposed to study the dynamics of the historical vegetation, such as the methods of pointing research, time-space mutual substitution and dynamic models (Peng, 1996). Due to the fact that pointing research was not carried out before, other methods were taken into consideration.

The method of time-space mutual substitution was used extensively to study the changes in the vegetation and soil, though it could not guarantee the invariableness of the environmental factors in a different time and space (Peng, 1996; Xue *et al.*, 2011). Here, time-space mutual substitution was used to evaluate the historical situation of this vine. In order to evaluate the changes in the coverage area of *P. scandens*, we investigated 50 areas where this weedy vine existed but did not grow intensively, and in which the ecosystem was not destroyed. In these areas, the coverage area of this vine was about 0.5~4 m^2 in each sampling site, and the average coverage area was about 2 m^2. The sites of breaking out were recorded through counting the individual plants in the overspreading sites. The past coverage area of this weedy vine was calculated based on the sites of breaking out and the mean coverage area. Because some barriers investigated in the present study were constructed several years ago, the original area of this vine in this area could be considered as 0.

The potential of this vine was also studied in the present study. Research was carried out from March 2011 to October 2011, the length and the coverage area were recorded. The site for pointing research was in Dongbu Huaqiaocheng, where the ecosystem was highly disturbed. In this sampling area, 76 individual plants were investigated. The length of the vines and the coverage area were recorded in March 2011 and October 2011. The length was measured using rulers (±0.1mm) and the area was evaluated according the shadow of this vine on the ground. The difference between the first investigated time and the last investigated time is the new growth.

Table 1. Characteristics of P. scandens communities in Shenzhen.

Distribution site	Types of land and community	Configuration of community	Space from disturbance (m)	Landform and slope direction	Management	Buildings and structures	Pollutions
Haishangtianyuan HSTY	Wetland; mangroves	1-2 layer in vertical level	0-1	estuary	Absent	Roads, illegal shanties, buildings	Polluted water
Xinda	Wasted land; grass	Herbs	5-10	Plain	Absent	dwelling houses and roads	Solid wastes
Honggang Park	Forest park; shrub & grass	1-2 layer in vertical level	0-10	East of the hill	Weak	Roads, factories and voltage sets	Solid wastes
Wanghong Dakan (WH-DK)	Roadside & waste land; shrub & grass	1-2 layer in vertical level	0	Plain	Absent	Road and buildings	Solid wastes
Yantianao	Wasted land; shrub & grass	Herbs	5-15	East of the hill	Absent	Houses and roads	-
Wuzhipa	Roadside; -	1 layer in vertical level	0	Plain	Absent	Roads and waste buildings	-
Qinghulijiao (QHLJ)	Wasted land; grass	herbs with few shrubs	0	Plain	Absent	Overpass and high voltage sets	Solid wastes
Qilin Mountain	Forest park; Shrub & grass	1-2 layer in vertical level	0	East and northeast of the hill	Absent	Roads and high voltage sets	-

In Shenzhen City, this weedy vine is distributed intensively and is familiar to all, where it is mainly distributed in 8 areas, based on our field investigation, including two forest parks (Honggang Park & Qilin Mounatin), three wastelands (Xinda, Yantianao & Qinghulijiao), wetland (Haishangtianyuan-HSTY) and two roadsides (WanghengDakan-WHDK and Wuzhipa) (Table 1). In WHDK, two sites were chosen, a grass community, and an evergreen broad forest community. In order to study the changes in the *P. scandens* community we chose 6 sampling areas, including all types. In other sampling areas, this vine only climbs the barriers, thus we only evaluated the coverage area. The sampling quadrats were investigated in each sampling area including 3 quadrats (10m×10m) in Honggang Park, 3 quadrats (10m×10m) in Qilin Mountain, 3 quadrats (10m×10m) in WHDK, 5 quadrats (10m×10m) in HSTY, 3 quadrats (1m×1m) in WHDK and 3 quadrats (1m×1m) in QHLJ. Some small quadrats of 1m×1m were also investigated in the grass layer randomly in each quadrat of 10m×10m. The same number of quadrats acted as a control near our observed community, where the distance was less than 20 meters from the investigated sampling quadrats and had a similar habitat. During the quadrats observations, the species, abundance, types of land and community, and the configuration of the community were investigated according to Wang *et al*., (1996) (Table 1).

All the work was carried out between 2009 and 2011. The mean value of the species and abundance and independent samples t-test was performed using an SPSS 11.5 software package (SPSS Inc, USA), the level of significance was 0.05.

Results

P. scandens was previously distributed sporadically in most of the ecosystems in Shenzhen City, China, but it is densely distributed in 8 areas now, including the forest ecosystem, the wetland ecosystem, the garden, the roadside and wasteland (Fig. 3), where the ecosystems were disturbed and quite vulnerable. In these areas, this species spread intensively (Fig. 4), with a coverage area of 5930m^2, 2500m^2, 250m^2, 4000m^2, 300m^2, 160m^2, 120m^2 and 74753m^2 in Haishangtianyuan, Xinda, Honggang Park, WH-DK, Yantianao, Wuzhipa, Qinghulijiao and Qilin Mountain, respectively (Table 2). The current coverage area is about 24-5000 times that of the past coverage area. According to the concept of pattern (Wu, 2007), the distribution pattern of *P. scandens* has changed from sporadic to dense in these areas.

In the observed areas, this weedy vine climbs and covers more than 29 plant families, 39 genera and 45 species (Table 3), and the coverage area is at a serious level, according to Yu *et al.* (2009).

Results from pointing research showed that the length of this vine shifted from 0.5m to 3m, with a mean growing length of 2.82m/a; the coverage area of each individual shifted from 0.2 to 4m^2 with a mean coverage area of 1.64 m^2/a. The average growth rate was 1.3cm/d, and the maximum growth rate was 1.9cm/d, nearly half the growth rate of *Mikania micrantha,* which is a typical exotic invasive species (Wang *et al.*, 2004), meaning that this weedy vine has the potential to overspread.

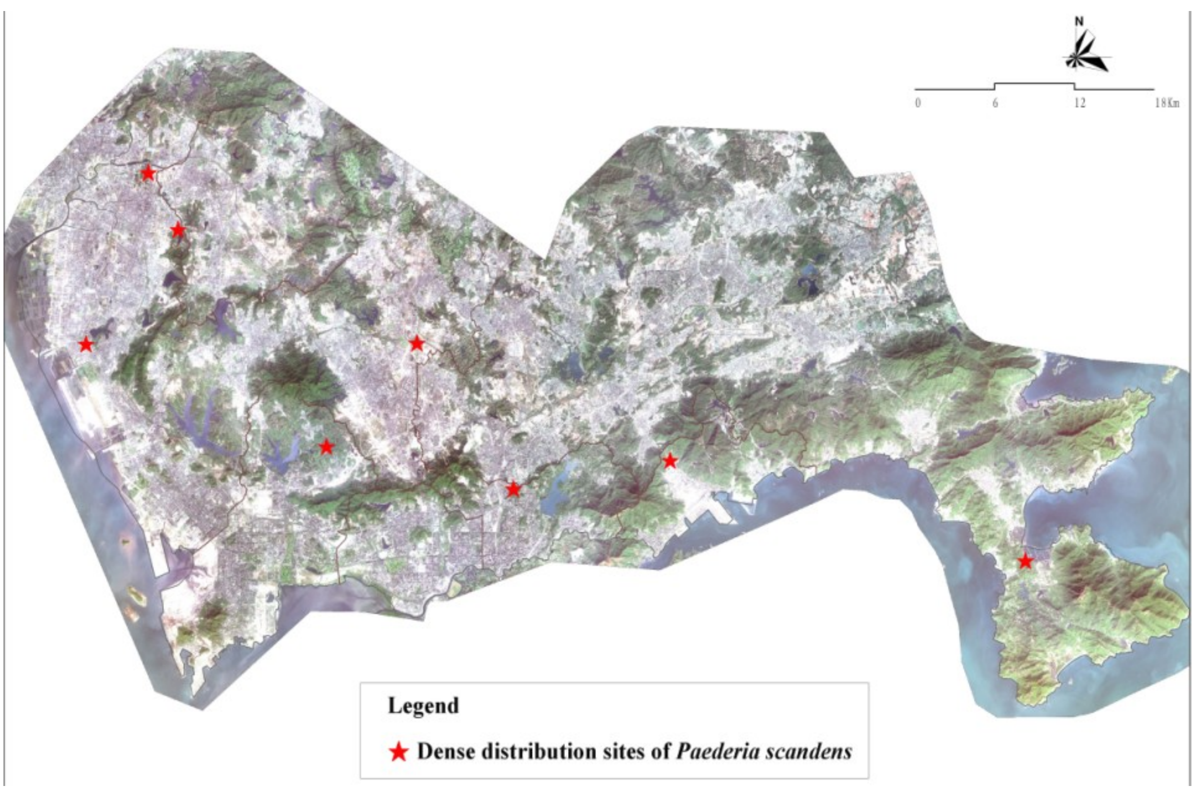

Fig. 3. Dense distribution area of *P. scandens* in Shenzhen, China.

Fig. 4. The covering area of *P. scandens* in present study (a. forestry park; b. wetland; c. waste land; d. fruit garden and roadside).

Table 2. Changes of the coverage area of P. scandens.

Distribution site	**Past coverage area of *P. scandens* (m^2)**	**Recent Coverage area of *P. scandens* (m^2)**
Haishangtianyuan	12.5	5930
Xinda	7.5	2500
Honggang Park	5	250
Wangheng Dakan	25	4000
Yantianao	5	300
Wuzhipa	0	160
Qinghulijiao	5	120
Qilin Mountain	15	74753

In the *P. scandens* communities, the configuration is simple, and there is no tree or shrub, especially in the wetlands, while the control has a relatively fine configuration of trees and shrubs. According to the number of species of the *P. scandens* community, not only the tree and shrub layer but also the grass layer, the community with mass coverage of *P. scandens* had a lower value than the control (Fig. 5). In two investigated sites (Qinghulijiao and WH-DK), the number of species of the grass community was significantly higher than those of the *P. scandens* community ($p<0.05$) (Fig. 6).

As far as the abundance is concerned, the impacted community had a lower value in the tree and shrub layer while a relatively higher value was found in the control (Fig. 5), and a significant value was found between the community of *P. scandens* and the control ($p<0.05$) (Fig. 7).

Table 3. The impacted species in the *P. scandens* community.

S. No.	Name of damaged species	Associated families	Associated genus
1.	*Metasequoia glyptostroboides*	Taxodiaceae	*Metasequoia*
2.	*Casuarina equisetifolia*	Casuarinaceae	*Casuarina*
3.	*Kandelia candel*	Rhizophoraceae	*Kandelia*
4.	*Aegiceras corniculata*	Myrsinaceae	*Aegiceras*
5.	*Acrostichum aureum*	Acrostichaceae	*Acrostichum*
6.	*Litsea pungens*	Lauraceae	*Litsea*
7.	*Microcos paniculata*	Tiliaceae	*Microcos*
8.	*Ficus elastica*	Moraceae	*Ficus*
9.	*Broussonetia papyrifera*	Moraceae	*Broussonetia*
10.	*Bridelia tomentosa*	Euphorbiaceae	*Bridelia*
11.	*Acacia confusa*	Leguminosae	*Acacia*
12.	*Celtis tetrandra*	Ulmaceae	*Celtis*
13.	*Schefflera octophylla*	Araliaceae	*Schefflera*
14.	*Ficus hispida*	Moraceae	*Ficus*
15.	*Cinnamomum burmannii*	Lauraceae	*Cinnamomum*
16.	*Ilex pubescens*	Aquifoliaceae	*Ilex*
17.	*Acacia mangium*	Leguminosae	*Acacia*
18.	*Eucalyptus robusta*	Myrtaceae	*Eucalyptus*
19.	*Litchi chinensis*	Sapindaceae	*Litchi*
20.	*Dimocarpus longana*	Sapindaceae	*Dimocarpus*
21.	*Ficus simplicissima*	Moraceae	*Ficus*
22.	*Vitex negundo*	Liliaceae	*Vitex*
23.	*Sapium discolor*	Euphorbiaceae	*Sapium*
24.	*Eucalyptus citriodora*	Myrtaceae	*Eucalyptus*
25.	*Ilex asprella*	Aquifoliaceae	*Ilex*
26.	*Lantana camar*	Verbenaceae	*Lantana*
27.	*Rhus chinensis*	Anacardiaceae	*Rhus*
28.	*Urena lobata*	Malvaceae	*Urena*
29.	*Synedrella nodiflora*	Compositae	*Synedrella*
30.	*Lophatherum gracile*	Gramineae	*Lophatherum*
31.	*Eupatorium catarium*	Compositae	*Eupatorium*
32.	*Mallotus apelta*	Euphorbiaceae	*Mallotus*
33.	*Polygunum chinense*	Polygonaceae	*Polygunum*
34.	*Psychotria rubra*	Rubiaceae	*Psychotria*
35.	*Herba Bidentis*	Asteraceae	*Herba*
36.	*Miscanthus floridulus*	Poaceae	*Miscanthus*
37.	*Albizia falcataria*	Mimosaceae	*Albizia*
38.	*Aporusa dioica*	Euphorbiaceae	*Aporusa*
39.	*Trema tomentosa*	Ulmaceae	*Trema*
40.	*Clerodendrum fortunatum*	Verbenaceae	*Clerodendrum*
41.	*Schima superba*	Theaceae	*Schima*
42.	*Mangifera indica*	Anacardiaceae	*Mangifera*
43.	*Sonneratia apetala*	Sonneratiaceae	*Sonneratia*
44.	*Sonneratiacaseolaris*	Sonneratiaceae	*Sonneratia*
45.	*Bruguiera gymnoihiza*	Rhizophoraceae	*Bruguiera*

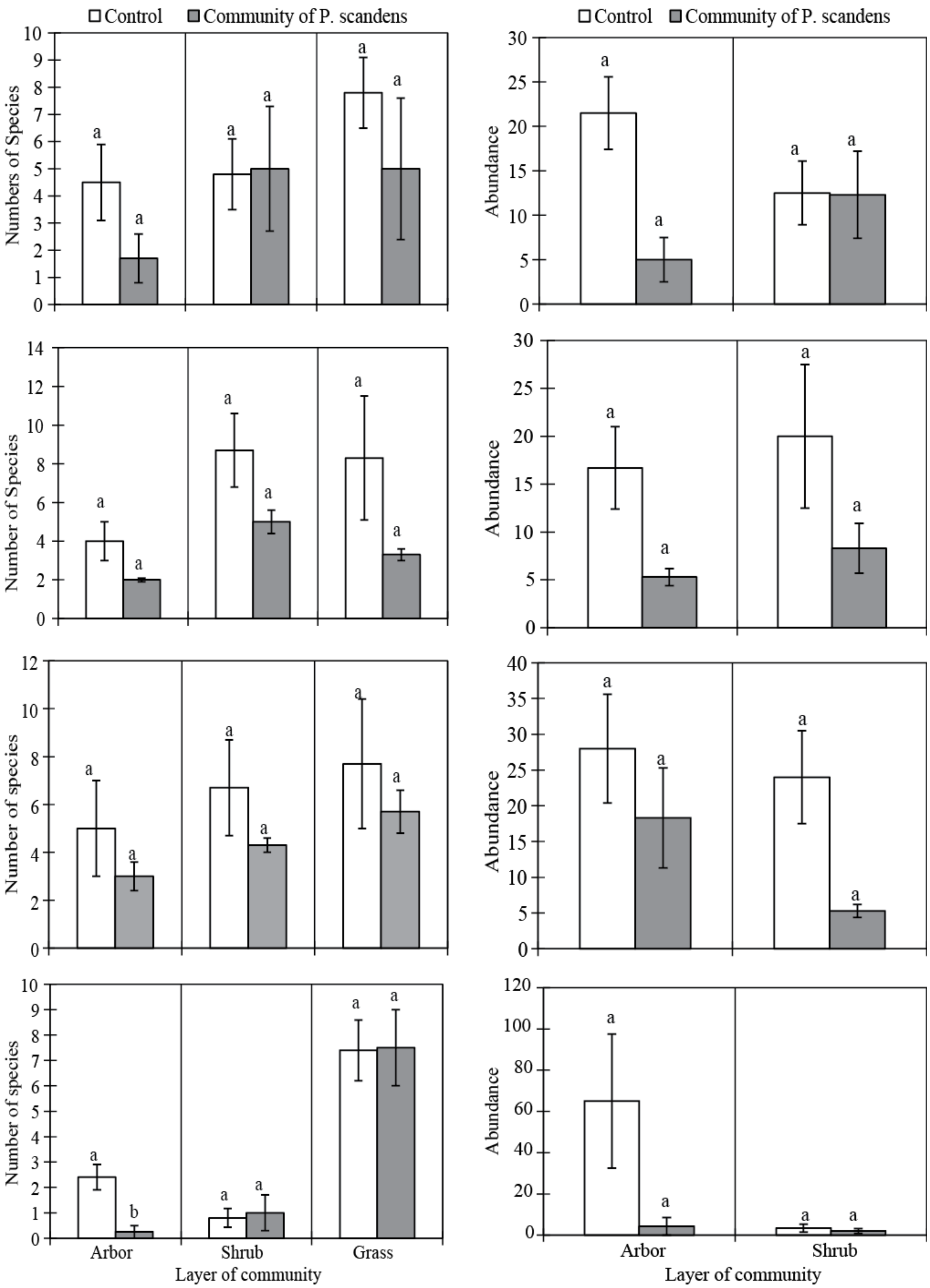

Fig. 5. Diversity of the *P. scandens* community (S: investigated sites; S1: Qilin Mountain; S2: Honggang park; S3: Wangheng-Dakan; S4: Haishangtianyuan. Similar letters indicate non-significant differences while different letters indicated significant differences between landscapes. Bars represent one standard error).

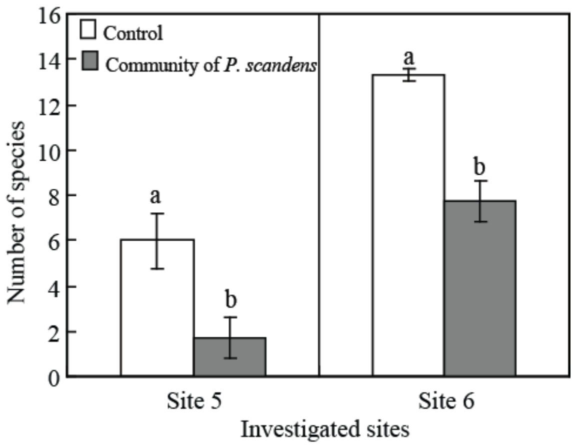

Fig. 6. The number of species of the grass community and the *P. scandens* community (Site 5: Qinghulijiao; Site 6: Wangheng Dakan; Similar letters indicate non-significant differences while different letters indicated significant differences between landscapes. Bars represent one standard error. Bars represent one standard error).

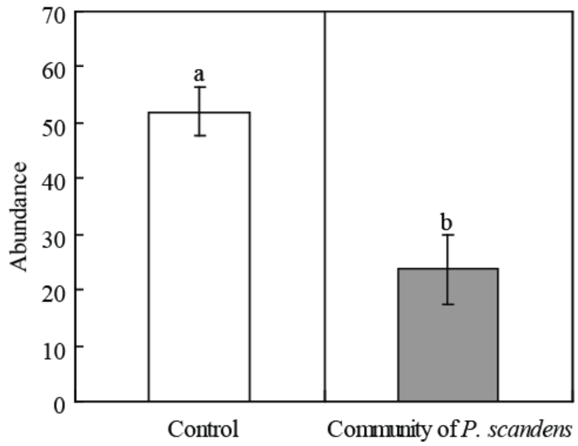

Fig. 7. Comparison of the abundance (arbor + shrub) between the community of *P. scandens* and the control in the site of WanghengDakan (Similar letters indicate non-significant differences while different letters indicated significant differences between landscapes. Bars represent one standard error).

Discussions

Based on the historical records, *P. scandens* was previously distributed sporadically in Shenzhen (Anon., 1977; Kang *et al.*, 2005; Shu & Jia, 2006; Liao *et al.*, 2007), however, it has recently appeared in mass in vulnerable areas with a simple community configuration, a low and dense canopy, little space from human beings, weak or absent management and many buildings and other structures (Table 1), meaning that the distribution pattern of this species has changed (Wu, 2007) and there has been a big influence of urbanization on this vine.

Similar cases were found in Baiyunshan Forest Park of Guangzhou City China and Xiqiaoshan Forest Park of Foshan City, China (Peng *et al.*, 2009; Yu *et al.*, 2009). In these two parks, this vine was previously only recorded sporadically (Peng & Fang, 1996; Liu, 2002), but nowadays the coverage area has been increased by 500 m^2 and 15000m^2, respectively. Based on our observation, the intensive growth of this weedy vine was also found in Qingxi town, Dongguan City, China, another city to the east of the Pearl River, where this vine grows in the wasteland and the coverage area is about 100m^2 for a single community.

This vine not only spreads intensively in parks but it also spreads quickly in a broad range of ecosystems. We could not present all the coverage data of this vine in southern China because we did not investigate all the cities, but it is possible that this weedy vine has spread in some cities of this region based on the present investigation, the big disturbance from rapid urbanization, and the same climate belt.

This vine is a familiar species in East and South-East Asia (Anon., 1977), meaning that the tropical and sub-tropical climatic condition is suited for its growth. The survival habitat of this vine will increase with the extending of the tropical region toward the two poles (Seidel *et al.*, 2007) in the coming years, thus the distribution pattern may continue to change with the changing of the climate belt. Actually, some new distribution records have been found in the north of China (Wang *et al.*, 2001; Feng *et al.*, 2002; Liu, 2002), and Pemberton & Pratt (2002) also adjusted the distribution limit based on their new investigations. Therefore, this weedy vine will not only change the coverage area in the community but also the distribution limit will increase in the future.

Though the speed of growth of this weedy vine is not as fast as that of invasive species such as *M. micrantha* and *Ipomoea cairica,* its growth rate is fast compared to that of common vines (Wang *et al.*, 2004). It was interesting to find that the construction cost of the native non-overspreading of *P. scandens* was higher than that of the native overspreading one (Song *et al.*, 2007; Shen *et al.*, 2011), meaning that the overspreading *P. scandens* would gain benefit under the changing environment and had more power to elongate its stem through regulating the construction cost itself and causing the overspreading. As the growth speed and the construction cost are two important elements in growth potential (Nagel & Griffin, 2001; Song & Peng, 2009), it could be considered that this weedy vine has the potential to overspread, to some extent.

There are 2 aspects to the impact of urbanization on ecosystems: First, the disturbance is increased with the increase in construction, and, second, the stability is decreased. According to the disturbance hypothesis, which is one of the most important theories for the overspreading of the vine, disturbance provides opportunities and useful resources for species and increases the community's invisibility (Hobbs & Huenneke, 1992; Saether *et al.*, 2000; Granados & Körner, 2002; Wang, 2002; Saeed *et al.,* 2011; Wu *et al.,* 2012). High disturbance increases the overspreading potential and creates an empty niche (Sher & Hyatt, 1999). Williamson & Fitter (1996) considered that a weedy vine could change into an overspreading or invasive vine if the related environment has changed. In the present measured sites, the community configuration was quite simple, most of the plants were destroyed, with few trees and much wasteland left by the urban construction, and thus the ecosystem was insecure. The disturbed ecosystem provides many empty niches, along with resources such as light, and opportunities for *P. scandens* to grow fast.

An ecosystem has resistance and resilience that can maintain the stability of the configuration, while the stability changes with the changing environment (Grimm & Wissel, 1997; Qureshi *et al.,* 2011). Thirty years has passed since the revolution and opening-up in Shenzhen, the urbanization rate reached 100% in 2004, with big disturbance occurring in the environment, which would result in a decrease or collapse of the eco-stability. The overspreading area of *P. scandens* was found in the unstable area (Table 1). According to the diversity resistance hypothesis (Kennedy *et al.*, 2002; Akmal *et al.,* 2011) and the theory of diversity and stability, the community with a simple configuration is quite unstable and would be easy to invade (Fig.5) thus it was considered that the decreasing eco-stability and non-balance condition of the ecosystem promoted the growth of this vine and allowed it to overspread easily, and consequently led to the changes in this vine.

The changes in the habitat and the configuration of the *P. scandens* community resulted in the overspreading of this vine, and the increase in the *P. scandens* resulted in the decline of the community's diversity. With the overspreading of *P. scandens*, the biodiversity changed and revealed a decrease trend compared to the common community, especially the grass community (Fig. 6), which was consistent with the influence of exotic invasive species on the native diversity (Langeland & Burks, 1998). Because *P. scandens* has invasive characteristics similar to those of exotic invasive species including dense canopies, overlapping leaves, strong climbing ability, rapid elongation (Fig. 4), lower construction costs, higher resource capture ability and utilization efficiency (Sheer & Hyatt, 1999; Leishman *et al.*, 2010; Shen *et al.*, 2011), this native overspreading species probably restrained the growth of other native plants and led to a decreasing biodiversity in the measured community. Under the condition of the large coverage rate of *P. scandens*, other native plants could not get enough resources to photosynthesize, resulting in the weak growth or death of understory species. The seeds buried in the soil layer could not germinate due to the lack of enough light and causing a loss of seedlings.

In the past few decades, there has been much concern about urban construction and economic development in Shenzhen, while ecosystem management has been weak or absent. Although some effort was made to manage the urban ecosystem, it has been quite deficient and mainly limited to urban forests or municipal parks. Except for these areas, management has been weak or absent (Table 1) and the effect was not as expected. Because of the broad life range of this vine (Pemberton & Pratt, 2002), it can easily adapt to a changing environment. The malfeasance of human beings fostered the overspreading of this weedy species, to some extent, and the neglect of ecosystem management has had a positive impact on the growth of *P. scandens.*

P. scandens has had a big impact on the ecosystem, and this impact will continue if nothing is done about it. Field observations suggest that this vine is mainly diffused in vulnerable ecosystems which have been disturbed by urbanization, thus ecosystem management needs to be strengthened and even to develop some eco-friendly weed management system (Hashim *et al*., 2013), not only that of municipal parks, but also other key ecosystems. Both of the native distributional countries and the introducing countries should strengthen the management of it. Based on the field investigation and some previous researches (Norton, 2009; Zan & Li, 2010), the overspreading of it could be controlled if the ecological restoration and ecological regulation were attached to importance, and ecological engineering was implemented in the destroyed areas. In Shenzhen City, the "Basic Ecological Control Line" is facing much disturbance from rapid urbanization, in order to enhance the protection, this weedy vine must be controlled and the destroyed ecosystem should be restored.

Conclusions

P. scandens was distributed sporadically in the native distribution area based on the records, but its distribution pattern has changed from sporadic to dense in the highly disturbed areas now.

This weedy vine had the potential to overspread in highly disturbed areas, and the community with simple configuration offered more opportunities for *P. scandens* to overspread.

Integrating the present investigations and studies, we conclude that the overspreading of *P. scandens* in highly urbanized areas is not just an occasional case.

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