



Case Study of Baiyun and Caohai Lakes Implies How to Implement Wetland Restoration/Creation

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Abstract

This work discusses how to implement wetland restoration/creation from the viewpoint that wetland aquatic plants are divided into four life forms: emergent, submergent, floating and floating leaf plants. Caohai Lake and Baiyun Lake were selected to discuss the difference of the species richness changes during the creation/restoration process. Baiyun Lake and eight surrounding wetlands have been selected to discuss how the species richness, the dispersal and the colonization potential among four plant life forms affect the species richness changes and community restoration in the target wetland. The community composition changes in the introduced single dominant submergent and emergent plant community in Baiyun Lake have also been tracked to discuss how invasive plants' dispersal affects wetland restoration/creation. The result indicated that in the process of creation/restoration of Caohai Lake and Baiyun Lake, the emergent plants have been increasing, while the submergent, the floating and the floating leaf plants began to increase and then maintained a dynamic balance. The similarity of plant community composition between the target wetland Baiyun Lake and the surrounding wetlands increased gradually, which was mainly affected by distance and river-lake connectivity. In the natural wetlands, the most common plants are emergent plants, which account for approximately 80 percent of wetland plants; this implies a greater abundance of germplasm resources, dispersal and colonization potential of emergent plants than the other three plant life forms. In Baiyun Lake, invasive plants mainly affect the introduced emergent plants community. The study confirms that before implementing wetland restoration/creation, pre-restoration surveys are required to the target wetland and its surrounding wetland. The study also finds that in Guangdong province,

China, the restoration of wetland vegetation should give more priority to the submergent plants. Generally emergent plants community's invasive preventing and submergent plants germplasm resources introducing will be the focus of the human intervention in wetland restoration/creation.

Subject Areas

Biodiversity, Ecology, Environmental Sciences, Environmental Sciences, Plant Science

Keywords

Wetland Restoration, Community Composition, Emergent Plants, Submergent Plants, Dispersal and Colonization Potential

1. Introduction

There are usually two approaches to the creation/restoration of a wetland ecosystem. One is “self-design”; the other, more commonly used approach is “biological engineering” [1] [2]. Self-design’s emphasis is on the concept that the wetland system itself will optimize its design by selecting for the assemblage of plants, microbes, and animals best adapted to existing conditions, but only if sufficient propagules can enter the system [3] [4]. Biological engineering involves the introduction of specific plants, whose survival becomes the measure of success for the restoration [1]. For a wetland, successful creation/restoration systems will eventually be indistinguishable whether started with self-design or biological engineering [1] [5] [6]. Self-designed systems may require more time to reach the creation/restoration destination, while biological engineering often leads to failed creation/restoration efforts or encourages practices that oppose the goal of a sustainable landscape [1] [5] [7]. From the perspective of self-designed systems, the entry of species is mainly through natural spread [1], but the introduction of aquatic plants by human can accelerate aquatic plant community succession in the initial succession stages of wetland restoration [8]. Therefore, semi self-design has been proposed and is given more attention compared to biological engineering processes [9]. To achieve semi self-design, it needs the wetland itself to play the role of autonomic regulator, meanwhile the human interference promotes the restoration of wetland vegetation. The question remains: what work should be given to nature and which jobs need human involvement?

Considering that self-design and biological engineering are both based on the entry of species [1], understanding the dispersal and colonization potential of aquatic plants may be helpful to wetland vegetation restoration [10] [11] [12]. The main factors influencing aquatic plant dispersal and colonization include the effectiveness of seed transmission, as well as the amount of seed available for transmission. Regarding methods of transmission, most aquatic species are considered zoochorous [13] [14] [15] and are mediated by birds [15] [16]; other

seed dispersal methods include hydrochory [16] [17] [18], wind [19], and anthropochory (dispersal by man), which is the most influential of all the dispersal mechanisms [18]. While asexual propagules are probably of importance to short-distance and local dispersal, sexual propagules are more likely to result in regional and long-distance dispersal [11] [20]. Although there are many strategies for transmission, spreading the germplasm resources of aquatic plants may be the bottleneck for the natural restoration of wetland habitats [21], as effective dispersal rates may be much lower than generally accepted values for aquatic species [20]. This means that the propagule numbers and species abundance, which can be seen as the dispersal potential for aquatic plants in the surrounding wetland, will affect the target wetland's restoration/creation.

As species are continually enter into and begin to colonize a landscape, species richness usually initially increases [22], as in the Napahai wetland, where the vegetation in the lakeside zone increased from 14 species to 26 species after 8 years of restoration [23]. The species' continual introduction by natural methods gives self-designed wetland systems significant opportunity to adjustment themselves [24]. As result, the structural characteristics of the vegetation of the created/restored wetland will become similar to those in a natural wetland after only a few years [25]. These results indicate that the recovery of wetland vegetation is a gradual process of species increasing. But for the process, few study give attention to the species richness change of different kinds of life forms aquatic plants.

Wetland aquatic plants are divided into 4 kinds of life forms according to the position of the roots relative to the soil and the position of the leaves relative to the water surface: emergent plants, part stems and leaves pierces the water surface with root attached to the substrate; submergent plants, completely grow under water with root attached to the substrate; floating plants, stream and leaves that float on the water surface without root attached to the substrates; and floating leaf plants, stream and leaves that float on the water surface with root attached to the substrates [26]. Now, few knowledge about the differences in the propagule abundance, dispersal and colonization potential of these four aquatic plant forms in a natural wetland and how do the differences affect wetland restoration/creation, also few knowledge about the species richness change of these four aquatic plant forms during wetland vegetation restoration.

We assume that there are exist the differences in the germplasm resources' abundance, as well as the dispersal and colonization potential among the four life forms plant in the nature; there are also exist the differences in the species richness increment among the four life forms plant during the wetland restoration process; these will affect the target wetland's plant community restoration and the implementation of wetland restoration/creation

Two restored/created wetlands were selected for use in discussion of the species richness changes in each plant life form during the creation/restoration process: 1) Caohai Lake in Guizhou Province, which was restored over the 35 years since 1981 via self-design; and 2) Baiyun Lake in Guangdong Province,

which was constructed over 6 years via biological engineering. Baiyun Lake and the eight different types of wetland surrounding it were selected to enable discussion of how surrounding wetlands affect the species richness changes in the target wetland and how the differences in the germplasm resources' abundance, as well as the dispersal and colonization potential among the four plant life forms in the natural setting surrounding the wetland, affect the target wetland's plant community restoration. The community composition changes in the introduced single dominant plant community in Baiyun Lake have also been tracked to discuss how natural species dispersal affects wetland restoration/creation, especially for invasive species. Lastly, implementing guidelines for wetland restoration/creation have been proposed according to the advantages and disadvantages of biological engineering and self-design.

2. Methods

2.1. Wetland Plant Community Composition Changes during Wetland Restoration/Creation

2.1.1. Study Site

The wetland plant species changes during the restoration of Baiyun Lake in Guangdong Province have been studied and have been compared with those of Guizhou Province's Caohai Lake, which has been restored by self-design over 35 years.

Figure 1 shows the geographical location and shape of Baiyun lake. It is located in the northwest of Baiyun District (N23°13', E113°12') of Guangzhou city. It belongs to a maritime subtropical monsoon climate, with an annual average rainfall of approximately 1720 mm and an annual average temperature 20°C - 22°C. Baiyun Lake is the largest artificial lake in Guangzhou, which was constructed over a period of 6 years (up to 2016), composed of an eastern side and a western side. The east lake's water area is 0.66 km², while the west lake's water area is 0.36 km², both lakes with a maximum depth of approximately 3.5 m. The lake's water is sourced from Pearl River through pumping (the inlet water is Grade V: mainly suitable for agricultural water area and general landscape waters, while the intake place is close to an efflux of Liuxi River into Pearl River) and flows first into the west lake, after purification by sedimentation and plant absorption, it moves into the east lake, receives the plant absorption again in the east lake and is introduced into the Shijin River. The lake's construction began in December 2006 and was completed in April 2010. In the beginning, only some of the emergent plants were planted in the lakeshore area, and in 2013, small patches of *Vallisneria natans* were additionally planted in the closed shallow water. In 2016, a new submergent plant community restoration project was implemented, and *Hydrilla verticillata*, *Potamogeton wrightii*, *Myriophyllum spicatum*, *Ceratophyllum demersum* and more *Vallisneria natans* were planted in the closed lakeshore area.

Figure 1 shows the geographical location and shape of Caohai lake, which located in Weining County, west of Guizhou Province (N26°47'32" - 26°52'52",

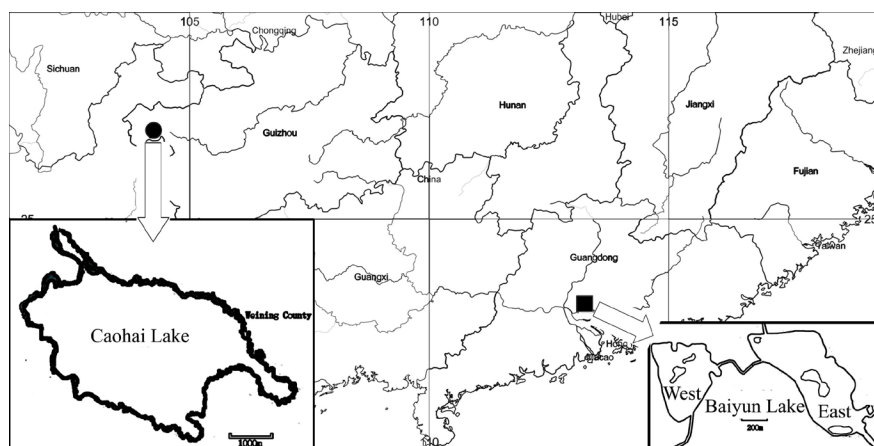


Figure 1. The location of Baiyun Lake in Guangdong Province and Caohai Lake in Guizhou Province. ■: Baiyun Lake, ●: Caohai Lake. Mapped by SimpleMappr (<http://www.simplemappr.net/>).

E104°16'10" - 104°20'40", at an altitude of 2171.7 m). Caohai Lake is a completely and typically karst plateau shallow lake and wetland. It had been drained of water in the 1970s; then, the government decided to restore it in 1981, and the water level had been recovered in 1982. Currently, the wetland's water area is approximately 19.8 km², with a maximum depth approximately 3 m; however, the average water depth less is than 1.5; the lake's water is alkaline (pH 8.0). Caohai Lake belongs to a temperate climate, with an annual average rainfall of approximately 950.9 mm and an annual average temperature 10.5°C.

2.1.2. Vegetation Data Collection

Vegetation data for Caohai Lake includes two parts, as showed in **Table S1**. One part comes from our investigation, conducted in June, July and October of 2015 and in January, April, July of 2016; the other part is historical vegetation data found in surveys from 1983 [27], 2005 [28], and 2013 [29]. In our vegetation survey, vegetation was assessed using a line-intercept method. To compare with historical data, the line-intercept corresponding to the study site in 1983 and 2005 was used. Vegetation data for Baiyun Lake come from our investigation, only east lake vegetation had been involved in this study. It was conducted in July 2013 and again in April 2014, April 2016 and July 2016 using the line-intercept technique.

In the line-intercept technique, the wetland plant species name, frequency and abundance have been recorded; species have been photographed.

2.2. The Comparison of Community Composition Structures between the Restored/Created Wetland and the Surrounding Natural Wetland

2.2.1. Study Site

To compare the plant community composition between the restored wetland and the surrounding natural wetland, vegetation surveys of Baiyun Lake and the other 8 surrounding wetlands in Guangdong Province were conducted. **Figure 2**

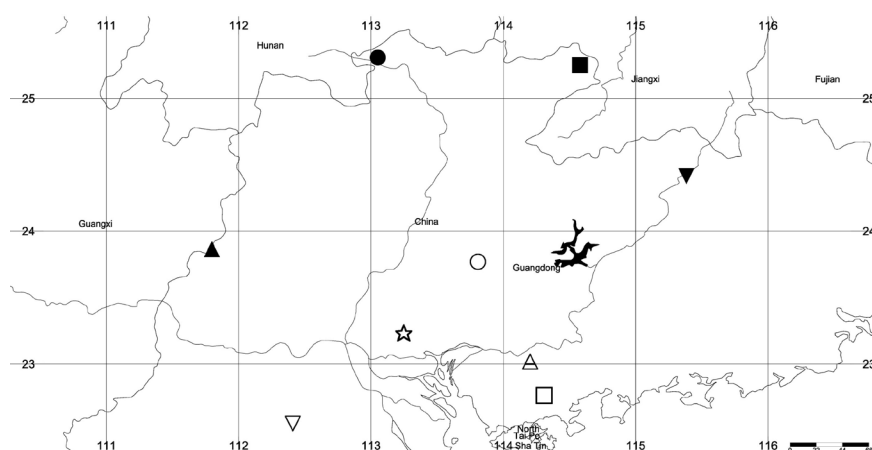


Figure 2. The location of Baiyun Lake and the other 8 surrounding wetlands in Guangdong Province. ☆: Baiyun Lake (BL), □: Longgang River (LG), Δ: Tong Lake (TL), ○: Liuxi River (LX), ▽: Dashahe Reservoir (DS), ▲: He Jiang upstream (HJ), ●: Wu Jiang upstream (WJ), ■: Zhen Jiang upstream (ZJ), ▼: Dong Jiang upstream (DJ). Mapped by SimpleMappr (<http://www.simplemappr.net/>).

shows the geographical location of this 9 wetlands. Four wetlands were close to Baiyun Lake: the Dashahe Reservoir wetland (DS, reservoir wetland, approximately 115 km from Baiyun Lake), the Liuxi River wetland (LX, riverine wetland, approximately 80 km from Baiyun Lake), the Tong Lake watershed wetland (TL, mixed pool and river wetlands, approximately 100 km from Baiyun Lake) and the Longgang River wetland (LG, riverine wetland, approximately 115 km from Baiyun Lake). The other four wetlands, farther away from Baiyun Lake, include the He Jiang upstream wetland (HJ, river and farmland mixed wetlands, approximately 210 km from Baiyun Lake), the Wu Jiang upstream wetland (WJ, river and farmland mixed wetland, approximately 250 km from Baiyun Lake), the Zhen Jiang upstream wetland (ZJ, river and farmland mixed wetland, approximately 260 km from Baiyun Lake) and the Dong Jiang upstream wetland (DJ, river and farmland mixed wetland, approximately 300 km from Baiyun Lake).

2.2.2. Vegetation Data Collection

Vegetation was assessed using a line-intercept method. Each investigation of the 8 surrounding wetlands lasted approximately two days: driving, when the road is close to the water, stopping, investigating and taking plant photos for approximately 30 minutes, line-intercept was done between 2013 and 2016, while the Liuxi River wetland had an additional vegetation survey in June 2017. The line-intercept included the wetland plant species name, abundance records, and all photos taken of the investigated species. Additionally, there are special concerns about invasive species in the wetlands.

In the Baiyun Lake wetland, only the eastern lake vegetation had been researched. This investigation had been conducted in July 2013 and April 2014, as well as April 2016 and July 2016, using the line-intercept technique.

2.3. The Community Composition Changes in the Community of Introduced Plants during Vegetation Restoration

Tracking surveys of the introduced plant community in Baiyun Lake were conducted in 2013 and 2016. In the tracking surveys, the community composition changes of the introduced single dominant plant community were recorded. The introduced single dominant plant community included *Cyperus papyrus*, *Thalia dealbata*, *Thalia geniculata*, *Vallisneria natans*, *Nelumbo nucifera*, *Nymphaea mexicana*, *Ludwigia adscendens*, *Myriophyllum aquaticum*, *Phragmites australis*, *Arundo donax*, *Pontederia cordata*, *Acorus calamus*, *Colocasia esculenta*, *Canna glauca* and *Echinodorus grisebachii* communities.

2.4. Data Analysis

The wetland plant species have been divided into 4 kinds of lifeforms: emergent plants (EP, include the plant which part stems and leaves pierces the water surface with root attached to the substrate and the plant which live beside water but the root system is low than the high water level), submergent plants (SP), floating plants (FP) and floating leaf plants (FLP), according to the position of the roots relative to the soil and the position of the leaves relative to the water surface (Sculthorpe 1967). Species abundance was recorded with a 5-level classification: Soe (Sociales, there are a lot of plant and the overground plants are closed), Cop (Copiosae, is numerous), Sp (Sparsal, is small and scattered), Sol (Solitariae, is small and sparse), Un (Unicum, individual or single), quantified as 5, 4, 3, 2 and 1 in **Table S2**, respectively according to Drude abundance; the species not seen in the survey were recorded as 0 in **Table S2**. In **Table S2**, Total Frequency (*TF*) is the sum of the frequency of the species in the 8 wetlands, while Total Abundance (*TA*) is the sum of the abundance of the species in 8 wetlands. In this study, plant species that were introduced but not found in the 8 surrounding wetlands were excluded from analysis. The data analysis and figure plot were performed using R language (Definition Version 3.3.3 for Windows). The relationship between Baiyun Lake and the 8 wetlands was evaluated via Jaccard index [30] and Clustering analysis (hclust, ward. D2).

$$\text{Jaccard index} = c / (a + b - c)$$

a: The number of species in the A communities; b: The number of species in the B communities; c: The number of species both in the A and B communities.

3. Results

3.1. The Species Richness, Frequency and Abundance of Four Plant Life Forms in Baiyun Lake and 8 Surrounding Wetlands

In the vegetation survey result, 147 species of wetland and aquatic plants were recorded, belonging to 44 families and 90 genera; 120 species of native plants accounted for approximately 40% of the records of Guangdong Province aquatic and wetland plants, while exotic plants included approximately 27 species, accounting for approximately 18.4% of the total survey of the plants. The number

of species of each wetland (except Baiyun Lake) was 44.5 ± 9.93 species, and the proportion of exotic plants in each wetland varied from 2.27% to 24.4%. Under the influence of artificial introduction, the number of species and exotic species of Baiyun Lake are higher than the natural wetland (**Table 1** and **Table S2**).

In the 147 identified species, 9 species were submergent plants, 6 species were floating leaves, 5 species were floating plants and 127 species were emergent plants. Among which, *H. verticillata*, *V. natans*, *P. wrightii*, *Potamogeton crispus* and *Chara vulgaris* were the relatively high abundance and frequency submergent plants; *Commelina communis*, *Polygonum lapathifolium*, *Leersia hexandra*, *Paspalum paspaloides*, *Colocasia esculenta*, *Alternanthera philoxeroides*, *Polygonum chinense*, *Bidens pilosa* var. *radiata* and *Arundo donax*, were the relatively high abundance and frequency emergent plants. In addition to the floating plants, *Eichhornia crassipes* and *Pistia stratiotes*, two invasive plants were relatively high in abundance and frequency, and of floating leaf plants, only *Ludwigia adscendens* were more common (**Table S2**).

3.2. The Relationship between Baiyun Lake and 8 Surrounding Wetlands in Guangdong Province

Figure 3(a) (Clustering analysis) and **Figure 3(b)** (Jaccard community similarity analysis) showed that in 2013, the wetland plant community composition of Baiyun Lake was more similar to that of the Shenzhen Longgang riverine wetland, which is near Baiyun Lake and in the early stage of wetland vegetation restoration; after three years of recovery, it was more similar to the Liuxi River, which is closest to and interconnected with Baiyun Lake. In general, the community species composition of Baiyun Lake was more similar to that of the Liuxi river, the Shenzhen Longgang riverine wetland, the Tong Lake watershed wetland and the Dashahe Reservoir wetland, the four wetlands near Baiyun Lake; it

Table 1. The summary of line-intercept survey result of Baiyun Lake and 8 surrounding wetlands. a: include 26 cultivation species, b: include 32 cultivation species.

Location	Families	Genera	Species	Exotic Plants	Exotic Plants (%)
BL13	27	40	46a	18	39.1
BL16	32	58	85b	23	26.7
LX	20	50	66	12	18.2
LG	15	27	37	7	18.9
DS	15	33	47	9	19.1
TL	16	32	41	10	24.4
ZJ	19	33	48	3	6.25
WJ	25	36	44	1	2.27
HJ	17	30	34	7	20.59
DJ	23	33	39	3	7.7
Total	44	90	147	27	18.4

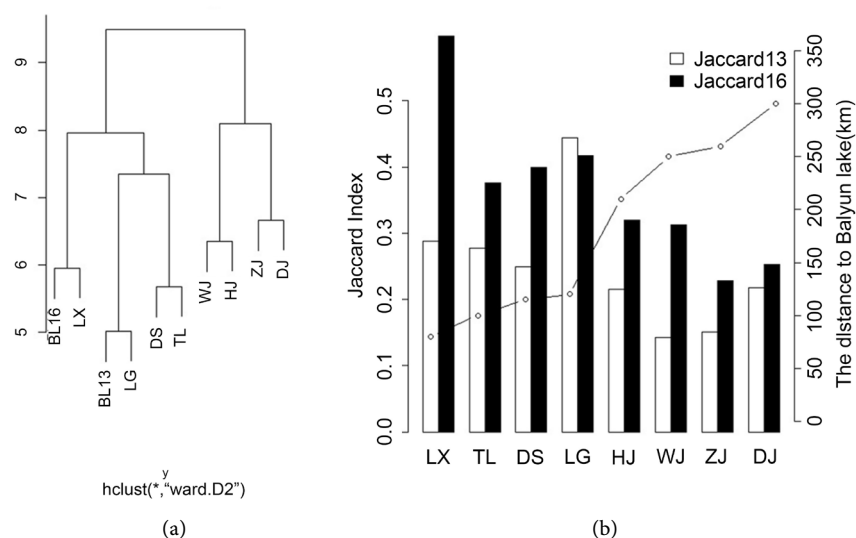


Figure 3. The species composition clustering analysis results (a) and The Jaccard Community Similarity Index analysis results (b) of Baiyun Lake and 8 surrounding wetlands in Guangdong Province. (BL13: Baiyun Lake 2013, BL16: Baiyun Lake 2016; LX: Liuxi River wetland, LG: Longgang River wetland, DS: Dashahe Reservoir wetland, TL: Tong Lake watershed wetland, ZJ: Zhenjiang River upstream wetland, WJ: Wujiang River upstream wetland, HJ: Hejiang River wetland, DJ: Dongjiang River upstream wetland; GD: all wetlands in Guangdong Province).

is less similar to He Jiang upstream, Wu Jiang upstream, Zhen Jiang upstream and Dong Jiang upstream wetlands, those four wetlands farther away from Baiyun Lake.

3.3. The Proportion of Different Life Forms of Aquatic Plants in Baiyun Lake, Its 8 Surrounding Wetlands and All Wetlands in Guangdong Province

Figure 4 showed that in the natural wetlands, the most common wetland plants are emergent plants ($82.49\% \pm 5.25\%$), followed by submergent plants ($6.6\% \pm 3.85\%$), floating plants ($6.42\% \pm 2.69\%$) and floating leaf plants ($4.48\% \pm 1.81\%$). In the process of vegetation restoration and succession of the new wetland, Baiyun Lake also maintains similar percentages for the four types of plant life form in the natural wetland.

3.4. The Four Types of Aquatic Plant and Total Aquatic Plant Richness Changes during Vegetation Restoration

Figure 5(a) showed that during 2013-2016, the total species in Baiyun Lake increased from 28 to 71, as the number of emergent plant species increased from 23 to 59, while the other three types of plant life form increased in smaller amounts. Similar to Baiyun Lake, as showed in Figure 5(b) of Caohai Lake, during 1983-2016, the total species number increased from 41 to 79, as emergent plants increased from 19 to 55. Therefore, in the process of the reconstruction and recovery of wetland plants, emergent plant numbers increased (Figure 5(a),

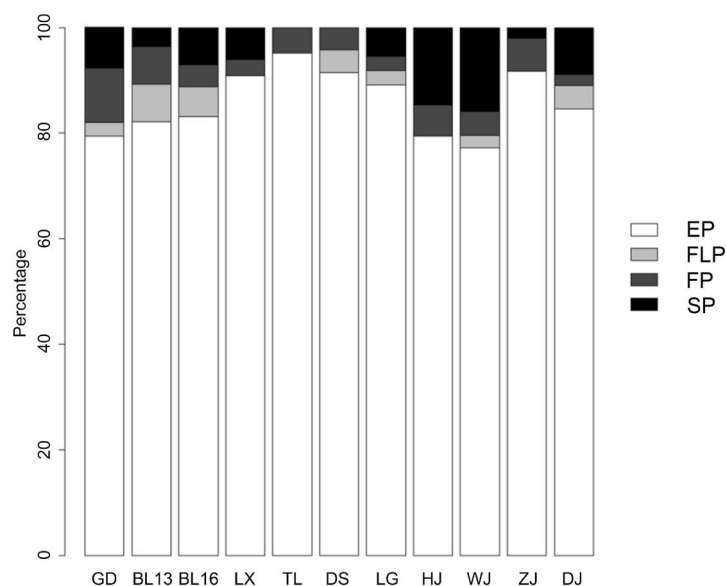


Figure 4. The proportions of different life forms of aquatic plants in Baiyun Lake, 8 surrounding wetlands and all wetlands in Guangdong Province. (BL13: Baiyun Lake 2013, BL16: Baiyun Lake 2016; LX: Liuxi River wetland, LG: Longgang River wetland, DS: Dashshahe Reservoir wetland, TL: Tong Lake watershed wetland, ZJ: Zhenjiang River upstream wetland, WJ: Wujiang River upstream wetland, HJ: Hejiang River wetland, DJ: Dongjiang River upstream wetland; GD: all wetlands in Guangdong Province).

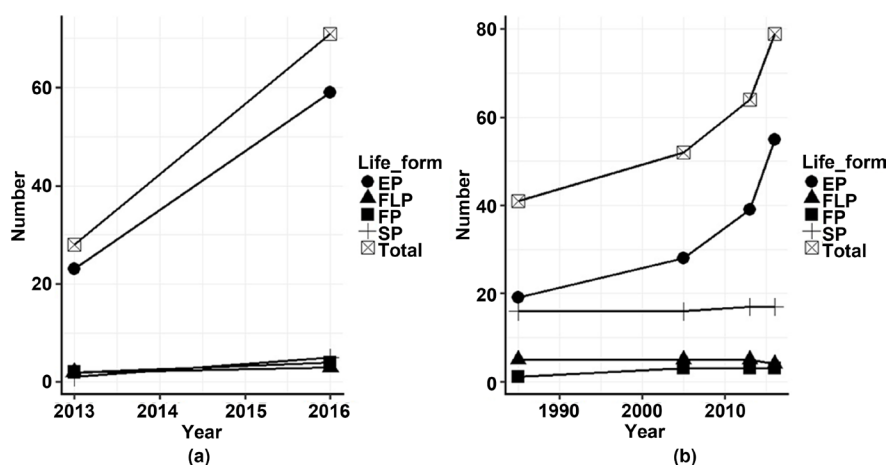


Figure 5. Richness changes of four types of aquatic plant and total aquatic plants for Baiyun Lake (a) and Caohai Lake (b) during vegetation restoration.

Figure 5(b)), while the submergent, the floating and the floating leaf plants also began to increase (**Figure 5(a)**), and in the end, they became balanced (**Figure 5(b)**).

3.5. The Community Composition Change of the Introduced Wetland Plant Community in Baiyun Lake

According to the tracking survey, as **Table 2** demonstrated that from 2013 to 2016, *C. papyrus*, *T. geniculata*, *V. natans*, *N. nucifera*, *N. mexicana*, *L. adscendens*,

Table 2. The community composition changes of the partial introduced single dominant emergent plant community in Baiyun Lake.

Dominant species		Species composition	
2013	2016	2013	2016
<i>P. cordata</i>	<i>A. philoxeroides</i>	<i>P. cordata</i>	<i>L. crustacea</i> , <i>E. prostrata</i> , <i>A. sessilis</i> , <i>A. philoxeroides</i> , <i>W. trilobata</i>
<i>P. cordata</i>	<i>P. cordata</i> , <i>H. vulgaris</i>	<i>P. cordata</i>	<i>P. cordata</i> , <i>H. vulgaris</i>
<i>C. prolifer</i>	<i>A. philoxeroides</i>	<i>C. prolifer</i>	<i>C. prolifer</i> , <i>A. philoxeroides</i> , <i>E. prostrata</i> , <i>P. distichum</i>
<i>C. esculenta</i>	<i>W. trilobata</i>	<i>C. esculenta</i>	<i>W. trilobata</i> , <i>C. esculenta</i>
<i>A. calamus</i>	<i>W. trilobata</i>	<i>A. calamus</i> , <i>W. trilobata</i>	<i>A. calamus</i> , <i>W. trilobata</i> , <i>A. philoxeroides</i>
<i>C. glauca</i>	<i>B. pilosa</i> var. <i>radiata</i>	<i>C. glauca</i>	<i>B. pilosa</i> var. <i>radiata</i> , <i>C. glauca</i>
<i>E. grisebachii</i>	<i>C. diffusa</i>	<i>E. grisebachii</i>	<i>C. diffusa</i> , <i>E. grisebachii</i> , <i>P. paspaloides</i> , <i>C. eragrostis</i> , <i>M. aquaticum</i>
<i>E. grisebachii</i>	<i>L. hexandra</i>	<i>E. grisebachii</i>	<i>L. hexandra</i> , <i>E. grisebachii</i> , <i>F. miliacea</i> , <i>E. crusgalli</i> , <i>P. repens</i>

M. aquaticum, *P. australis* and *A. donax* all continued to maintain a single dominant community. The advantages of *P. cordata*, *A. calamus*, *C. esculenta* and *C. glauca* in a partial single dominant community were replaced by the invasive species *A. philoxeroides*, *W. trilobata* and *B. pilosa* var. *radiata*. The advantages of *E. grisebachii* in a partial single dominant community were replaced by *L. hexandra* or *C. diffusa*. In addition, the community tracking survey also showed that the original single optimal *P. cordata* community and *E. grisebachii* community was also infiltrated by the exotic plants *M. aquaticum* and *H. vulgaris*.

4. Discussion

4.1. Increase in Emergent Plant Richness Contributes to Species Richness Increases during Wetland Restoration/Construction

Much research shows that the aquatic plant richness of the natural wetlands was increased, such as farmland wetlands in north-west Poland [31], Changhu Lake [32] [33], Lashi Lake [34] [35], and Napa Lake [23]; there are also reports of emergent plant coverage and wetland plant richness increases in restoration wetlands [36], while our study indicates that the major contributors to the increase in species richness during wetland restoration are emergent, particularly in those wetlands that have been restored for years. In these study wetlands, the ratio of emergent plants to total wetland plants is high, and the richness of emergent plants increases the most; the composition changes in submergent, floating and floating leaf plants in the total wetland plant figures is small, and the richness changes are also smaller.

4.2. The Species Spreading from Surrounding Wetlands Contributed to the Target Wetland Restoration and Reconstruction

The aquatic plant germplasm resources of the target wetland were mainly sourced from surrounding wetlands. In 2013, there were only 23 species of emergent plants in Baiyun Lake, and this dramatically increased to 59 species in 2016. When the wetlands had just been built, most of the emergent plants may have come from the original soil seed bank, in general, and after the environment changes and most of the original species are cleared, those plants whose seeds are pre-existing in the seed bank are rapidly recruited [37] [38]. After several years, few new species still come from the original soil seed bank because only fresh seeds can greatly increase the possibility of a species settling [39]; thus, we believe that most of the new increases in species numbers between 2013 and 2016 mainly come from the distribution of surrounding wetlands. In addition, during Baiyun Lake's wetland plant community restoration process, wetland plant community composition and structure becomes more similar to the surrounding wetlands gradually over time. The closer to the wetland, the higher similarity of species composition; in particular, the Liuxi River wetland, which has river-lake connectivity with Baiyun Lake, has the highest similarity with Baiyun Lake. The result is confirmation that the plant communities in created marshes will become similar to those in the natural marshes, taking only a few years [25]. This also indicates that newly increasing plant species in Baiyun Lake may come from surrounding wetlands. The wetlands around Baiyun Lake have many more emergent plants, aside from the other three types of aquatic plants. This leads to the richness and abundance of emergent plant germplasm that enters in Baiyun Lake, more than the other three life forms of aquatic plants.

4.3. The Restoration of Wetland Vegetation Should Give More Priority to the Submergent Plants

Rational utilization of self-design and biological engineering in wetland restoration/construction needs to differentiate between emergent plants and submergent, floating and floating leaf plants. For Caohai Lake, during the self-design of wetland vegetation, the richness of emergent plants was increasing, but the richness of submergent, floating and floating leaf plants changed less. Referring to Baiyun Lake, the low abundance of the submergent plant species and germplasm resources in the surrounding wetland limited the submergent plants' spontaneous recovery in Baiyun Lake: no submergent plants were spreaded naturally in last 6 years, these results confirmed that species dispersal determine the number of species of submergent plants in restored wetlands [40], also confirmed that the need of submergent plant germplasm's introduction during the Baiyun Lake restoration. So, the input of submergent germplasm resources was increased in April 2016, including *V. natans*, *H. verticillata*, *P. wrightii*, *M. spicatum* and *C. demersum*.

4.4. Invasive Plants Will Seriously Affect the Restoration of Aquatic-Terrestrial Ecotone and Their Control Needs Human Intervention

The restoration of wetlands requires the re-establishment of a native wetland plant community [41], where invasive species may cause unexpected changes [42] or dramatic ecological disturbances [9] because they have the ability to exclude other plant species [38]. The aquatic-terrestrial ecotone is vulnerable to invasive plants, and numerous invasive plants can harm this area. In Baiyun Lake's aquatic-terrestrial ecotone, *A. philoxeroides*, *B. pilosa* var. *radiata*, *W. trilobata* and other invasive plants spread faster and excluded other plant species, greatly influencing the regional vegetation restoration. In addition, the introduction of *M. aquaticum* and *H. vulgaris* have a potential risk of invasion [43] [44]. Therefore, implementing restoration/construction of wetland is needed to prevent invasive plant hazards to the aquatic-terrestrial ecotone.

5. Conclusion

The study confirms that before implementing wetland restoration/creation, pre-restoration surveys are required to the target wetland and its surrounding wetland. The study also finds that in Guangdong province, China, the restoration of wetland vegetation should give more priority to the submergent plants. Generally emergent plants community's invasive preventing and submergent plants germplasm resources introducing will be the focus of the human intervention in wetland restoration/creation.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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Appendix

Table S1. The vegetation data of Caohai Lake from 1985 to 2016. EP: Emergent plants, SP: Submergent plants, FP: Floating plants, FLP: Floating leaf plants. “+” marked species are record species in the surveys.

Life form	Species	Family	Genus	1985	2005	2013	2015-2016
EP	<i>Sagittaria sagittifolia</i>	Alismataceae	Sagittaria	+	+	+	+
EP	<i>Alisma plantago-aquatica</i>	Alismataceae	Alisma	+	+	+	+
EP	<i>Scirpus triqueter</i>	Cyperaceae	Scirpus	+	+	+	+
EP	<i>Scirpus tabernaemontani</i>	Cyperaceae	Scirpus	+	+	+	+
EP	<i>Juncellus serotinus</i>	Cyperaceae	Juncellus	+	+	+	+
EP	<i>Scirpus triangulates</i>	Cyperaceae	Scirpus	+	+	+	+
EP	<i>Scirpus yagara</i>	Cyperaceae	Scirpus	+	+	+	+
EP	<i>Eleocharis sp.</i>	Cyperaceae	Eleocharis	+	+	+	+
EP	<i>Zizania latifolia</i>	Gramineae	Zizania	+	+	+	+
EP	<i>Acorus calamus</i>	Araceae	Acorus	+	+	+	+
EP	<i>Leersia hexandra</i>	Gramineae	Leersia	+	+	+	+
EP	<i>Epilobium hirsutum</i>	Onagraceae	Epilobium	+	+	+	+
EP	<i>Rumex nepalensis</i>	Polygonaceae	Rumex	+	+	+	+
EP	<i>Oenanthe javanica</i>	Umbelliferae	Oenanthe	+	+	+	+
EP	<i>Commelina diffusa</i>	Equisetaceae	Equisetum	+	+	+	+
EP	<i>Echinochloa crusgalli</i>	Gramineae	Echinochloa	+	+	+	+
EP	<i>Juncus effusus</i>	Juncaceae	Juncus	+	+	+	+
EP	<i>Polygonum lapathifolium</i>	Polygonaceae	Polygonum	+	+	+	+
EP	<i>Ranunculus sceleratus</i>	Ranunculaceae	Ranunculus	+	+	+	+
FP	<i>Spirodela polyrhiza</i>	Lemnaceae	Spirodela	+	+	+	+
FLP	<i>Marsilea quadrifolia</i>	Marsileaceae	Marsilea	+	+	+	+
FLP	<i>Nymphoides peltatum</i>	Menyanthaceae	Nymphoides	+	+	+	+
FLP	<i>Potamogeton distinctus</i>	Potamogetonaceae	Potamogeton	+	+	+	+
FLP	<i>Polygonum amphibium</i>	Polygonaceae	Polygonum	+	+	+	+
SP	<i>Ceratophyllum platyacanthum</i> subsp. <i>oryztorum</i>	Ceratophyllaceae	Ceratophyllum	+	+	+	+
SP	<i>Potamogeton lucens</i>	Potamogetonaceae	Potamogeton	+	+	+	+
SP	<i>Potamogeton maackianus</i>	Potamogetonaceae	Potamogeton	+	+	+	+
SP	<i>Potamogeton pectinatus</i>	Potamogetonaceae	Potamogeton	+	+	+	+
SP	<i>Potamogeton perfoliatus</i>	Potamogetonaceae	Potamogeton	+	+	+	+
SP	<i>Potamogeton malaianus</i>	Potamogetonaceae	Potamogeton	+	+	+	+
SP	<i>Potamogeton crispus</i>	Potamogetonaceae	Potamogeton	+	+	+	+
SP	<i>Nitella mucosa</i>	Characeae	Nitella	+	+	+	+
SP	<i>Nitellopsis obtusa</i>	Characeae	Nitellopsis	+	+	+	+
SP	<i>Chara vulgaris</i>	Characeae	Chara	+	+	+	+
SP	<i>Myriophyllum spicatum</i>	Haloragidaceae	Myriophyllum	+	+	+	+

Continued

SP	<i>Hydrilla verticillata</i>	Hydrocharitaceae	Hydrilla	+	+	+	+
SP	<i>Ottelia acuminata</i>	Hydrocharitaceae	Ottelia	+	+	+	+
SP	<i>Utricularia aurea</i>	Lentibulariaceae	Utricularia	+	+	+	+
SP	<i>Najas marina</i>	Najadaceae	Najas	+	+	+	+
SP	<i>Najas minor</i>	Najadaceae	Najas	+	+	+	+
FLP	<i>Trapa natans</i>	Trapaceae	Trapa	+	+	+	
EP	<i>Alternanthera sessilis</i>	Amaranthaceae	Alternanthera		+	+	+
EP	<i>Kalimeris indica</i>	Compositae	Kalimeris		+	+	+
EP	<i>Taraxacum mongolicum</i>	Compositae	Taraxacum		+	+	+
EP	<i>Trifolium repens</i>	Leguminosae	Trifolium		+	+	+
EP	<i>Verbena officinalis</i>	Verbenaceae	Verbena		+	+	+
EP	<i>Conyza canadensis</i>	Compositae	Conyza		+	+	+
EP	<i>Polygonum hydropiper</i>	Polygonaceae	Polygonum		+	+	+
FP	<i>Lemna minor</i>	Lemnaceae	Lemna		+	+	+
FP	<i>Azolla imbricata</i>	Azollaceae	Azolla		+	+	
EP	<i>Dichrocephala benthamii</i>	Compositae	Dichrocephala		+		
EP	<i>Xanthium sibiricum</i>	Compositae	Xanthium		+		
EP	<i>Equisetum ramosissimum</i>	Equisetaceae	Equisetum			+	+
EP	<i>Phragmites australis</i>	Gramineae	Phragmites			+	+
EP	<i>Typha angustifolia</i>	Typhaceae	Typha			+	+
EP	<i>Iris tectorum</i>	Iridaceae	Iris			+	+
EP	<i>Rumex japonicus</i>	Polygonaceae	Rumex			+	+
EP	<i>Sparganium stoloniferum</i>	Sparganiaceae	Sparganium			+	+
EP	<i>Rumex dentatus</i>	Polygonaceae	Rumex			+	+
EP	<i>Polygonum lapathifolium</i> var. <i>salicifolium</i>	Polygonaceae	Polygonum			+	+
SP	<i>Potamogeton pusillus</i>	Potamogetonaceae	Potamogeton			+	+
EP	<i>Carex cruciata</i>	Cyperaceae	Carex			+	
EP	<i>Lythrum salicaria</i>	Lythraceae	Lythrum			+	
EP	<i>Houttuynia cordata</i>	Saururaceae	Houttuynia			+	
EP	<i>Hydrocotyle sibthorpioides</i>	Umbelliferae	Hydrocotyle			+	
EP	<i>Mariscus umbellatus</i>	Cyperaceae	Mariscus			+	
EP	<i>Carex heterolepis</i>	Cyperaceae	Carex				+
EP	<i>Artemisia selengensis</i>	Compositae	Artemisia				+
EP	<i>Paspalum paspaloides</i>	Gramineae	Paspalum				+
EP	<i>Catabrosa aquatica</i>	Gramineae	Catabrosa				+
EP	<i>Cynodon dactylon</i>	Gramineae	Cynodon				+
EP	<i>Rumex crispus</i>	Polygonaceae	Rumex				+

Continued

EP	<i>Ranunculus japonicus</i>	Ranunculaceae	Ranunculus	+
EP	<i>Oenanthe linearis subsp. Rivularis</i>	Umbelliferae	Oenanthe	+
EP	<i>Galinsoga parviflora</i>	Compositae	Galinsoga	+
EP	<i>Rorippa islandica</i>	Cruciferae	Rorippa	+
EP	<i>Rorippa indica</i>	Cruciferae	Rorippa	+
EP	<i>Beckmannia syzigachne</i>	Gramineae	Beckmannia	+
EP	<i>Polypogon fugax</i>	Gramineae	Polypogon	+
EP	<i>Juncus prismatocarpus</i>	Juncaceae	Juncus	+
EP	<i>Plantago asiatica</i>	Plantaginaceae	Plantago	+
EP	<i>Polygonum nepalense</i>	Polygonaceae	Polygonum	+
EP	<i>Polygonum longisetum var. rotundatum</i>	Polygonaceae	Polygonum	+
EP	<i>Polygonum viscosum</i>	Polygonaceae	Polygonum	+
EP	<i>Ranunculus chinensis Bunge</i>	Ranunculaceae	Ranunculus	+
EP	<i>Ranunculus cantoniensis</i>	Ranunculaceae	Ranunculus	+
EP	<i>Mazus japonicus</i>	Scrophulariaceae	Mazus	+
FP	<i>Ricciocarpus natans</i>	Ricciaceae	Ricciocarpus	+

Table S2. The line-intercept survey result of Baiyun Lake and 8 surrounding wetlands. EP: Emergent plants, SP: Submergent plants, FP: Floating plants, FLP: Floating leaf plants. TF: Total Frequency, the sum of the frequency of the species in the 8 wetlands, TA: Total abundance, the sum of the abundance of the species in the 8 wetlands. *marked species are introduced before 2013, #marked species are introduced in 2016. Species abundance classification quantification as 5, 4, 3, 2, 1, and 0; for species cultivated in Baiyun Lake but not seen in the surrounding wetland, their abundance is recorded as “/”.

Origin	Life form	Family	Genus	Spices	B13	B16	LX	LG	DS	TL	ZJ	WJ	HJ	DJ	TF	TA
Native	SP	Hydrocharitaceae	Vallisneria	** <i>Vallisneria natans</i>	4	5	4	3	0	0	0	3	5	0	4	15
Native	SP	Hydrocharitaceae	Hydrilla	# <i>Hydrilla verticillata</i>	0	5	4	0	0	0	0	4	3	4	4	15
Native	SP	Potamogetonaceae	Potamogeton	* <i>Potamogeton wrightii</i>	0	3	4	0	0	0	0	5	1	0	3	10
Native	SP	Potamogetonaceae	Potamogeton	<i>Potamogeton crispus</i>	0	0	3	3	0	0	0	2	0	1	4	9
Native	SP	Characeae	Chara	<i>Chara vulgaris</i>	0	0	0	0	0	0	0	3	0	2	2	5
Native	SP	Haloragaceae	Myriophyllum	# <i>Myriophyllum spicatum</i>	0	2	0	0	0	0	0	2	1	0	2	3
Native	SP	Ceratophyllaceae	Ceratophyllum	* <i>Ceratophyllum demersum</i>	0	2	0	0	0	0	0	1	1	0	2	2
Native	SP	Najadaceae	Najas	<i>Najas graminea</i>	0	0	0	0	0	0	1	0	0	0	1	1
Native	FP	Lemnaceae	Lemna	<i>Lemna minor</i>	0	2	0	0	0	0	3	3	0	2	3	8
Native	FP	Lemnaceae	Spirodela	<i>Spirodela polyrhiza</i>	0	0	0	0	0	0	0	3	0	2	2	5
Native	FP	Azollaceae	Azolla	<i>Azolla imbricata</i>	0	0	0	0	0	0	0	0	0	5	1	5
Native	FLP	Trapaceae	Trapa	* <i>Trapa incisa</i>	0	1	/	/	/	/	/	/	/	/	/	/
Native	FLP	Hydrocharitaceae	Hydrocharis	* <i>Hydrocharis dubia</i>	0	1	/	/	/	/	/	/	/	/	/	/
Native	FLP	Onagraceae	Ludwigia	* <i>Ludwigia adscendens</i>	5	5	0	3	1	0	0	0	0	2	3	6
Native	FLP	Nelumbonaceae	Nelumbo	* <i>Nelumbo nucifera</i>	5	5	0	0	1	0	0	0	0	0	1	4
Native	FLP	Marsileaceae	Marsilea	<i>Marsilea minuta</i>	0	0	0	0	0	0	0	3	0	0	1	3

Continued

Native	EP	Typhaceae	Typha	* <i>Typha angustifolia</i>	3	3	/	/	/	/	/	/	/	/	/
Native	EP	Cyperaceae	Schoenoplectus	* <i>Schoenoplectus tabernaemontani</i>	4	3	/	/	/	/	/	/	/	/	/
Native	EP	Juncaceae	Juncus	* <i>Juncus effusus</i>	3	2	/	/	/	/	/	/	/	/	/
Native	EP	Iridaceae	Iris	* <i>Iris ensata var. hortensis</i>	4	4	/	/	/	/	/	/	/	/	/
Native	EP	Poaceae	Arundo	* <i>Arundo donax</i> "Versicolor"	4	4	/	/	/	/	/	/	/	/	/
Native	EP	Alismataceae	Alisma	* <i>Alisma canaliculatum</i>	4	4	/	/	/	/	/	/	/	/	/
Native	EP	Commelinaceae	Commelina	<i>Commelina communis</i>	4	5	5	5	5	5	4	4	4	5	8 37
Native	EP	Polygonaceae	Polygonum	<i>Polygonum lapathifolium</i>	0	2	5	4	3	3	3	3	4	4	8 29
Native	EP	Poaceae	Paspalum	<i>Paspalum paspaloides</i>	3	4	5	3	0	0	4	5	5	5	6 27
Native	EP	Poaceae	Leersia	<i>Leersia hexandra</i>	4	5	5	3	5	4	5	0	0	5	6 27
Native	EP	Araceae	Colocasia	* <i>Colocasia esculenta</i>	4	4	4	4	3	3	3	3	2	3	8 25
Native	EP	Polygonaceae	Polygonum	<i>Polygonum chinense</i>	0	0	5	0	5	0	4	0	2	4	5 20
Native	EP	Poaceae	Arundo	* <i>Arundo donax</i>	3	3	4	4	3	1	0	2	4	0	6 18
Native	EP	Poaceae	Panicum	<i>Panicum repens</i>	4	4	4	0	4	4	0	2	0	0	4 14
Native	EP	Asteraceae	Eclipta	<i>Eclipta prostrata</i>	2	3	2	2	2	1	2	2	2	0	7 13
Native	EP	Poaceae	Echinochloa	<i>Echinochloa crusgalli</i>	0	2	3	2	2	2	0	2	2	0	6 13
Native	EP	Amaranthaceae	Alternanthera	<i>Alternanthera sessilis</i>	0	3	2	2	2	3	0	3	1	0	6 13
Native	EP	Poaceae	Neyraudia	<i>Neyraudia reynaudiana</i>	0	0	4	0	0	3	3	0	0	3	4 13
Native	EP	Poaceae	Phragmites	* <i>Phragmites australis</i>	3	3	5	4	0	0	0	0	4	0	3 13
Native	EP	Onagraceae	Ludwigia	<i>Ludwigia hyssopifolia</i>	0	2	2	2	2	0	4	2	0	0	5 12
Native	EP	Polygonaceae	Rumex	<i>Rumex trisetifer</i>	3	3	2	2	2	3	0	0	0	1	5 10
Native	EP	Cyperaceae	Cyperus	<i>Cyperus iria</i>	0	2	2	1	1	1	1	2	1	0	7 9
Native	EP	Scrophulariaceae	Lindernia	<i>Lindernia procumbens</i>	0	3	2	0	2	0	0	3	2	0	4 9
Native	EP	Cyperaceae	Kyllinga	<i>Kyllinga polyphylla</i>	0	3	2	2	2	0	0	0	0	2	4 8
Native	EP	Cyperaceae	Fimbristylis	<i>Fimbristylis littoralis</i>	0	1	1	0	1	0	3	3	0	0	4 8
Native	EP	Polygonaceae	Polygonum	<i>Polygonum japonicum</i>	0	0	2	0	2	0	2	0	0	1	4 7
Native	EP	Pontederiaceae	Monochoria	<i>Monochoria vaginalis</i>	0	1	1	0	0	0	3	3	0	0	3 7
Native	EP	Juglandaceae	Pterocarya	* <i>Pterocarya stenoptera</i>	1	1	0	0	0	0	0	3	4	0	2 7
Native	EP	Scrophulariaceae	Lindernia	<i>Lindernia crustacea</i>	0	3	1	0	2	1	1	0	0	1	5 6
Native	EP	Cyperaceae	Eleocharis	<i>Eleocharis sp.</i>	0	0	0	0	3	0	1	0	1	1	4 6
Native	EP	Cruciferae	Cardamine	<i>Cardamine hirsuta</i>	2	3	2	2	0	1	1	0	0	0	4 6
Native	EP	Myrtaceae	Syzygium	<i>Syzygium nervosum</i>	0	0	5	0	0	1	0	0	0	0	2 6
Native	EP	Commelinaceae	Floscopa	<i>Floscopa scandens</i>	0	0	3	0	0	0	3	0	0	0	2 6
Native	EP	Araceae	Acorus	<i>Acorus tatarinowii</i>	0	0	1	0	0	0	1	1	1	1	5 5
Native	EP	Polygonaceae	Polygonum	<i>Polygonum hydropiper</i>	0	0	1	0	1	1	0	0	2	0	4 5
Native	EP	Equisetaceae	Equisetum	<i>Equisetum ramosissimum</i>	0	0	2	0	0	0	1	1	1	0	4 5

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Native	EP	Ranunculaceae	Ranunculus	<i>Ranunculus sceleratus</i>	2	2	0	2	0	2	0	0	0	1	3	5
Native	EP	Onagraceae	Ludwigia	<i>Ludwigia octovalvis</i>	0	1	1	0	2	2	0	0	0	0	3	5
Native	EP	Cyperaceae	Cyperus	<i>Cyperus exaltatus</i>	0	0	0	1	1	3	0	0	0	0	3	5
Native	EP	Araceae	Alocasia	<i>Alocasia cucullata</i>	3	3	1	2	0	2	0	0	0	0	3	5
Native	EP	Poaceae	Sesbania	<i>Sesbania cannabina</i>	0	1	1	1	1	0	0	0	1	0	4	4
Native	EP	Polygonaceae	Polygonum	<i>Polygonum perfoliatum</i>	0	0	0	0	1	1	1	0	0	1	4	4
Native	EP	Scrophulariaceae	Mazus	<i>Mazus pumilus</i>	1	1	1	0	0	0	1	1	0	1	4	4
Native	EP	Juncaceae	Juncus	<i>Juncus prismatocarpus</i>	0	1	1	0	1	0	1	0	0	1	4	4
Native	EP	Cyperaceae	Cyperus	<i>Cyperus haspan</i>	0	1	0	0	1	1	1	0	0	1	4	4
Native	EP	Polygonaceae	Polygonum	<i>Polygonum longisetum</i> <i>var. rotundatum</i>	0	2	2	1	0	0	0	1	0	0	3	4
Native	EP	Gentianaceae	Nymphoides	<i>Ipomoea aquatica</i>	0	0	0	0	1	1	0	2	0	0	3	4
Native	EP	Poaceae	Zizania	<i>Zizania latifolia</i>	0	0	0	0	0	0	2	2	0	0	2	4
Native	EP	Brassicaceae	Rorippa	<i>Rorippa globosa</i>	2	2	2	2	0	0	0	0	0	0	2	4
Native	EP	Cyperaceae	Rhynchospora	<i>Rhynchospora corymbosa</i>	0	0	1	0	3	0	0	0	0	0	2	4
Native	EP	Callitricheaceae	Callitriche	<i>Callitriche palustris</i>	0	2	0	0	0	0	0	0	0	4	1	4
Native	EP	Cyperaceae	Schoenoplectus	<i>Schoenoplectus mucronatus</i> <i>subsp. robustus</i>	0	0	0	0	4	0	0	0	0	0	1	4
Native	EP	Polygonaceae	Polygonum	<i>Polygonum thunbergii</i>	0	0	0	0	0	0	4	0	0	0	1	4
Native	EP	Lythraceae	Rotala	<i>Rotala indica</i>	0	0	0	0	0	0	1	1	0	1	3	3
Native	EP	Ranunculaceae	Ranunculus	<i>Ranunculus cantoniensis</i>	0	0	1	0	0	1	0	0	0	1	3	3
Native	EP	Polygonaceae	Polygonum	<i>Polygonum plebeium</i>	2	2	1	1	1	0	0	0	0	0	3	3
Native	EP	Cyperaceae	Cyperus	<i>Cyperus difformis</i>	0	2	0	1	0	1	0	1	0	0	3	3
Native	EP	Rubiaceae	Adina	<i>Adina rubella</i>	0	0	0	0	1	1	0	1	0	0	3	3
Native	EP	Polygonaceae	Polygonum	<i>Polygonum pubescens</i>	0	0	2	0	0	0	1	0	0	0	2	3
Native	EP	Apiaceae	Oenanthe	<i>Oenanthe javanica</i>	0	1	1	0	0	0	2	0	0	0	2	3
Native	EP	Onagraceae	Ludwigia	<i>Ludwigia x taiwanensis</i>	0	0	0	0	1	2	0	0	0	0	2	3
Native	EP	Guttiferae	Hypericum	<i>Hypericum japonicum</i>	0	0	0	0	0	0	2	0	0	1	2	3
Native	EP	Commelinaceae	Murdannia	<i>Commelina diffusa</i>	0	4	2	0	0	1	0	0	0	0	2	3
Native	EP	Asteraceae	Bidens	<i>Bidens tripartita</i>	0	0	0	0	0	0	2	1	0	0	2	3
Native	EP	Poaceae	Alopecurus	<i>Alopecurus aequalis</i>	0	1	1	0	0	0	0	0	0	2	2	3
Native	EP	Araceae	Acorus	* <i>Acorus calamus</i>	5	4	1	0	0	0	2	0	0	0	2	3
Native	EP	Scrophulariaceae	Veronica	<i>Veronica anagallis-aquatica</i>	0	2	3	0	0	0	0	0	0	0	1	3
Native	EP	Cyperaceae	Schoenoplectus	<i>Schoenoplectus triqueter</i>	0	0	0	0	0	0	0	0	3	0	1	3
Native	EP	Salicaceae	Salix	<i>Salix chaenomeloides</i>	0	0	0	0	0	0	0	3	0	0	1	3
Native	EP	Cyperaceae	Cyperus	<i>Cyperus odoratus</i>	0	2	3	0	0	0	0	0	0	0	1	3
Native	EP	Cyperaceae	Cyperus	<i>Cyperus eragrostis</i>	0	2	3	0	0	0	0	0	0	0	1	3
Native	EP	Cyperaceae	Carex	<i>Carex heterolepis</i>	0	0	3	0	0	0	0	0	0	0	1	3

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Native	EP	Polygonaceae	Polygonum	<i>Polygonum jucundum</i>	0	0	0	1	0	0	0	0	1	0	2	2
Native	EP	Polygonaceae	Polygonum	<i>Polygonum barbatum</i>	0	0	1	0	0	1	0	0	0	0	2	2
Native	EP	Commelinaceae	Murdannia	<i>Murdannia bracteata</i>	0	0	0	0	0	0	0	0	1	1	2	2
Native	EP	Onagraceae	Ludwigia	<i>Ludwigia epilobioides</i>	0	0	0	0	0	0	1	1	0	0	2	2
Native	EP	Campanulaceae	Lobelia	<i>Lobelia nummularia</i>	0	0	0	0	0	0	1	0	0	1	2	2
Native	EP	Scrophulariaceae	Lindernia	<i>Lindernia antipoda</i>	0	1	1	0	0	0	0	1	0	0	2	2
Native	EP	Saururaceae	Houttuynia	<i>Houttuynia cordata</i>	0	0	0	0	0	0	1	0	0	1	2	2
Native	EP	Cyperaceae	Fimbristylis	<i>Fimbristylis quinquangularis</i>	0	0	0	0	0	0	1	1	0	0	2	2
Native	EP	Cyperaceae	Fimbristylis	<i>Fimbristylis aestivalis</i>	0	2	0	0	1	1	0	0	0	0	2	2
Native	EP	Commelinaceae	Commelina	<i>Commelina benghalensis</i>	0	0	0	0	0	0	1	1	0	0	2	2
Native	EP	Typhaceae	Typha	<i>Typha orientalis</i>	0	0	0	0	0	0	0	2	0	0	1	2
Native	EP	Alismataceae	Sagittaria	<i>Sagittaria trifolia subsp. leucopetala</i>	0	0	0	0	0	0	0	2	0	0	1	2
Native	EP	Polygonaceae	Polygonum	<i>Polygonum kawagoeanum</i>	2	2	0	0	0	0	0	0	0	2	1	2
Native	EP	Poaceae	Coix	<i>Coix lacryma-jobi</i>	0	0	2	0	0	0	0	0	0	0	1	2
Native	EP	Lamiaceae	Scutellaria	<i>Scutellaria barbata</i>	0	0	0	0	0	0	0	0	0	1	1	1
Native	EP	Polygonaceae	Rumex	<i>Rumex japonicus</i>	0	0	0	0	0	0	0	1	0	0	1	1
Native	EP	Lythraceae	Rotala	<i>Rotala rosea</i>	0	0	0	0	0	0	1	0	0	0	1	1
Native	EP	Brassicaceae	Rorippa	<i>Rorippa indica</i>	1	1	0	1	0	0	0	0	0	0	1	1
Native	EP	Polygonaceae	Polygonum	<i>Polygonum sieboldii</i>	0	0	0	0	0	0	1	0	0	0	1	1
Native	EP	Poaceae	Paspalum	<i>Paspalum thunbergii</i>	0	2	0	0	0	1	0	0	0	0	1	1
Native	EP	Campanulaceae	Lobelia	<i>Lobelia chinensis</i>	0	0	0	0	0	0	0	0	1	0	1	1
Native	EP	Balsaminaceae	Impatiens	<i>Impatiens chinensis</i>	0	0	0	0	0	0	1	0	0	0	1	1
Native	EP	Acanthaceae	Hygrophila	<i>Hygrophila erecta</i>	0	0	0	1	0	0	0	0	0	0	1	1
Native	EP	Cyperaceae	Fuirena	<i>Fuirena umbellata</i>	0	0	0	0	1	0	0	0	0	0	1	1
Native	EP	Cyperaceae	Eleocharis	<i>Eleocharis yokoscensis</i>	0	0	0	0	0	0	1	0	0	0	1	1
Native	EP	Cyperaceae	Eleocharis	<i>Eleocharis atropurpurea</i>	0	0	0	0	0	0	0	0	0	1	1	1
Native	EP	Cyperaceae	Cyperus	<i>Cyperus pilosus</i>	0	0	0	0	0	0	1	0	0	0	1	1
Native	EP	Cyperaceae	Cyperus	<i>Cyperus imbricatus</i>	0	0	0	1	0	0	0	0	0	0	1	1
Native	EP	Cyperaceae	Cyperus	<i>Cyperus compressus</i>	0	0	0	0	0	0	1	0	0	0	1	1
Native	EP	Cyperaceae	Cyperus	<i>Cyperus compactus</i>	0	0	0	0	1	0	0	0	0	0	1	1
Native	EP	Pteridaceae	Ceratopteris	<i>Ceratopteris thalictroides</i>	0	1	0	0	1	0	0	0	0	0	1	1
Native	EP	Cyperaceae	Carex	<i>Carex baccans</i>	0	0	0	0	0	0	1	0	0	0	1	1
Alien	FP	Pontederiaceae	Eichhornia	<i>Eichhornia crassipes</i>	2	1	3	5	5	5	3	0	3	3	7	27
Alien	FP	Araceae	Pistia	<i>Pistia stratiotes</i>	5	5	2	0	2	3	2	0	1	0	5	10
Alien	EP	Acanthaceae	Ruellia	* <i>Ruellia brittoniana</i>	5	5	/	/	/	/	/	/	/	/	/	/
Alien	EP	Alismataceae	Echinodorus	* <i>Echinodorus grisebachii</i>	4	4	/	/	/	/	/	/	/	/	/	/

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Alien	EP	Apiaceae	Hydrocotyle	<i>*Hydrocotyle vulgaris</i>	4	4	/	/	/	/	/	/	/	/	/	/
Alien	EP	Cannaceae	Canna	<i>*Canna glauca</i>	5	5	/	/	/	/	/	/	/	/	/	/
Alien	EP	Cyperaceae	Cyperus	<i>*Cyperus prolifer</i>	4	4	/	/	/	/	/	/	/	/	/	/
Alien	EP	Cyperaceae	Cyperus	<i>*Cyperus papyrus</i>	4	4	/	/	/	/	/	/	/	/	/	/
Alien	EP	Haloragaceae	Myriophyllum	<i>*Myriophyllum aquaticum</i>	4	4	/	/	/	/	/	/	/	/	/	/
Alien	EP	Marantaceae	Thalia	<i>*Thalia geniculata</i>	4	4	/	/	/	/	/	/	/	/	/	/
Alien	EP	Marantaceae	Thalia	<i>*Thalia dealbata</i>	5	5	/	/	/	/	/	/	/	/	/	/
Alien	EP	Nymphaeaceae	Nymphaea	<i>*Nymphaea sp</i>	4	4	/	/	/	/	/	/	/	/	/	/
Alien	EP	Pontederiaceae	Pontederia	<i>*Pontederia cordata</i>	5	5	/	/	/	/	/	/	/	/	/	/
Alien	Ep	Scrophulariaceae	Angelonia	<i>*Angelonia angustifolia</i>	4	4	/	/	/	/	/	/	/	/	/	/
Alien	EP	Amaranthaceae	Alternanthera	<i>Alternanthera philoxeroides</i>	3	4	4	3	4	5	0	2	2	3	7	23
Alien	EP	Asteraceae	Bidens	<i>Bidens pilosa var. radiata</i>	3	5	5	4	3	5	0	0	0	3	5	20
Alien	EP	Poaceae	Pennisetum	<i>Pennisetum purpureum</i>	0	0	3	5	3	5	0	0	0	0	4	16
Alien	EP	Poaceae	Brachiaria	<i>Brachiaria mutica</i>	0	0	5	5	0	5	0	0	0	0	3	15
Alien	EP	Asteraceae	Wedelia	<i>Wedelia trilobata</i>	0	5	5	3	0	5	0	0	1	0	4	14
Alien	EP	Asteraceae	Ageratum	<i>Ageratum conyzoides</i>	0	2	3	0	2	2	2	0	1	0	5	10
Alien	EP	Asteraceae	Soliva	<i>Soliva anthemifolia</i>	2	2	1	0	2	2	0	0	0	0	3	5
Alien	EP	Asteraceae	Gymnocoronis	<i>Gymnocoronis spilanthoides</i>	0	0	0	0	0	0	0	0	5	0	1	5
Alien	EP	Lythraceae	Cuphea	<i>Cuphea balsamona</i>	0	1	2	0	0	1	0	0	1	0	3	4
Alien	EP	Asteraceae	Aster	<i>Aster subulatus</i>	0	1	1	0	1	0	0	0	0	0	2	2
Alien	EP	Asteraceae	Pluchea	<i>Pluchea sagittalis</i>	0	1	2	0	0	0	0	0	0	0	1	2
Alien	EP	Asteraceae	Synedrella	<i>Synedrella nodiflora</i>	0	0	0	0	1	0	0	0	0	0	1	1
Alien	EP	Cyperaceae	Cyperus	<i>*Cyperus involucratus</i>	3	2	0	1	0	0	0	0	0	0	1	1